

**American Romanian Academy of Arts and Science**



**PROCEEDINGS**  
**of the 39th ARA Congress**

**July 28-31, 2015**  
**Frascati, Rome, Italy**

**The American Romanian Academy  
of Arts and Sciences (ARA)**



**The 39<sup>th</sup> ARA Proceedings**

**July 28-31, 2015, Frascati,**

**Rome, Italy**

Proceedings of the 39<sup>th</sup> Annual Congress of the American Romanian Academy of Arts and Sciences, July 28-31, 2015, National Institute of Nuclear Physics, Frascati, Roma

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## ARA President's Wellcome Message

Professor Ruxandra Vidu, PhD  
President  
American Romanian Academy  
of Arts and Sciences  
University of California, Davis



It is a distinct pleasure to welcome you to the 39<sup>th</sup> ARA Congress, in Frascati, Rome, Italy, where intellectuals of Romanian descent from all around the world, and friends of Romania of all nationalities meet to discuss recent contributions to art and science. In addition, various topic talks will present revolutionary ideas in technology, medicine, education, arts/culture, and other fields that mark our lives and shape our future.

We are very happy to present you this year Keynote Speakers: Doina Uricariu (Director of the Romanian Cultural Institute in New York, writer/poet), Bogdan Simionescu (Vice-president of Romanian Academy, Professor of Polymer Science), Sorin Rosca (President of Romanian Chemical Society, Professor of Organic Chemistry, UPB), Ioan Opris (Senior Research Scientist in Neuroscience, Department of Physiology and Pharmacology, Wake Forest University, School of Medicine) si Tudor Ratiu (Professor, Mathematics, Ecole Polytechnique Federale de Lausanne, Switzerland), and the Invited Speakers: Livio Dimitriu and Mihaela Leonida.

The success of ARA Congress depends on our dedicated and loyal members, and to those of you who join us for our Congress each year. I'd like to extend a warm welcome to all the new members who have joined us this year, as we have seen our numbers rise. I look forward to seeing you all in Frascati, Rome, for our 39<sup>th</sup> ARA Congress, which looks set to be a great event in the American Romanian academic community of arts and sciences.

We are glad to see you at the 39th ARA Congress and hope you have a great time.

Ruxandra Vidu  
ARA President

## Foreword

The Frascati National Laboratories of the Istituto Nazionale di Fisica Nucleare (LNF-INFN) is welcoming the 39<sup>th</sup> Congress of the American Romanian Academy of Arts and Sciences (ARA), a prestigious institution joining intellectuals of the Romanian descent from all around the world, and friends of Romania of all nationalities. The participants, coming from various countries in the world, will meet in Frascati (Roma) to discuss their most recent achievements and contributions to arts and science, in the stimulating environment of a research institute devoted to fundamental research in the field of physics, near Roma, in the famous Castelli Romani region.



The participants to the Congress will have the opportunity to visit the LNF-INFN laboratory, which is hosting the first particle-antiparticle collider in the world, ADA, historical site of the European Physical Society (EPS), and the actual DAΦNE electron-positron collider, as well as the ongoing experiments.

In this challenging and stimulating environment, the participants to the 39<sup>th</sup> ARA Congress will have a lively exchange of ideas, which could develop in future fruitful collaborations towards a deeper understanding of the human nature and of the Universe, and to put the basis of new technologies for the pressing societal challenges.

Dr. Catalina Oana Curceanu  
LNF-INFN  
Chair of the 39<sup>th</sup> ARA Congress



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**Luminita Gliga**  
**PhD in visual arts**

**Statement**

My connections with the art are natural and real. I feel lucky that I chose art or art had chosen me in order to express. Thus, painted image is a form of communicating with people. Basically, as a professional artist, I am interested in everything that have direct relevance to contemporary life. The known and unknown can easily become a source of inspiration for me, too. My work explores a new world of shapes and colors in a personal composition. The essence of each painting is the connection between the subject matter and myself. My painting more concerns itself with the vague territory between abstraction and the known and seen world. Since I was a student at The Art University in Bucharest I got used to follow some steps from my paintings: a theoretical documentation, sketches and in the end starting the work.

Apocalypse, Ephesus, Nestatornik, Autobiography in images, Terravision, Subselenarium, Inflorescences are some of my experiments of non-figurative paintings using the acrylics.

**Biographical Sketch:** Luminita Gliga (b. October 23. 1975). Since 2003 - Member of U.A.P. Romania, member of A.I.A.P. - UNESCO. In 2002 the National University of Arts Bucharest, Faculty of Fine Arts, Department of Painting. In 2008 obtained her PhD in Visual Arts at the National University of Arts Bucharest. Since 2008 - Member of the Romanian-American Academy of Arts and Sciences (ARA)

- More than 40 one-man shows in Romania and abroad. More than 45 group shows, international art festivals, art fairs in the United States (New York City: New Art Center (2012), Amsterdam Whitney Gallery (2011),

Broadway Gallery (2010), ICO Gallery (2009), Florida (2013)), Italy (Ferrara: Estense Castle (2011)), Japan (Tokyo: Metropolitan Art Space Exhibition Gallery (2004)), China (Beijing: NY Arts Beijing Space (2011)), Belgium (Bruselles: Galeria Arthis (2010)), England (London: “Parallax Art Fair”, Chelsea Town Hall (2014), The Brick Lane Gallery (2010)) Switzerland (Zurich: Art Show Zurich (2010)), France (Paris (Thuillier Gallery (2004, 2007), Cannes (International Show “MCA”(2004 – 2009)), Russia, Germany and in almost all major cities of Romania.

- Listed in: International Contemporary Artists, Vol.2 (USA), International Dictionary of Artists, Vol.1 (USA); Suu Art Magazine (Spain); HUBNERS WHO IS WHO; “Personalitati feminine contemporane din Romania (Dictionar biografic; autor George Marcu); “Dictionarul personalitatilor din Romania”(Biografii contemporane editia 2014); catalog Terravision collection "contemporary artists" (44); catalog collection "contemporary artists" (36); catalog collection "contemporary artists" (27), "Luminita Gliga - painter" - CD and catalog; catalog “paintings 7”

- Among the distinctions that have been awarded for artistic activity - ARA Award for Art "Ionel Jianu" American Academy - Romanian Arts and Sciences, The Official Diploma "MCA" and Gold Medal, Cannes, France, Diploma and Golden Silver Medal at the Academic Society "Arts-Sciences-Lettres" in Paris, France

Works in private collections and institutions in Austria, Canada, China, Denmark, England, France, Germany, Ireland, Italy, Romania, USA;

- Critical References: Corneliu Antim, Victoria Anghelescu, Achitei Gh, Gh Craciun, Paul Cornel Chitic, Rasvan Theodorescu, Gheorghe Vida, Jean Louis Avril (France), Rusu MN (USA), Abraham Lubelski (USA), David Kastner (USA).

## CONTENT

ARA President's Wellcome Message.....	3
Foreword.....	4
Thank you to our sponsors!.....	5
Luminita Gliga, Statement.....	6
Poetry and the Politics of Memory .....	11
Dr. Doina Uricariu	
Polymer engineering focusing on drug/gene delivery and tissue engineering: from simple towards complex architectures and hybrid materials .....	15
Bogdan C. Simionescu	
New Carbon - Carbon Coupling Reactions Mediated by Aluminum, Chromium and Samarium Reagents .....	17
Sorin I. Rosca	
Geometric mechanics techniques in image registration .....	18
Tudor Ratiu	
Prefrontal cortical microcircuits: from executive control to pathological disruption and back to normal .....	19
Ioan Opris PhD	
Architecture: Problems of Translation .....	20
Dr. Livio Dimitriu	
Old Romanian Iconographers and Their Icons on Glass: Materials, Techniques, and Secrets.....	26
Mihaela D. Leonida	
Matrix of Constraints for the Motion of the Planar Kinematic Chains with Rotational Links with Clearances.....	32
Jan-Cristian Grigore, Alexandru Jderu, Marius Enachescu	
Influence of the electrochemical treatment on the magnetic properties of nanowires.....	37
George Tepes, Alecs Andrei Matei, Maria Diana Vranceanu, Cosmin Mihai Cotrut, Dionezie Bojin, Victor Kuncser, Ruxandra Vidu	
KrF excimer laser ablation in helium yields the highest amount of SWCNTs over other inert gases.....	43
Calin Moise, Adrian Katona, Doru Dinescu, Jasim Al-zanganawee, Dionezie Bojin, Marius Enachescu	
Prospects of the Thermoelectricity Based on Organic Materials .....	47
Anatolie Casian and Ionel Sanduleac	
Modern routes for materials rapid processing .....	52
C.Plapcianu, M.C.Bartha, M.Burdusel and R.Vidu	
Composite Materials with Complex Compositions used in Vehicle Brake System: a Review .....	58
Ileana Nicoleta POPESCU, Lucica Grigora TOMA, Ruxandra VIDU	

Identification of the Roll Response for the Cessna Citation X Business Aircraft Engine.....	64
Ruxandra Mihaela Botez, Julian Anthony and Clement Hamel	
The influence of climatic factors on the performance of photovoltaic panels.....	70
Mirela-Ionela Mihai, Vladimir Tanasiev, Adrian Badea and Ruxandra Vidu	
Optimization of Engine Model Parameters Gain and Time Constant for the Cessna Citation X Business Aircraft Engine .....	76
Ruxandra Mihaela Botez, Julian Anthony and Clementa Hamel	
Electrodeposition Of Thermoelectric Films $\text{Co}_x\text{Ni}_{(1-x)}\text{Sb}_3$ AND $\text{Co-Sb}_x\text{Te}_{(1-x)}$ in Citrate Solutions .....	82
Ruxandra Vidu, Maria Perez-Page, Dat V. Quach, Pieter Stroeve	
New Method for Encapsulation of Oregano Essential Oil into Carbon Nanotubes .....	88
Mariana PRODANA, Madalina Georgiana ALBU, Durmus Alpaslan KAYA, Andrada NEGRU, Dionezie BOJIN, Marius ENACHESCU	
A Digital Charge Amplifier Model for Hysteresis Reducing of Piezoelectric Actuators .....	93
Ilie POPA, Cristin Livede, Alexandru Jderu, Marius Enachescu	
The drift removal methods Science with Tendency .....	99
Ionel Sabin and Ionel Ioana	
The tendency of demythification Micro Expressions and Graphology in Education A psycho-educational analysis model .....	105
Antoaneta-Firuța TACEA, Maria POP MION	
Adaptive Coding in Visual Cortical Circuits.....	109
Bryan J. Hansen and Valentin Dragoi	
Considerations regarding the necessity of adapting the physical therapy approach to optimize the quality of life of paraplegic persons .....	115
Ioan Cosmin Boca, Mirela Dan	
Cardiovascular Mortality: An overview of Premature Death in the Republic of Moldova.....	119
Elena Raevschi	
<i>In Silico</i> Evaluation of Radiobiological Hypoxia And Its Effect on Tumour Control During Radiotherapy .....	124
Loredana G. Marcu and David Marcu	
Surprise Romanian Presence Abroad .....	128
Ileana Costea	
Des histoires familiales pour engager les élèves dans l'écrit et valoriser les langues et cultures d'origine à l'école: les « textes identitaires plurilingues ».....	132
Angela Stoica	
Romanian flavor of an American painter .....	136
Jerry W. McDaniel, Ileana Costea	
Arghezi's epic poetic text in the volume "Una sută una poeme" .....	142
Boca Raluca	

39 <sup>th</sup> ARA Congress Visual Literacy in the Digital Age .....	146
Dr. Isabelle Sabau and Dr. Carmen Sabau	
39 <sup>th</sup> ARA Congress Lucian Grigorescu .....	151
Dr. Carmen Sabau, Dr. Isabelle Sabau	
Paradise or Annihilation ~ Paradis sau neant .....	156
Dr. Dinu Leonte	
The Romanian Goddess <i>Ileana Simziana</i> the Sun's sister.....	161
Ana R. Chelariu	
Filozofia ca încercare de întemeiere si gasire a unui sens pentru modernitate....	166
Dorin Stoica	
The Evolution of the Integration Process as Effect of the Treaties Signing Between the Republic of Moldova and European Union .....	174
Mămăligă Ilie	

# Poetry and the Politics of Memory

Dr. Doina Uricariu

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**Abstract:** The politics of memory are full of acts of censorship, of anamorphoses, of provoked or induced amnesias, of therapies, of lobotomies, before they are attributed to psychoanalysis, left in the care of Freud and Jung, of Marxist-Leninism, of cosumerism, populism, minimalism and post-modernism. I will read you a few poems and I will tell you a little bit about my volumes of memoirs simply in order to point out that poetry signifies memory and history. This implicitly brings to mind the Sighet Memorial, a place which gathers and recounts of poems written, passed on, and memorized in prisons. Memory is an essential bridge between two shores. That is why I wished so intently to bring recently the Sighet Memorial across the Atlantic Ocean, as well as on the East Coast of the USA, and further on on its West Coast. Memory defines us and becomes our true identification card, which may become also our driver's licence into the future, isn't it?

De-a lungul turneului de literatură și de prezentare a muzeului de la Sighet, pe care l-am avut în California, după evenimentele de la Book Expo America, de la Javits Center, și cele din Auditorium Hall, de la Institutul Cultural Roman din New York, în timpul lecturilor de la Biblioteca Congresului SUA și de la Ambasada României, la Washington, m-am gândit la cutremurătoarea istorie vie a comunismului în România și la soarta acestei memorii în postcomunism. Ce s-ar fi întâmplat cu istoria și memoria Gulagului românesc, a vieților fiecăruia dintre noi în comunism, dacă ea nu ar fi fost prezentată de memorialul de la Sighet și de cărțile publicate de Academia Civică sau de alte edituri, unde au apărut cărțile detenției, depozițiile deportaților, jurnalele rezistenței și paginile disidenței reale, nu contrafăcute.

M-am gândit la memoria acelor vremuri, așa cum mai persistă în fiecare dintre noi și în creația noastră.

Memoria umană este un material vernacular, care ne construiește și ne definește.

Așa cum în arhitectura vernaculară sunt ziditoare pământul chirpicilor, lemnul și piatra, stuful și... pădurile de bambus...

Vorbind despre cartile mele de memorii, peste 3000 de pagini scoase în 4 volume, sub titlul *Maxilarul inferior* și *Scara leilor*, m-am gândit la miracolul memoriei umane, ca la o geneză și reconstrucție de sine. Nu o să vă vorbesc dvs. însă despre ceea ce oamenii de știință consideră drept "a neural super-computer of huge capacity and speed", nici despre "different types of memory, des-pre "our short term and long term memories, as encoded and stored in different ways and parts of the brain", "about the enigma that is the human memory".

O să vă propun să ne gândim la memorie, memorii, istorie și literatură din perspectiva unei afirmații făcute de marele actor englez Jeremy Irons. Poate vi-l amintiți din multe filme. Poate l-ați văzut în *Mașina timpului* /*The Time Machine*, filmat în 2002. "We all have our time machines. Some take us back, they are called memories. Some take us for-ward, they're called dreams." Uneori simplificările și utopiile sau distopiile din filme ne ajută să vizualizăm realități pe care ochiul nostru le pierde din vedere. Cu toții avem o mașină a timpului cu care călătorim spre tre-cut și spre viitor. În

fiecare dintre cărțile pe care le-am scris, viuesc motoarele acestei mașini sau se aud zgomotele trăsurilor, căruțelor, bicicletei sau ale roților de tren purtând călători, deportați spre câmpuri de muncă forțată sau lagăre de exterminare. În poemele mele din comunism auziți și o mașină a tim-pului raționalizată, funcționând cu benzină pe cartelă. O mașină sau care circula, în funcție de numărul par sau impar, sub care era înmatriculată, doar în duminicile cu soț sau fără soț. Politicile memoriei dictează spălarea creierelor sau experimentul Pitești care a asmuțit victimele unele împotriva altora, transformându-i pe deținuți în torționari și criminali, printr-o clonare a infernului și josniciei amorale. Martirii sunt preschimbați în Iuda.

Memories, poetry, history are influenced by political and cultural forces. We can understand the political means by which different events are remembered or discarded, or recorded and presented in poems, history, literature and mentalities. Politics of memory are shaping collective memory, the way history is written and passed on. I understood how the politics of memory are working in Romania, după felul în care instituția monarhiei și Familia Regală au fost prezentați poporului român după 1990 și pâ-nă azi. Și pe propria mea piele de scriitor. De la amenințările cu moartea pe care le-am primit după primul interviu cu regele Mihai pe care l-am publicat cea dintâi în România, în *România Literară* în 23 august 1990 și până la publicarea acestor patru volume de memorii *Maxilarul inferior* și *Scara leilor*, ambele titluri, bestselluri la scala României, nominalizate la Premiile Uniunii Scriitorilor și Premiile Asociației Scriitorilor București, la Premiul pentru proză și eseu și la premiile special ale revistei *Observator cultural* dar nepremiate în final decât cu premiul publicului acordat de revista *Observator cultural* și Premiul pentru proză al revistei *Convorbiri literare*. Dat fiind că spiritul re-publican, antimonarhist nu agreea perspectiva și mai

ales procesul de recuperare al memoriei valorilor monarhiei.

Politicile memoriei sunt pline de acte ale cenzurii, de anamorfoze, de amnezii provocate și induse, de terapii, de lobotomie, îna-inte să fie trecute în seama psihanalizei, pe mâna lui Freud, a lui Jung, a Marxism leni-nismului, a consumismului, populismului, minimalismului și post-modernismului. Memories, history and poetry, are written and seen, and influenced by cultural and political forces. Government policies, social norms, popular culture, social rules influence the way events are remembered.

O să vă citesc câteva poeme și o să vă povestesc puțin despre cărțile mele de memorii doar pentru a ne aminti că poezia înseamnă memorie și istorie, ceea ce ne reamintește inclusiv Memorialul de la Sighet care adună și povestește despre poeziile scrise, transmise și memorate în închisori. Memoria este o punte esențială între două maluri. De aceea am dorit atât de puternic să aduc memorialul de la Sighet peste Oceanul Atlantic și mai departe, la Oceanul Pacific, pe Coasta de Vest. Memoria la care ne ra-portăm este actul nostru de identitate, care poate fi și permisul nostru de conducere, nu-i așa? To Read Poems Between Wedding Candles

I wrote this well-behaved poem in the memory of an evening of poetry reading, a long time ago, during the Communist Regime in Romania. I recited my poems in the meeting hall of a provincial Cultural Center, with the electricity turned off by order of the Mayor. We, the poets, were gathered on the stage. The hall was filled beyond capacity, a black box, illuminated by only two large wedding candle-sticks brought in by someone in the audience.

In this country blessed by the lamp of Ilyich Lenin  
there is no light but at hours most descent  
the light bulbs are put to sleep  
just like bodies removed from the living.

Up on the stage, inside this black box  
we read long poems in the dark  
we huddle among the wedding candles  
that burn so light may be shed on these  
times.

Lonely, among the white canes  
Of wax that sputter on the shores  
The words of Issaiah dancing  
Are different somehow on the page turned

one speaks of road dust, of haystacks with  
mint-flavor  
one speaks of the bird's crucified flight  
the poet is but a lonely groom that descends  
and is wedded for times better or worse

still lingering there, among the burnt  
ribbons  
are round rings, the home of the candle  
bearing the wedding mark on its shoulders  
a guarding angel opens the gates of the  
prison.

he, among candles, in the dark depth of this  
box  
the long poem read under the light of the  
candle,  
Did the gates open of your Heavenly  
Kingdom?  
in this country of light bulbs ever-ordered  
to sleep.

### **Să citești poeme între lumânările de la cununie.**

Am scris acest poem cuminte în amintirea unei seri de poezie în care am citit la un cămin cultural poeme într-o sală cu lumina stinsă în urma ordinului primit de la județ. Eram complet în întuneric, noi scriitorii pe scenă și sala plină ca o cutie neagră, având drept lumină doar două lumânări de cununie aduse de cineva.

În țara blagoslovită de lampa lui Ilici  
nu e lumină decât la ore decente  
becurile sunt trimise să doarmă  
ca niște trupuri din viață absente.

Urcați pe scenă, în cutia neagră  
citim în întuneric lungi poeme  
stăm între lumânările de cununie  
ce ard spre a lumina această vreme.

Însingurați, între toiagurile albe  
de ceară care sfârie în maluri  
Cuvintele din Isaia dănțuiește  
Sunt altele jucând pe foaia-ntoarsă

vorbești de colburi, de căpițe, cu miros de  
mentă  
de crucea păsării din înălțime  
poetul ca un mire singur  
la bine și la rău coboară în sine.

mai stăruie acolo, în panglicile arse  
verigile rotunde, lăcașul lumânării  
cu semnul cununiei lângă umeri  
un înger păzitor deschide poarta închisorii.

el între lumânări, în întunericul cutiei  
poemul lung citit la lumânare,  
de parcă s-ar fi deschis porțile împărăției?  
în țara cu becurile trimise mereu la culcare



**About DOINA URICARIU:**

*By Doreen Schmidt, Editor, Napa Valley, California, USA*

Rare is the poet who fluidly captures the world in its tiniest to most expansive detail. Uricariu's ecstatic delight dances across the page in precisely and perfectly chosen words. Those words abound and revel in the visceral elements of flora, fauna and minerals. It is illuminating to encounter a poet with such insistent and red-blooded reverence for nature and passion, baby goats and oracke, cornsilk and dandelions, roots and ore, agate and olives, pegmatites and chalcedony, architectures of man and nature. She enters the earth, rolls around inside it, paints its walls with words vibrant as blood, with war paint's urgency.

Uricariu deftly weaves together concepts that we in the West don't often experience through our poets: the sacred and spiritual, the ecstatic and mundane, who writes in wonder that "God was about to teach light how to write." Her work is informed but not encumbered by the orthodoxy of her religious belief, her words unblemished by twisted interpretations belonging to others. She wears her spirituality like Rumi: another rare and visceral, light-filled, reverent presence. It is all the same for her: her fervent embrace of religion, nature, sexuality and maternity. Why should it be otherwise? In a segmented society that often segregates earthly and spiritual concerns, the whole and every part of the whole, it is refreshing to be reminded of their integrity and integral connectivity by a poet who writes as she believes: with a child's purity, a purist's specificity, an academic's erudition, a poet's faith.

Doina Uricariu is an important contemporary Romanian writer with an unmistakable lyric voice born out of a generous sensuous universe, intersected by constant moral, philosophical, and political questioning. She started out in poetry with the volume *Healings*, published in 1976 after a seven-year wait in the hands of the Communist censorship. Eight other volumes of poetry followed: *Jugastru Sfiala*, *Happy Beings*, *The Hand-covered Face*, *Atrocious Eye*, *The Heart Institute*, *The Power of Leviathan*, *The Axonometric Heart*, three volumes of poetry published in Italy, a bi-lingual German-Romanian volume of poetry *Das Herzzinstitut / The Heart Institute*.

Mrs. Uricariu's poetry has been translated in anthologies and individual volumes in English, German, French, Swedish, Norwegian, Russian, Serbian, Czech, Hebrew, Albanian and in other twenty languages. She published volumes of criticism and literary history, essays, and art criticism that are considered milestones on their respective subjects: *Apocrypha on Emil Botta*, *Ecorches*, *Paradoxical Lyricism*, *Søren Kierkegaard*, *Maria Pillat-Brates: Poetry and Reverie*, *Antonovici*, *Vlaicu Ionescu*, *the Artist*. Doina Uricariu prepared and edited reference editions on *Emil Cioran*, *Dominic Stanca*, *Jeni Acterian*, *Emil Botta*, and *The Podrom Filokalia*. She published four volumes of her memoirs in two books entitled *The Lower Jaw* and *The Lions Stair*.

Dr. Doina Uricariu is member of Romanian Writers Association, European Cultural Society, and International PEN CLUB. Knight of the Order of Faithful Service of Romania conferred by the President of the country. Knight of the Order of the Romanian Crown conferred by the Royal House of Romania. She is currently the director of the Romanian Cultural Institute in New York.

# Polymer engineering focusing on drug/gene delivery and tissue engineering: from simple towards complex architectures and hybrid materials

Bogdan C. Simionescu  
Romanian Academy, Romania

**Abstract:** Nowadays there is a pronounced need for new materials for biomedical application, able to provide more efficient treatments and to insure minimization of the side effects, to increase patient compliance and satisfaction. Advances in polymer science – focusing on an improved control of polymer molecular weight and polydispersity, structure, properties and functionality through new synthetic approaches – have led to the development of several novel systems designed for drug/gene delivery and tissue engineering, areas with pivotal role for both research/academic community and industry, generating new niche markets. In this respect, recent years have witnessed an increased interest in the rational design of complex polymeric structures. The main objectives are related to the development of tailored polymer materials, engineered to exert distinct biological functions, implying multifunctionality as well as appropriate form/architectural features (with implication of nanotechnology), giving rise to specificity and high responsiveness.

Several types of macromolecular compounds including micelles, polymersomes, nano- and microparticles (-capsules/-spheres), molecular imprinting polymers, dendrimers, nanogels, hydrogels and interpenetrated polymer networks have been developed and tested as potential systems of interest for the envisaged applications. To gain further clinical importance the new materials (resulting in preformed or *in-situ* forming biomedical systems) must provide not only high physicochemical and biological performances but also processing ability (required by the manufacturing techniques). These demands – and especially the last one – often imply combination of natural and synthetic polymers (blends, block/graft copolymers, bioconjugates, interpenetrating networks, etc.), while improved performances may be mainly achieved by composite materials (inorganic/organic, biocomposites). The targeted application site or cargo may require specific material category (biodegradable, bioresorbable), dimension scale (micro/nano size) and topographic characteristics. Some of the existing essential obstacles and limitations may be surpassed by combining systems and approaches from apparently different application domains. Thus, controlled drug delivery and its application in tissue engineering for tissue growth support and stimulation attracted much attention over the last decade, while combination of gene therapy and tissue engineering within a single system resulting in a powerful synergism of treatment options for regenerative medicine (scaffold mediated gene therapy) seems to be the favored alternative for tissue healing. Recent results make the domain very attractive, but key issues are to be solved to develop technologies of clinical impact.

In this context, the presentation summarizes the history and challenges in the discussed domains, pointing on polymers as a possible solution to specific challenges, and outlines the current state of the art, focusing on the newest strategies to improve systems

effectiveness and responsiveness (design keys, preparative approaches). Expected future directions are underlined. After discussing the rationale for using newest advances in macromolecular chemistry, technologies and characterisation tools, as well as for the need of computer assisted design /mathematical modeling systems, some recent original results are briefly described.

**Acknowledgement.** This work was financially supported by the Romanian National Authority for Scientific Research, CNCS - UEFISCDI, project PN-II-ID-PCCE-2011-2-0028.



#### **Biographical Sketch:**

Bogdan C. Simionescu obtained a polymer engineering degree from the Polytechnic Institute of Iasi (1971) and the PhD degree from the Catholic University of Leuven, Belgium (1975).

Present position: Professor of polymer science (Department of Natural and Synthetic Polymers, "Gheorghe Asachi" Technical University of Iasi), and senior researcher of "Petru Poni" Institute of Macromolecular Chemistry of Romanian Academy, Iasi, Romania; director of the Centre of Excellence "Polymers" and of the Interdisciplinary Platform (education and research) "Multifunctional polymeric materials", "Gheorghe Asachi" Technical University of Iasi.

Visiting/associate professorships/visiting scientist: Ecole Nationale Supérieure de Chimie de Mulhouse, Mulhouse, France

(1991); Université du Littoral, Dunkerque, France (1995); Freiburger Materialforschungszentrum, FMF, Freiburg, Germany (1996); Society of Polymer Science, Japan (1996); Centre of Polymer Chemistry, Zabrze, Poland (2001, 2005); Université Montpellier 2, LEMP/MAO, Montpellier, France (2001); Université d'Angers, Angers, France (2005); Université de Rouen, Rouen, France (2007); University of Czestochowa, Czestochowa, Poland (2014).

Scientific interests: radical polymerization and copolymerization; unconventional polymerizations; combined polymer synthesis techniques; solution properties of ultrahigh molecular weight polymers; polysiloxanes and siloxane-containing block and graft copolymers; functional micro- and nanoparticles; macromolecular architectures; biomaterials

Publications/ lectures: more than 350 papers; books and book chapters; more than 100 lectures in Europe, Japan, Canada, USA.

Member of Romanian Academy (since 2000); President of the Iasi Branch of Romanian Academy (2012 – 2014); Vice-president of Romanian Academy (since 2014); member of the European Academy of Sciences and Arts (since 2007).

# New Carbon - Carbon Coupling Reactions Mediated by Aluminum, Chromium and Samarium Reagents

Sorin I. Rosca

"Politehnica" University Bucharest, Romania  
"C.D.Nenitescu" Organic Chemistry Department

**Abstract:** The aim of the research, reported in this presentation, is to exploit exceptional behaviour of the  $\eta^6$ -arenetricarbonylchromium complexes to stabilize practically all types of transient intermediates (benzyl carbenium ions, carbanions or radical type species). On this research line we have reported a facile and efficient coupling of  $\eta^6$ -complexed benzyl carbenium ions (generated by acid catalysis from corresponding alcohols/acetates) with highly nucleophilic arenes. The scope of this new carbon - carbon coupling reaction is enlarged by demonstrating its stereo specificity (retention of configuration). When this property is associated with the use of difunctional reagents (for both chromium complex and arene) the polycoupling process provides macromolecular products exhibiting totally controlled configuration. On the other hand, a new enantioselective synthesis of pertinent  $\alpha$ -amino acids based on stereo selective alkylation of an aza-allylic carbanion (generated by deprotonation of a planar chiral  $\eta^6$ -complexed Schiff base) is also reported.

Another route to generate new aryl - alkyl bonds consists in coupling of  $\eta^6$ - (halogeno-benzene) tricarbonylchromium complexes with organic halides or dialkyl ketones mediated by  $\text{SmI}_2$  /THF-HMPA. In this case, the high reaction rate and the selectivity of the carbon - carbon coupling are attributed to an important labilization of the carbon - halogen bond as well as to the increase of radical - acceptor properties of the chromium complexes. Substantial experimental data are rationalized in terms of a reaction mechanism involving a Sm(IV) unstable species as transient intermediate. During our investigation on the reduction of organic halides with Ni - Al alloy, in aqueous alkaline solution, a new carbon - carbon coupling reaction of benzyl halides was discovered, providing a surprising, but definite existence of an organoaluminum compound in a protic solvent.



**Biographical Sketch:** Dr. Sorin ROSCA is a Professor of Organic Chemistry, Emeritus of "Politehnica" University Bucharest and is the President of Romanian Chemical Society. He holds a PhD in Organic Chemistry from Polytechnic Institute of Bucharest and a Dr. Honoris Causa title from Ovidius University, Constanta (Romania). His academic career in the Department on Organic Chemistry, Politehnica University includes, in different periods, positions of Head of the Department, Dean of the Faculty and Vice Rector of the University. His research interests concern organometallic chemistry, enantioselective reactions, mechanisms of organic and electroorganic reactions, authentications of food products by modern physical methods. He was Visiting Professor at "Paul Sabatier" University Toulouse (France), and Kyu-shu University Fukouka (Japan) and has numerous scientific presentations in universities from USA, UK, Japan, France, Germany, Greece, Turkey, etc. Prof. Rosca is a member of Romanian Academy of Technical Sciences and a corresponding member of the Academy of Sciences from Toulouse. He was co-director of PhD theses in the universities of Paris Sud, Orleans, Caen and Toulouse. His awards include Romanian ("Ordinul Muncii" si "Serviciu Credincios") and French ("Palmes Academiques") scientific decorations, Opera Omnia Award of the Politehnica University, the Prize of the chemical journal "Revista de Chimie" and others.

# Geometric mechanics techniques in image registration

Tudor Ratiu

Department of Mathematics, Station 8  
Ecole Polytechnique Federale de Lausanne  
CH-1015 Lausanne, Switzerland

**Abstract:** The underlying principles of image registration can be cast in terms of geometric mechanics methods. This talk will present several aspects of this remarkable technology transfers from continuum mechanics to imaging.



## Biographical Sketch:

Citoyen des Etats-Unis, Tudor Ratiu est né en 1950 à Timisoara, Roumanie. Il a obtenu un diplôme en mathématiques en 1973 ainsi qu'un diplôme de maîtrise en mathématiques appliquées en 1974 à l'Université de Timisoara. Pour des raisons politiques il lui est interdit de poursuivre ses études et en 1975 il est obligé de quitter son pays. En 1980 il obtient un doctorat à l'Université de Californie à Berkeley avec une thèse en mécanique géométrique et est nommé professeur assistant de recherche T.H. Hildebrandt à l'Université de Michigan, Ann Arbor.

En 1983 il rejoint l'Université d'Arizona, Tucson, comme professeur associé et en 1987 l'Université de Californie, Santa Cruz, où il est nommé professeur ordinaire en 1988. Il

lui a été décerné une bourse postdoctorale du Fonds national scientifique américain, une bourse de la fondation A.P. Sloan, la chaire de recherche professoriale Miller à Berkeley, une bourse Fulbright et le prix allemand A. von Humboldt. Il a été professeur et chercheur invité dans plusieurs départements et instituts de recherche mathématiques du monde.

Les thèmes principaux de sa recherche sont l'analyse globale, la mécanique des fluides et du plasma, la dynamique hamiltonienne, la mécanique géométrique, la géométrie symplectique et de Poisson, la théorie de bifurcations et l'étude des systèmes complètement intégrables. Ses travaux concernent l'aspect mathématique de ces problèmes ainsi que leurs applications en physique et les sciences d'ingénieur. Il est auteur, en collaboration, de plusieurs livres de spécialité.

En 1997 il est nommé professeur ordinaire en analyse au Département de mathématiques et entre en fonction en juillet 1998.

# Prefrontal cortical microcircuits: from executive control to pathological disruption and back to normal

Ioan Opris PhD

Department of Physiology and Pharmacology

**Abstract.** The prefrontal cortex of the primate brain has a modular architecture based on the aggregation of neurons in mini-columnar arrangements with afferent and efferent connections distributed across many brain regions to represent, select and/or maintain behavioral goals and executive commands. Prefrontal cortical microcircuits are assumed to play a key role in the perception to action cycle that integrates relevant information about environment, and then selects and enacts behavioral responses. Thus, neurons within the inter-laminar cortical microcircuits participate in various functional states requiring the integration of signals across cortical layers and the selection of executive variables. Recent research suggests that executive abilities emerge from cortico-cortical interactions between inter-laminar prefrontal cortical microcircuits, whereas their disruption is involved in a broad spectrum of neurologic and psychiatric disorders such as autism, schizophrenia, Alzheimer's disorder and drug addiction. The focus of this talk is on the structural, functional and pathological facets of prefrontal cortical microcircuits that involve the mechanism of executive control, by looking at normal and disrupted aspects, and discussing technological potential for reversal of such disruption. Based on recent technological progress it has been demonstrated that micro-stimulation of infra-granular cortical layers with patterns of micro-currents derived from supra-granular layers led to an increase in cognitive performance. This suggests that inter-laminar prefrontal cortical microcircuits are playing a causal role in improving cognitive performance. An important reason for the new interest in cortical modularity comes from both the impressive progress in understanding anatomical, physiological and pathological facets of cortical microcircuits and the potential promise of neural prosthetics to partially reverse some of the symptoms in neurological and psychiatric disorders.



**Biographical Sketch.** Ioan Opris is a Senior Research Scientist in Neuroscience, working in the Department of Physiology and Pharmacology at Wake Forest University School of Medicine. Ioan's academic background is in Physics/ Biophysics and Neuroscience. He received a BS in Physics/ Biophysics and a PhD in Physics with the dissertation on statistical physics aspects of neuronal networks, followed by substantial postdoctoral training in cognitive neuroscience, primate neurophysiology and neural prosthetics at Columbia, Yale and Wake Forest universities. Ioan's current research focusses on neural microcircuits and decision/memory prosthetics. He and his team have provided the first demonstration of inter-laminar columnar processing in prefrontal cortical microcircuits during executive

decisions in nonhuman primates and also on the laminar microcircuits in the subfields CA3-CA1 of primate hippocampus. Ioan is also collaborating with Dr. Casanova's team studying autism spectrum disorders in children by applying transcranial magnetic stimulation and neuro-feedback. Moreover, he edits and writes topics on the interface between Physics and Cognitive Neuroscience, having two books (one in press and the other in preparation) for Springer. He initiated a new section in the *Frontiers in Neuroscience* journal named *Frontiers in Neural Technology* that is now underway.

# Architecture: Problems of Translation

Dr. Livio Dimitriu

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**Abstract:** For the past few centuries, architecture has been systematically discussed in Western culture as a “language”, autonomous from other disciplines and yet influenced by them. Architects study the complexity of culture that surrounds them and attempt to make their work a mirror of it: geometry, biology, all of the arts, philosophy, sociology, etc. The predicament in transforming such an enormous variety of interests in a built form that is to be inhabited involves a process of translation from one “language” into another. For example, geometry is not architecture, yet architecture employs it; poetry is not architecture, yet architecture makes use of it. The paper examines a few case studies concerned with the methodology of translation among poetry, painting, sound, sculpture and architecture: Rimbaud, Apollinaire, and Juan Gris, and Livio Dimitriu’s *Stairwells* volume (1974-1979) inside the New York avant-garde movement *Pamphlet Architecture*; the sculptor’s Constantin Brancusi’s *Targu Jiu Complex* in Romania (1936-1937); Le Corbusier’s *Maison Cook* in Paris (1927). What makes for an act of translation to fail? What makes for an act of translation to succeed? It involves moving from one discipline to another, and similarly from one language to another. Where literalness does stop, and where does “creative intuition” take over? The conclusion involves the extraordinary impact of Marcel Duchamp inside Twentieth Century, as best exemplified in architecture by the most original *oeuvre* of the Carlo Scarpa.

## Architecture: Autonomous Language

Since the Italian Renaissance, Western culture has systematically discussed architecture as a “language” autonomous from other disciplines, yet influenced by, and incorporating them. Architects study the complexity of surrounding culture and attempt to make their work a mirror of it: geometry, biology, all of the arts, philosophy, sociology, etc. The linguistic analogy as applied to architecture is here to stay whether one may agree with it or not.

The notion of the autonomy of architecture became fundamental to Italian theory and criticism, and practice, through the 1970s and is still going strong today, with world-wide impact.

The view of architecture as a language and autonomous in nature is fundamental to this discussion. In layman’s terms, autonomy signifies in this context that archi-

itecture can operate independently of other disciplines, similarly to how English can operate independently of other languages, let’s randomly say Romanian or Mongolian, even though it may react to the nature of and developments in such other languages.

The predicament of architecture consists in transforming its enormous variety of interests into a built form that is to be inhabitable. The process involves a translation from the “languages” of various other fields of endeavor into the specific language of architecture. For example, geometry is not architecture, yet architecture employs it; poetry is not architecture, yet architecture makes use of it. The problems of translation from another discipline into architecture are identical to those encountered in literature, for example. Literal translation is possible

and required in the case of exact sciences, but becomes totally ineffective when it comes to poetry. A common error in architecture and especially in the teaching of architecture is to require correct linear thinking. No doubt, linear thinking ought to be taught. But impeccable linear thinking cannot be confused with the creative act that necessitates knowing when and how to deviate from and especially break the rules once the rules are under control. In this sense, a creative break-through in physics, for instance, has always involved both rules and breaking the rules.

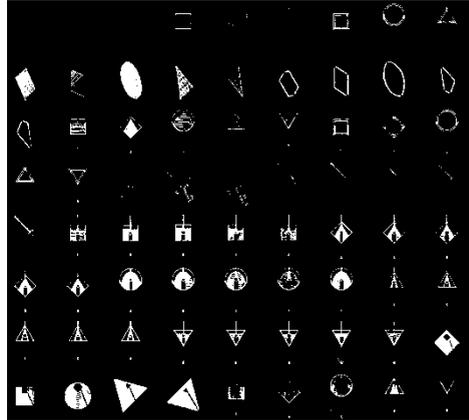


**Figure 1.** RAG (Rimbaud – Apollinaire - Gris) House, unpublished plan study, 1975-1976.

## 2 To Inhabit a Poem

The examples offered in this analysis deal first with the impossibility of translating literally from other disciplines, even related ones such as painting, poetry, and music, into architecture. The project for the RAG (Rimbaud – Apollinaire - Juan Gris) House, 1975-1976 (Figure 1), while perhaps visually compelling to some, is but an early and literal attempt on my part to make a poem / a painting habitable, architecturally speaking. Rimbaud's synesthesia proposed in the poem *Délires / Alchimie du verbe / Voyelles* (1873) provided the color-coding of sound and was applied to Apollinaire's poem *The Three Musicians* in *Calligrammes* (1918).

The printed shape, the image of this poem, is homage to Picasso's painting by the same name from the Analytical Cubism period. The compositional method that wraps up the expression of the architecture project is also a Cubist one derived from studying the painting of Juan Gris of the same period.



**Figure 2.** Livio Dimitriu, *Stairwells* synoptic panel, 1974-1979.

Despite the apparent visual complexity of the imagery, the resulting project cannot escape the linearity of its thinking, the literalness of the translation in this case, the fear of breaking rules once they have been established and digested. This early project fails in producing the invention of a surprising space, the ultimate goal of all architecture.

What is lacking? I had quasi-intuitively understood, as early as 1974, that there was a need for a personal vocabulary, the rudiments of language for space-making and its rules of transformation. By 1978, I developed a personal, private "language" with syntax and grammar that permitted over the following decade an explosion of nationally and internationally award winning projects. The fundamental study *Stairwells* was started in 1974, and published in 1980 (Figure 2), among the first issues of the avant-garde *Pamphlet Architecture Series* which I co-founded. It was re-published by Princeton University Press [1,2]. Dr. Alberto Sartoris, one of the few surviving

members of the original founding group of the Modern Movement at the Congress of La Sarraz (Switzerland) hailed *Stairwells* in very complimentary terms when the study was republished in 1988. The rules of permutations and combination possible by the elements of *Stairwells* are not unlike the use and re-use of words when writing poetry, a process in which breaking syntax in a controlled context produces a sense of wonder and bewilderment essential to all artistic endeavors, and I would venture to say essential to all scientific breakthroughs as well, such as the shift from Newton to Einstein's physics, and beyond.

### 3 Brancusi at Targu Jiu: Methodology

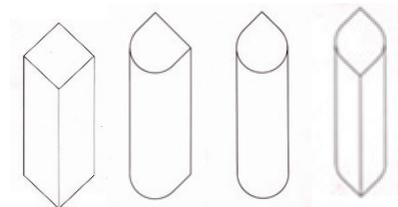
In the case of *Stairwells* one speaks of "form polluted by function". "Polluted" is employed here with a positive and constructive connotation: form that is transformed by function. An alternative lesson can be learned from sculptor Constantin Brancusi's *Targu Jiu Complex* (1937). My analysis of Targu Jiu Complex was first published in 1974 (Figure 3) and was widely accepted after a lengthy series of lectures in the US and abroad on the subject of *Brancusi Architect*. The position was hailed in 1988, by the most important historian of architecture alive today, Prof. Kenneth Frampton of Columbia University, as one of the few fresh perspectives on Brancusi, in memory. The argument for analysis is based on documentation provided in footnotes, in Barbu Brezianu's primary source volume *Brancusi in Romania* (1972). These Brancusi sculptures for public spaces, function has been systematically removed. *The Gate of the Kiss* was originally intended to be the actual gate of the Municipal Park. Brancusi insisted to shift the gate to the inside of the park. There is no evidence why he did so. The image of "gate" for this sculpture becomes stronger precisely because its function has been weakened as much as possible. Brancusi employed the same strategy by when it came to *The Table of Silence*. Its layout went through three

stages, the last one being the final (Figure 3). In this case also there is no evidence as to why he did so, except that the sequence of changes reveals clearly the reason. In the first stage, paired chairs were placed close to the table.



**Figure 3.** Analysis of successive versions considered by Brancusi for the layout of the *Table of Silence*, Targu Jiu, Romania, 1936-1937.

The distance from the chairs to the table and among the chairs was a functional one. The resulting image is one that involves 12 people potentially engaged in a noisy conversation while having a meal. The second stage preserved the paired chairs but increase the distance to the table. The mental image becomes that the intimacy of couples interacting around the table, with the table impossible to use. This becomes the equivalent of a gathering of people speaking in *sotto voce*. The final version involves twelve chairs placed away from the table and evenly spaced away one from another. The specificity of the dimensions involved erodes functional connotations such as eating at this table or conversations among visitors seated around it. Once the function has been eliminated, silence can reign undisturbed, and thus: *The Table of Silence*. Brancusi's sculptures are achieved by the elimination of function.



**Figure 4.** Transformations of the central column, from ground to the roof levels, in Le Corbusier's *Maison Cook*, Paris, France, 1927.

#### 4 Le Corbusier's Methodology

In *Maison Cook* in Paris (1927), Le Corbusier sets up a very complex system of reading through the placement and shape of structural columns. The vertical column at the center of the plan, attached to the main stair of the house, constantly changes shape as it moved vertically from one floor to another (Figure 4). The shape at each individual floor gives the visitor a clue as to the nature of the movement on that particular floor. The stacking of the column's various shapes, the assemblage of forms, can only be achieved as a mental exercise. It is not possible to see it with the eye, but it can be seen with the eye of the mind. Le Corbusier achieves architecture by allowing form to be imbued with function. Yet the mental image of the entire column piercing the section of the building speaks of rotation in space and is not concerned with the specificity of functional solutions at each floor. This mental image is evidently indebted in its meaning to Brancusi's series of *Birds in Space*, vertical columns assembling various shapes for bases, the connection between base(s) and the bird, and the bird itself.

#### 5 Marcel Duchamp's Methodology

Perhaps one of the most revolutionary methodology in the arts of the last century was proposed by Marcel Duchamp through his "ready mades". His famous *Urinal* proposes the transformation of the meaning of form by a simple act of repositioning the form in space. Duchamp's groundbreaking *Urinal* (Figure 5) was literally "quoted" by Le Corbusier in the small side chapel of Ronchamp, as the repositioning in space of this object allows it to become pure space, under light and shaped by shadows, thus ready and able to accept any new meaning one wishes it to have. The absolutely unique Italian architect Carlo Scarpa, a good friend of Marcel Duchamp, has used systematically the "ready mades" approach especially in the latter part of his own career. In Scarpa's solution for one water

spout at the chapel at the chapel of *Brion Cemetery* of San Vito in Altivole, the "correct" design is repositioned in space by being installed intentionally up-side-down (Figure 6). The water spout is not simply a functional solution masterfully executed, but becomes the idea of a water spout. The "correct" solution has been installed up-side-down. The function here is underlined by the negation of function.



Figure 5. Marcel Duchamp, *Urinal Fountain*, 1917.

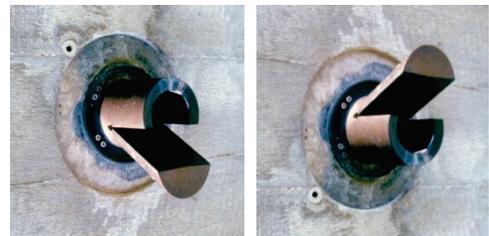


Figure 6. Carlo Scarpa, Detail of water spout in the Brion Vega Cemetery, San Vito in Altivole, Italy, (1968-1978). The "correct" and the "as built" solutions.

Like in Brancusi's work, a table becomes the idea of a table. Like for Corbusier, the column becomes the idea of a column. In all such cases, the artfulness consists in taking the visual image, poignant as it may be, and attempting to transform it into a mental image. Solutions are "found" in reality through a relentless search for

repeated de contextualizing and re-contextualizing that which already exists, bringing about a fresh invented perception which is seen by others as innovation. One intentionally plays here on the Italian words *innovazione* vs. *invenzione*. It is not an accident that Brunelleschi spoke of his Opera del Duomo's *machine* as miraculous inventions.

#### 4 Translations: Architecture / Literature

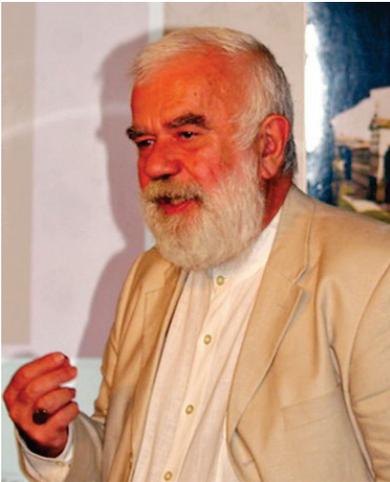
What makes for an act of translation to fail? What makes for an act of translation to succeed? In architecture, the act of translation involves moving from one discipline to another, from one physical context to another, and from one functional program to another. In literature, translation moves a text from one language to another, and like in any other discipline, one is bound to fail if translating words and original syntax, or attempt to translate sound and breathing. Literalness, under the pretext of a misplaced and naïve notion of “respect” for the original, fails to capture meaning. If one attempts to understand the mechanism of how the original text is able to produce a

mental image, and find the equivalent mechanism in another language, all poetry becomes possible to translate. In literature, like in architecture, one must translate relationships and not mere facts. One needs to capture the meaning of the space in-between, the void, and not only the solids that make the void possible. Like for Carlo Scarpa, to graft Zen culture onto Italian Renaissance, both found objects” and ready mades”, and then become obsessed with the void in-between, leads to originality. To paraphrase the English poet William Blake, the role of art (and by this one means also mathematics, pure physics, and precise sciences in general) is to scratch the surface of reality to reveal truth.

There are no problems of translation. There are only poor translators.

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- 2) Livio Dimitriu and others, *Pamphlet Architecture 1-10* (Princeton University Press, 1980).



#### Biographical Sketch:

Dr. Livio Dimitriu is an American architect/educator, with a New York private practice since 1978. His urban projects have received 13 national and international gold, silver, and bronze medals, and honorable mentions, in the USA, Italy, and Singapore. His projects have been exhibited at the German Architecture Museum, Taiwan Fine Arts Museum, Museum of Finnish Architecture, the Venice Biennale, MoMA, the Smithsonian, Museum of Modern Art/Paris, and many other institutions and galleries in 28 countries. Mr. Dimitriu has authored and contributed to 31 volumes in 10 countries on 3 continents, along with articles and projects in over 100 magazines worldwide.

Mr. Dimitriu founded USA Institute in 1978, a New York public service and research organization sponsored by the banking and marble, granite, and stone industry, academic institutions, and private donors. He is Chief Editor of USA Books, and has been a Senior

International Magazine Editor for a cumulative 25 years with *Controspazio*, *Octogon*, and *Arhitext*. Mr. Dimitriu co-founded the avant-garde Pamphlet *Architecture* in 1978, and started the first series of volumes ever on *New York Architects* in 1987. He has been a founding member of the Islandic School of Architecture, a past member of the Olivetti Foundation Scientific Committee and the Canadian Schools of Architecture Accreditation Board, a Senior Fulbright Scholar to Europe, a grant recipient of the National Foundation for the Arts, and twice a recipient of a Romanian Government Research Grant, and of a Pratt Institute Research Grant.

Mr. Dimitriu has held academic appointments/directorships at 21 universities in North America, Europe, and Asia. He has presided and/or participated in scores of competition juries in Europe, Asia, South America, and the USA, and curated over 45 premiere traveling exhibitions, including *New York Architects*, *Scarpa*, *Sartoris*, *Figini & Pollini*, *Botta*, *Gregotti*, *Vacchini*, *Purini*, and *Anselmi*.

Mr. Dimitriu accepted a Ph.D. in Theory/History of Architecture with the highest honors from the Ion Mincu University of Architecture and Urbanism in Bucharest, an Honorary Master Architect in Stone from the Antica Corporazione in Verona/Italy, and a B. Arch. from The Cooper Union in New York. He is currently a tenured Full Professor at Pratt Institute.

His early interest in literature received a Romanian National Youth Award for Prose in 1968, after mastering the language during 10 years of forced residence in that country, imposed on a foreign citizen, during late 1950s to late 1960s. In the USA, he audited New York University courses with Alain Robbe-Grillet, Tristan Todorov, Julia Kristeva, and Borelli, and lectured on European avant-garde literature with the Kiremidjian courses at Brooklyn College, Modern Languages Association, and American Society of Esthetics, and other American academic institutions.

# Old Romanian Iconographers and Their Icons on Glass: Materials, Techniques, and Secrets

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**Abstract:** Peasant icons offer the strange image of a folk art, clearly outlined and unique in its technical quality and sensitivity. They are the result of the harmonious merging of moralizing teachings and the mythology of an ancient faith, of subjects taken from the Romanian folklore, from apocryphal books, and the precepts of a local ethical code, thousands of years old. The slight emotional emphasis therein is on the national and social context of a people with a stormy and too frequently changing history. The study introduces the Romanian icons on glass in the cultural environment of Central and Eastern Europe making comparative notes and historic connections. Less known information about how the peasant iconographers prepared their own materials and the technical skills they mastered in creating these icons is presented together with examples of icons from different geographical areas of today's Romania.

## Introduction

Peasant icons on glass are a unique form of folk art both in technical quality and sensitivity. While a few paintings on glass were found in Central Europe (mainly Bohemia and Austria), the area where this type of craft was practiced extensively and reached maturity was Transylvania and Northern Moldova. It is not clear when this art appear in the Romanian area. Because of the frailty of the glass support, and of the poor adherence of colors to this shiny, non-porous surface, not too many ancient icons on glass reached us. Icons found in different collections, which bear an indication that makes it possible to date them (Figure 1), belong usually to the second half of the eighteenth century [1]. In the Romanian area this genre reached its pinnacle during 1830-1900. After 1900 this technique was used by very few iconographers [2].

Some researchers consider that this form of art, painting sacred figures on the back of a glass plate, came to the Romanian area from Central Europe [3,4]. In support of this hypothesis, it is worth mentioning that in Transylvania most of the names of

the colors, pigments and other materials used by the peasant painters have a Germanic resonance. However, this may also indicate the source of materials since the themes and models used are designated by pure Romanian terms.



**Figure 1.** Icon on glass, dated 1838 and signed Matei Popa

According to the principles of iconography, the themes and their frequency as well as the characteristics of the details do not point to a Germanic model but to a Romanian, Byzantine or Near Eastern one. The chromatics and the

often used golden background remind us of Byzantium where painting on glass was already known several centuries earlier [3]. There is still an unanswered question. If this form of art came to Romania from Central Europe, why cohabiting ethnicities in Transylvania, of the same Catholic faith as the peoples of Central Europe, did not adopt it?

Well-known centers for painting on glass developed in Transylvania, whereas those in other regions were few and much less studied. The products of the various centers bear certain local characteristics that can be easily detected [5]. In the Olt Country (center in Southern Transylvania) two different currents were detected: one represented by the icons made by skilled iconographers and another one represented by much less educated craftsmen [6]. This is not surprising since long before the art of painting on glass developed in the Romanian area, iconographers had lived and worked there using other techniques. The iconographic recommendations of the hermeneias and the imprint of those who painted on wood are easy to see in the icons painted on glass.

The icons were transported by carts belonging to the iconographers themselves, to peddlers, or were carried by shepherds during the seasonal migrations of flocks from one pasture to another. Icons painted on glass spread throughout all the Romanian provinces, often far away from the centers where they were made. Icons were purchased as presents for different occasions or for a girl's dowry because, in certain regions, no girl could marry without owning an icon. Icons representing the Virgin (Figure 2) or the Nativity were especially popular since they were considered symbols of fecundity.

While the iconographic aspects of the icons on glass were studied by many researchers, little has been written about the skill and technical ability of those who painted them.

This study focuses on the material face of the icons on glass: the raw materials and the materials used to make them, on preparatory technologies, and on the techniques used by the Romanian iconographers who used glass as the support of the pictorial layer. The information comes from the secretive painter's manuals and from interviewing old iconographers who were still active during the last decades of the twentieth century.



Figure 2. Our Lady of Sorrows (orivate collection)

## 2. The Cast and the Time

In a peasant iconographer's workshop family provided help, as happened in other techniques of painting practiced in that area [7]. The steps that required no artistic gift or technical skills (grinding and sifting of the pigments, their "rubbing" in a mortar with a pestle, preparation of adhesives, dye stuffs, additives and binding materials, and making the frames) were carried out by members of the family with less experience. The coloring and the application of the local hues were carried out by more skilled members of the family. Still more qualified ones would make the drawing, the writing, and put in the patches of light. As a rule, retouching – almost impossible in this technique – and the application of the gold leaf were done only

by the head of the workshop. In busy workshops colors were applied concomitantly on several icons, to save both materials and time.

The peasant iconographers painted mostly during the cold season, when work in the fields and shepherding slowed down. The icons were sold at fairs or by peddling, for money or exchanged for cereals or wares from the homestead of the buyer. Often this trade took place also during winter when peasants and shepherds stayed home and many weddings were celebrated [8].

### 3. The Materials

Glass for the support was of the soda-lime type and it protected the painted layer like varnish does on easel painting. It was obtained from small factories (glăjării) existing, as a rule, in forested zones, due to the large volume of wood needed for furnaces. Glass was also supplied by local merchants, by hawkers or by pilgrims coming to monasteries on the patron saint's day [8]. The glass was cut into small pieces of various sizes for easier transportation. The size of the glass sheets was variable in different centers or even in the same center during different periods of time. In centers like Nicula (in the midst of a poor, less developed area) the icons were smaller than in the affluent center Scheii Braşovului, since the price of glass weighed heavily in the cost of the completed icon. No icons were painted on mirror glass in this geographical area.

The technological process for glass making was a rudimentary one. A mixture of quartz sand (silica as main ingredient), soda ash, limestone, and, sometimes, cullet (for furnace efficiency) was melted and then blown into cylinder-like shapes, the thickness of the wall being approximately the same as that of the future glass sheets. This thickness was not the same throughout the cylinder or throughout the glass sheet obtained when the cylinder was split lengthwise along a generating line and "stamped" down on slabs of smooth

chamotte bricks, previously heated in special ovens. As neither the melted nor the "stamped" glass could be maintained at the required optimal temperatures, gas bubbles of various sizes remained within the glass. Inner stress lines also appeared on cooling due to an uneven temperature within the sheet, increasing its brittleness. When, long after the icon was completed and framed, the glass sometimes broke without any apparent cause, probably due to accidental mechanical stress (vibrations, mechanical shock, uneven dilation) and when these accidents occurred in connection with certain significant family events, they acquired a miraculous connotation.

As a consequence of the rudimentary processing of the glass, its surface remained slightly undulated, having been cooled too much and too fast before being "stamped" down. These undulations can be detected with the finger tip. The effect of these imperfections was not always unpleasant. The differences in the thickness of the glass, the undulations and air bubbles embedded in the material and the fact that the colors are seen through the glass impart, owing to complex optical phenomena, depth to the hues and result in vibrant colors. When, towards the end of the 19th century, glass from commercial sources was exclusively used, without any of the defects mentioned, and when the Romanian folk painting on glass showed the first signs of decline, the charm of this kind of folk art was lost.

### 4. The Drawing and the Models

To ensure good adherence of the colors, fat was removed from the glass using lye wash, then rinsing with water and drying before painting. Lye wash was prepared either in large vessels or in the hollowed trunk of a hard wood tree by scalding ash.

In painting on glass the drawing was usually copied using a model, an engraving, a xylograph, or an illustration from a religious book and was drawn in pencil, ink, China ink, black or red

tempera. Some artisans drew from imagination or from the details of several models or engravings so as to create a composition of their own. When doing so, or even when using models, the iconographers would introduce or eliminate elements, trying to make each icon unique and thereby imprinting their own skill and feelings. In some peasant icons on glass perspective was totally ignored giving them a unique, primitive charm. When models were made, they were borrowed, copied, restored, refreshed, and inherited. They were lost by wear or by accident (fire, flood, invasion, vandalism) so that few still exist nowadays.

### 5. The Pigments and the Colors

The pigments used in painting icons on glass were obtained from other iconographers' workshops, prepared in the artisan's workshop, or bought from merchants and peddlers.

Raw materials from natural sources (iron salts, manganese and copper hydroxides and oxides, cinnabar, kaolin, chalk) were processed (cleaned, ground, sieved and washed) in the peasant workshops. From the hermeneias and Romanian miscellanea it can be seen that, in that area, several preparative technologies (for white lime, white lead, cinnabar, green copper acetate) used in other parts of the world were known and practiced with local innovations [7].

Certain organic dyes obtained from plants (by infusion or extraction) were used in addition to the inorganic pigments as well. These dyes were faded, by their very composition, to a more or less rapid decomposition under the sunlight which was not stopped by either the glass or the superposition of colors. These, however, offered some protection from the attack of the environmental agents to which icons were exposed. Sometimes this attack was strong enough for the dyes to disappear completely. The chalky, earthy or even faded colors in some older icons, when not

caused by the use of certain pigments of questionable quality, represent what is left from parts colored only using dyes whereas others, painted only using inorganic pigments, maintained a fresh hue and shine.

The black pigment used in painting on glass by the Romanian icon painters was prepared from carbon black obtained by the incomplete combustion of certain indigenous resins, of bones, oak or linden wood, grapevine stems, peach stones, or walnut shells followed by thoroughly grinding the resulting charcoal. The pigment obtained from grapevine stems resulted in a cold grey color of particular beauty characteristic for painters of yore from this area.

Unequally used, the few white pigments had a fairly varied composition (fine chalk or kaolin powder, ceruse and - starting from the second half of the nineteenth century - zinc oxide). The white pigments obtained from kaolin or chalk were prepared from the raw material found in natural deposits by breaking down, washing, drying and sifting. White lead (ceruse) was bought, obtained from other painters or prepared in the workshop by letting vapors of acetic acid (from concentrated vinegar prepared in the household) act on lead ore for about 40 days in the presence of carbon dioxide produced by the anaerobic fermentation of horse dung [7]. While these pigments were seldom bought, zinc oxide was always purchased from traders.

The red pigments were cinnabar (vermilion), minium (lead tetroxide), ferric trioxide, and, starting in the nineteenth century, fuchsia red. These were all provided by traders with the exception of cinnabar. This last pigment was obtained from natural local deposits and was also produced in some of the iconographers' workshops following recipes found in the Romanian painter's manuals. This procedure was the same as the one used in medieval Europe, at Mount Athos, or in China two thousand years earlier [8].

Contamination with minium (of higher density and cheaper than cinnabar), a fraudulent trick, was far less harmful in painting on glass than in easel or mural painting (owing to the protection of the glass and overlay of other colors and of gold leaf).

Ferric trioxide, a dark red pigment, was obtained from ochre by calcination or directly from natural deposits. The tint differed according to the ore it was extracted from, its purity, and the temperature and duration of calcination. The higher the temperature and the longer the duration, the darker the red due to the higher proportion of magnetite ( $\text{Fe}_3\text{O}_4$ ). Iconographers used sometimes a mixture of hematite and goethite to replace cinnabar (expensive) [9].

Yellow pigments were obtained from natural deposits or bought. However a yellow, as yet unidentified, plant extract was also used [10]. The ochre tint varied depending on the proportion of aluminum silicates in the ore, which would sometimes vary even within the same deposit. Ochres were particularly interesting for painting on glass because of their high opacity and covering capability. The imported Thassos ochre had a redder tint owing to its higher content of iron trioxide .

The green pigment used was copper acetate, prepared, as in Western Europe or at Mount Athos, in closed containers where acetic acid vapors (from concentrated vinegar) reacted with small pieces of copper.

Brown and purple pigments were manganese compounds obtained from natural deposits or from commercial sources. Azurite,  $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$ , and ultramarine, the former from natural sources and both from commercial sources, were used as blue pigments. Later on they were replaced by cobalt blue and ceruleum, both commercially available.

Gold pigment, primarily used from the middle of the 18th to the end of the 19th century for aureoles, stars and sometimes

for the background, was prepared from imported bronze powder or gold leaf available commercially or from other workshops [5,10]. The use of gold is unanimously considered to be the influence of Byzantium. The bronze powder was increasingly used after oil colors started to be used. While in some icon centers (Braşov) it was little used, in some others (Nicula) only seldom, in Laz-Sebeş it was overused. In older icons, in the simpler ones, and even in the entire work of some iconographers ochre was used instead (less expensive).

Starting with the middle of the 19th century, in some icon centers (The Olt Country, Laz-Sebeş) the background of the icons on glass was no longer painted. Instead, metalized paper or tin foil was applied on the back of the painting. The colors did not adhere well to it and the painted layer soon began to peel off. The outlines however resisted better since the colors used to draw them were prepared with a stronger binder.

At first, icons on glass were painted with tempera colors and the influence of painting on wood panels was obvious. The colors were prepared by “rubbing” the pigments with a pestle in rudimentary mortars made of hard stone together with an emulsion of animal glue (from sheep skin or rabbit bones), egg yolk, and small amounts of ox gall and vinegar. Vinegar was added to the binders both as a coagulant and preservative of the colors against biodegradation.

Analysis of the layers painted in tempera in the early days is almost impossible today since most of them were subsequently restored using oil colors. Later on, at times that varied from one center to another, oil paints started to be used. They were prepared by “rubbing” the pigments with linseed oil. Ceruse was the only one which was “rubbed” with walnut oil because it is itself a pretty strong siccative. With the other colors a colorless siccative was added after “rubbing”.

## 6. The Technique

The technique of painting on glass was very simple and it was the same throughout the entire Romanian area. Four main difficulties were encountered in painting on glass. First, because the painting was done in a reversed position, the side painted on became the back of the icon and the order of the colored layers was reversed, thus making it fundamentally different from any other technique. A second difficulty was the virtual impossibility to retouch. Thirdly, colors have a poor adherence to glass, and lastly a big problem is the fact that icons on glass cannot be restored when necessary as easily as those painted on wood or those painted in the secco technique on dry plaster.

The outlines were traced with black pigment introduced in a mixture of linseed oil, turpentine and a little lead acetate (a colorless siccativ to ensure quick drying). Less often the drawing was done with a dilute emulsion of egg yolk in which carbon black was suspended. In certain centers (Nicula and Banat), some of the painters drew the outlines in black and other lines in red, especially the contour and features of the face, hands or uncovered parts of the body, as in fresco painting [11].

Many iconographers could not write. That is why the writing on some icons is drawn in a decorative motif. After many and repeated copies of a model, the letters and the words copied by artisans who could not read themselves had no longer any meaning.

The frames of the Romanian icons painted on glass were made using different wood essences, with or without a profile, painted, colored or stained with tanner's drench. The wood most used was fir but maple, plum tree, oak and walnut were used as well. The frames were sometimes made by the artisan himself or by the village carpenter. The icon was transported after having been framed as the painting readily came off. The back of the frame was covered with thin wood boards that both protected the icon and rendered the frame more rigid. In the Nicula center

cherry tree bark was also used to cover the back of smaller icons [3]. The papers put between the painting and the back for increased protection often offered interesting indications regarding the age of the icon, or about certain techniques used, or were even of historical or social interest.

Until the end of the 19th century the frame was assembled with wooden pegs and later on with metal nails. In some cases the framework was joined together by wooden tenons, which increased its rigidity and stability.

Painting on glass originated elsewhere, but the Romanian peasant iconographers made it their own and brought this art genre to heights unknown before or since. The originality and unitary style of Romanian icons on glass are impressive and the craft and technical knowledge which make their hidden face are no less so.

## Acknowledgment

To Mihail Mihalcu, the trail blazer.

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# Matrix of Constraints for the Motion of the Planar Kinematic Chains with Rotational Links with Clearances

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**Abstract:** Our goal is to present a general approach for the planar chains with rotational links with clearances. This approach is realized in a multibody style, the main problem being the determination of the matrix of constraints. **Introduction**

The application of the multibody type methods [1-13], made possible the elaboration of certain general algorithms for the numerical, dynamical and elasto-dynamical calculation of the kinematical and dynamical parameters for the mechanical systems' motions. These algorithms can be applied both to the determined kinematical mechanical systems with and without friction [4,9,14], respectively with one degree of mobility, and to the systems with one degree of mobility and a single motor element as, for instance, [2,7,12], the mechanical convertor of torque created by G. Constantinescu. The applications of the multibody type methods for the studying of the planar mechanical systems having articulations with clearances (rotational kinematical joints) [3,4,6,10,14], assumes the inserting of certain virtual without mass elements, which leads to singular matrix of inertia and, consequently, it does not permit the separation of the general system of equations in two systems from which result, in order, the time history of the reactions and then the time history of the kinematical parameters. In this paper we elaborate a multibody type method based on a new form of the matrix of constraints, method that permits the numerical dynamical study of the planar systems with rotational joints with or without clearance, with one or several degrees of freedom.

## 1. General Aspects

We consider the planar kinematical chain from the Figure 1 at which the elements denoted by 1, 2, ... are linked one to another by rotational kinematical links with or without clearance  $O_1, O_2$ . Denoting by  $C_i$  the centre of weight of an element  $i$ , which is either a bar, or a shell, and denoting by  $C_i x_i y_i$  the proper reference system, Figure 2, then the position of this elements, relative to the general fixed reference system  $OXY$ , is defined by the coordinates  $X_i, Y_i$  of the centre of weight, and by the angle  $\theta_i$  between the axes  $C_i x_i$  and  $OX$ .

This element, linked to the next element  $j$  by the rotational joint  $O_k$ , can have a point  $\tilde{O}_l(\tilde{X}_l, \tilde{Y}_l)$  with known motion,

$$\tilde{X}_l = \tilde{X}_l(t), \tilde{Y}_l = \tilde{Y}_l(t).$$

If the rotational kinematical joint  $O_k$  is with clearance, Figure 3, with permanent contact between the elements  $i$  and  $j$ , then the clearance can be defined by the difference  $r_k = O_k^{(i)} O_k^{(j)}$ ,  $r_k = r_k^{(i)} - r_k^{(j)}$ , between the radius  $r_k^{(i)}$  of the rim and the radius  $r_k^{(j)}$  of the shaft, and by the angle  $\alpha_k$  between  $O_k^{(i)} O_k^{(j)}$  and  $OX$ .

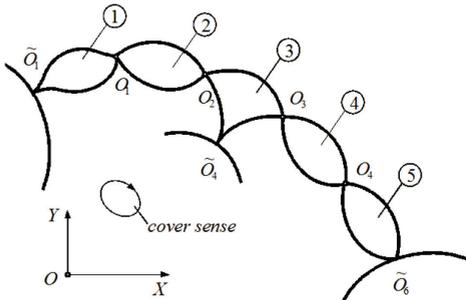


Figure 1. Planar kinematical chain.

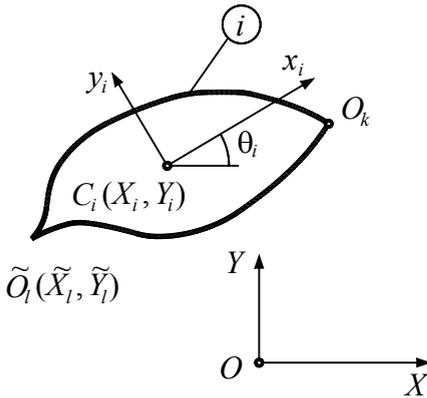


Figure 2. Determination of position for the element  $i$ .

**Functions of constraint. Conditions of constraint. Matrix of constraints**  
**Conditions given by the existence of the rotational kinematical joint**

We consider the elements  $i, j$ , Figure 4 linked one to another by the rotational kinematical joint with clearance  $O_k$  and let  $x_k^{(i)}, y_k^{(j)}$  be the coordinates of the point  $O_k^{(i)}$  in the local reference system  $C_i x_i y_i$ .

If we use the notations

$$U_{kX}^{(i)} = x_k^{(i)} \cos \theta_i - y_k^{(i)} \sin \theta_i \quad (1)$$

$$U_{kY}^{(i)} = x_k^{(i)} \sin \theta_i + y_k^{(i)} \cos \theta_i,$$

then the coordinates  $X_k^{(i)}, Y_k^{(i)}$  of the point

$O_k^{(i)}$  in the reference system  $OXY$  are expressed by the relations

$$X_k^{(i)} = X_i + U_{kX}^{(i)}, Y_k^{(i)} = Y_i + U_{kY}^{(i)}, \quad (2)$$

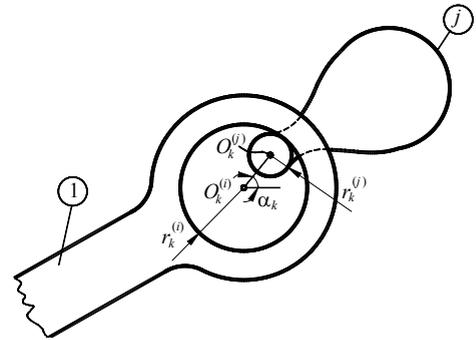
and the coordinates  $X_k^{(j)}, Y_k^{(j)}$  of the point  $O_k^{(j)}$  in the system  $OXY$  are obtained with the same relations (2) in which we replace the index  $i$  by the index  $j$ .

Keeping into account the sense cover sense of a contour, Figure 4, and using the notation

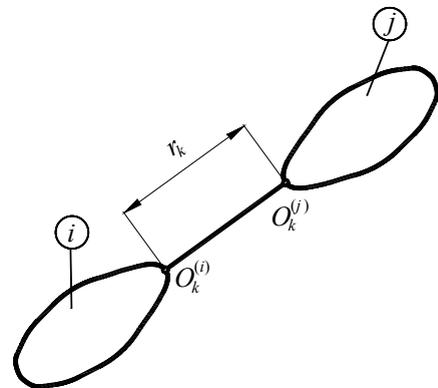
$$\{\mathbf{D}_k\} = \frac{1}{r_k} \begin{bmatrix} X_k^{(j)} - X_k^{(i)} \\ Y_k^{(j)} - Y_k^{(i)} \end{bmatrix} \quad (3)$$

one can write the constraining functions in the form, equations number (4)

$$\begin{cases} \{\mathbf{D}_k\} = \{\mathbf{0}\}, & \text{if } O_k \text{ is a kinematical joint without clearance} \\ \{\mathbf{D}_k\}^T \{\mathbf{D}_k\} - 1 = 0, & \text{if } O_k \text{ is a kinematical joint with clearance} \end{cases}$$

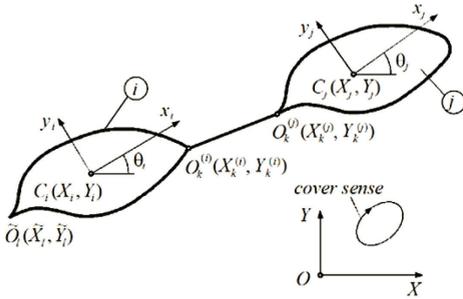


a) constructive schema



b) kinematical schema.

Figure 3. Rotational kinematical joint with clearance



**Figure 4.** The elements  $i, j$  and the rotational kinematical joint with clearance  $O_k$ .

By derivation of the relations (1), (3) in respect to time and keeping into account the notations

$$\begin{aligned} \left[ \mathbf{B}_k^{(i)} \right] &= \begin{bmatrix} 1 & 0 & -U_{ky}^{(i)} \\ 0 & 1 & U_{kx}^{(i)} \end{bmatrix} \\ \left[ \mathbf{E}_k^{(i)} \right] &= \left\{ \mathbf{D}_k \right\}^T \left[ \mathbf{B}_k^{(i)} \right] \\ \left\{ \mathbf{q}_i \right\} &= \left[ X_i \quad Y_i \quad \theta_i \right]^T \end{aligned} \quad (5)$$

one deduces the equalities

$$\begin{aligned} \dot{U}_{kX}^{(i)} &= -\dot{\theta}_i \cdot U_{kY}^{(i)}, \quad U_{kY}^{(i)} = \dot{\theta}_i \cdot U_{kX}^{(i)} \\ \left\{ \dot{\mathbf{D}}_k \right\} &= \frac{1}{r_k} \left[ \mathbf{B}_k^{(j)} \right] \left\{ \dot{\mathbf{q}}_j \right\} - \frac{1}{r_k} \left[ \mathbf{B}_k^{(i)} \right] \left\{ \dot{\mathbf{q}}_i \right\} \end{aligned} \quad (6)$$

In these conditions, by the derivation of the relations (4) in respect to time, one obtains the *conditions of constraint*, we can write the relation (7).

$$\begin{cases} \left[ \mathbf{B}_k^{(j)} \right] \left\{ \dot{\mathbf{q}}_j \right\} - \left[ \mathbf{B}_k^{(i)} \right] \left\{ \dot{\mathbf{q}}_i \right\} = \left\{ \mathbf{0} \right\}, \\ \text{if } O_k \text{ is a kinematical joint without clearance} \\ \left[ \mathbf{E}_k^{(j)} \right] \left\{ \dot{\mathbf{q}}_j \right\} - \left[ \mathbf{E}_k^{(i)} \right] \left\{ \dot{\mathbf{q}}_i \right\} = 0, \\ \text{if } O_k \text{ is a kinematical joint with clearance} \end{cases} \quad (7)$$

In the case of the rotational kinematical joint with clearance, Figure 4, using the angle  $\alpha_k$ , we can write the relation

$$\left\{ \mathbf{D}_k \right\} = \left[ \cos \alpha_k \quad \sin \alpha_k \right]^T \quad (8)$$

and from here results for the matrix  $\left[ \mathbf{E}_k^{(i)} \right]$  the expression (9);

$$\begin{aligned} \left[ \mathbf{E}_k^{(i)} \right] &= \\ &= \left[ \cos \alpha_k \quad \sin \alpha_k \quad -x_k^{(i)} \sin(\theta_i - \alpha_k) - y_k^{(i)} \cos(\theta_i - \alpha_k) \right] \end{aligned}$$

### 3.2. Conditions given by the existence of a point $\tilde{O}_l$ with known motion

In this case, denoting by  $\tilde{x}_l, \tilde{y}_l$  the coordinates of the point  $\tilde{O}_l$  in the reference frame  $C_i x_i y_i$  and using the notations  $\tilde{U}_{lX}^{(i)} = \tilde{x}_l^{(i)} \cos \theta_i - \tilde{y}_l^{(i)} \sin \theta_i$ ,  $\tilde{U}_{lY}^{(i)} = x_l^{(i)} \sin \theta_i + y_l^{(i)} \cos \theta_i$ ,

$$\left[ \tilde{\mathbf{B}}_l^{(i)} \right] = \begin{bmatrix} 1 & 0 & -\tilde{U}_{lY}^{(i)} \\ 0 & 1 & \tilde{U}_{lX}^{(i)} \end{bmatrix}, \quad \left\{ \tilde{\mathbf{F}}_l \right\} = \left[ \dot{\tilde{X}}_l \quad \dot{\tilde{Y}}_l \right]^T,$$

one obtains the equalities  $X_i + \tilde{U}_{lX}^{(i)} = \tilde{X}_l$ ,  $Y_i + \tilde{U}_{lY}^{(i)} = \tilde{Y}_l$ ,

which, by derivation in respect to time and keeping into account the relations  $\dot{\tilde{U}}_{lX}^{(i)} = -\dot{\theta}_i \cdot \tilde{U}_{lY}^{(i)}$ ,  $\dot{\tilde{U}}_{lY}^{(i)} = \dot{\theta}_i \cdot \tilde{U}_{lX}^{(i)}$ , lead us to the *constraining condition*

$$\left[ \tilde{\mathbf{B}}_l^{(i)} \right] \left\{ \dot{\mathbf{q}}_i \right\} = \left\{ \tilde{\mathbf{F}}_l \right\} \quad (10)$$

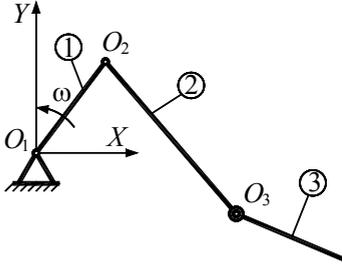
### 3.3. Matrix of constraints. Matrix equation of constraint

*Matrix of constraints* is obtained by assembling matrices of  $\left[ \mathbf{B}_k^{(i)} \right]$ ,  $\left[ \mathbf{E}_k^{(i)} \right]$ , and  $\left[ \tilde{\mathbf{B}}_l \right]$  type met in the relations (9), (10), relations which are written for each rotational kinematical joint, respectively for each point with known motion. Thus, for the kinematical chain drawn in the Figure 5, at which the element 1 has uniform rotational motion with the known angular speed  $\omega$ , and the rotational kinematical joint  $O_3$  is one with clearance, one obtains the matrix of constraints,

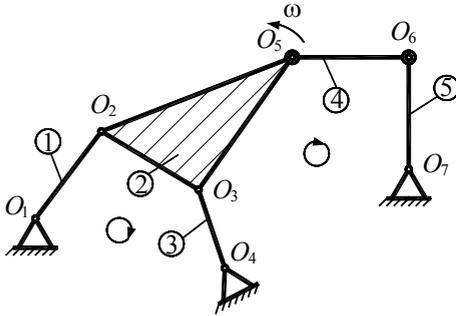
$$\left[ \mathbf{B} \right] = \begin{bmatrix} \left[ \tilde{\mathbf{B}}_2^{(2)} \right] & \left[ \mathbf{0} \right] \\ -\left[ \mathbf{E}_3^{(2)} \right] & \left[ \mathbf{E}_3^{(3)} \right] \end{bmatrix},$$

and if the length of the element 1 is equal to  $l_1$ , then the coordinates of the point  $O_2$  in the general reference system  $O_1XY$  are  $\tilde{X}_2 = l_1 \cos \omega t$ ,  $\tilde{Y}_2 = l_1 \sin \omega t$  and we get the matrix equations of constraining  $\left[ \mathbf{B} \right] \left\{ \dot{\mathbf{q}} \right\} = \left\{ \mathbf{C} \right\}$ ,

where  $\{\mathbf{q}\} = [X_2 \ Y_2 \ \theta_2 \ X_3 \ Y_3 \ \theta_3]^T$ ,  
 $\{\mathbf{C}\} = [-l\omega \sin \omega t \ -l\omega \cos \omega t \ 0]^T$ .



**Figure 5.** Kinematical chain with the element  $O_1O_2$  in rotational motion and the rotational kinematical joint  $O_3$  with clearance



**Figure 6.** System with five elements and the rotational kinematical joints  $O_5, O_6$ , with clearance.

In the case when the element 1 has not a determined motion, one obtains the matrix of constraints

$$[\mathbf{B}] = \begin{bmatrix} -[\mathbf{B}_1^{(1)}] & [\mathbf{0}] & [\mathbf{0}] \\ -[\mathbf{B}_2^{(1)}] & [\mathbf{B}_2^{(2)}] & [\mathbf{0}] \\ [\mathbf{0}] & -[\mathbf{E}_3^{(2)}] & -[\mathbf{B}_3^{(3)}] \end{bmatrix}$$

and the matrix equation of constraints is  $[\mathbf{B}]\{\dot{\mathbf{q}}\} = \{\mathbf{0}\}$ , where

$$\{\mathbf{q}\} = [X_1 \ Y_1 \ \theta_1 \ X_2 \ Y_2 \ \theta_2 \ X_3 \ Y_3 \ \theta_3]^T.$$

Analogously, for the system with five elements drawn in the Figure 6, with the rotational kinematical joint  $O_5, O_6$  with clearance, we obtain the matrix of constraints

$$[\mathbf{B}] = \begin{bmatrix} [\mathbf{B}_1^{(1)}] & [\mathbf{0}] & [\mathbf{0}] & [\mathbf{0}] & [\mathbf{0}] \\ -[\mathbf{B}_2^{(1)}] & -[\mathbf{B}_2^{(2)}] & [\mathbf{0}] & [\mathbf{0}] & [\mathbf{0}] \\ [\mathbf{0}] & -[\mathbf{B}_3^{(2)}] & [\mathbf{B}_3^{(3)}] & [\mathbf{0}] & [\mathbf{0}] \\ [\mathbf{0}] & -[\mathbf{E}_5^{(2)}] & [\mathbf{0}] & -[\mathbf{E}_5^{(4)}] & [\mathbf{0}] \\ [\mathbf{0}] & [\mathbf{0}] & [\mathbf{0}] & -[\mathbf{E}_6^{(4)}] & [\mathbf{0}] \\ [\mathbf{0}] & [\mathbf{0}] & [\mathbf{0}] & [\mathbf{0}] & [\mathbf{E}_6^{(5)}] \\ [\mathbf{0}] & [\mathbf{0}] & [\mathbf{0}] & [\mathbf{0}] & [\mathbf{B}_7^{(5)}] \end{bmatrix}$$

and the matrix equation of the constraints  $[\mathbf{B}]\{\dot{\mathbf{q}}\} = \{\mathbf{0}\}$ , where

$$\{\mathbf{q}\} = [X_1 \ Y_1 \ \theta_1 \ \dots \ X_5 \ Y_5 \ \theta_5]^T.$$

### 3.4. Derivative of the matrix of constraints with respect to time

From the relations (5), (6), in the conditions (7), (8), result;

$$[\dot{\mathbf{B}}_k^{(i)}] = -\dot{\theta}_i \cdot \begin{bmatrix} 0 & 0 & U_{kX}^{(i)} \\ 0 & 0 & U_{kY}^{(i)} \end{bmatrix}$$

$$[\tilde{\mathbf{B}}_l^{(i)}] = -\dot{\theta}_i \cdot \begin{bmatrix} 0 & 0 & \tilde{U}_{lX}^{(i)} \\ 0 & 0 & \tilde{U}_{lY}^{(i)} \end{bmatrix}$$

$$[\dot{\mathbf{E}}_k] = \frac{1}{r_k} \{\dot{\mathbf{q}}_j\}^T [\mathbf{B}_k^{(j)}]^T [\mathbf{B}_k^{(i)}] - \frac{1}{r_k} [\mathbf{B}_k^{(j)}]^T [\mathbf{B}_k^{(i)}] + \{\mathbf{D}_k\}^T [\dot{\mathbf{B}}_k^{(i)}]$$

The derivative of the matrix  $[\mathbf{B}]$  with respect to time is obtained using these expressions.

### 4. Conclusions

The establishing in the paper of a new form of the matrix of constraints made possible the elaboration of the multibody method that permits both the numerical study of the general motion of the planar jointed systems with clearances, and the numerical study of the equilibrium positions.

The numerical applications solved here confirm the statements mentioned above.

### Acknowledgement

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# Influence of the electrochemical treatment on the magnetic properties of nanowires

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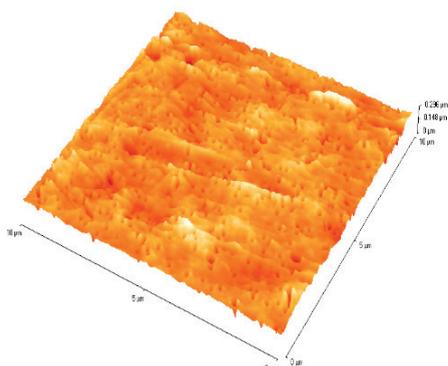
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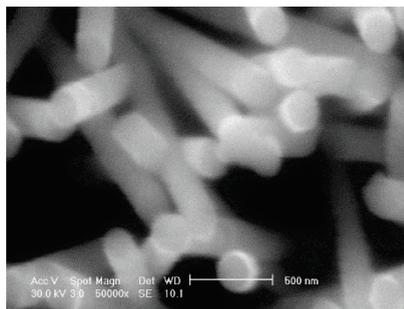
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**Abstract:** Synthesis of nanomaterials is one of the most researched areas. Nanomaterials are at the core of all modern nano-devices. The reduced size helps electronics to have increased performance, low energy consumption and low heat output. Properties of nanomaterials are mainly related to the involved large surface to volume ratio. Nanomaterials can be fabricated using different methods. One of the intensely used, inexpensive and with high degree of reproducibility is electrochemistry (EC), which can be used either to destroy (corrosion) or to create (thin films, nanoparticles, nanowires (NWs), etc.) materials. In this paper we focus on the effect of the electrochemical treatment (EchT) on the structural and magnetic properties of nanowires. Ni NWs were synthesized and analyzed by SQUID to study the magnetic properties induced by the EchT of the Au substrate. Ni NWs were synthesized in a gold-coated PCTE membrane using template synthesis. The EchT induced structural modifications of the Au substrate and further modifications of NWs magnetism.



AFM image of the Au plated PCTE template



SEM image of Ni Nanowires

## 1. Introduction

Common materials such as Fe, Co, Ni exhibit special chemical and physical properties when they have two dimensions in the nanometer range (i.e. nanotubes, nanowires or nanocables). This could be the main reason why after decades of researches all over the world there is still interest in studying properties of common 1-dimensional nanomaterials [1-4]. This particularity makes materials to exhibit interesting behavior compared to bulk materials, which can be exploited in order to create more energy efficient materials, with improved magnetic properties at room temperature (i.e. giant magnetic resonance, giant magnetostriction [2, 5]) and enhanced mechanical resistance.

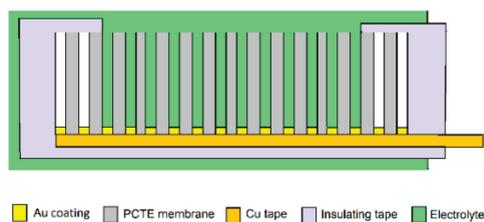
Ni is one of the metals that shows property changes when two dimensions are in the nanometer scale with the third much larger [6]. Nickel can be used in many applications, including biomedicine, sensors (general or biological), electrical devices, transparent conducting circuits [7], printable electronics, etc. For all these applications, the nanowire is the most investigated shape [8-11].

Nanowires (NWs) are commonly synthesized with high reproducibility using template based electrodeposition (ED) [3, 12-14]. Template synthesis consists in the electrodeposition of an electrically conductive element from an aqueous solution inside the transversal pores of a membrane. Before the nanowire growing process, the membrane is sputter coated on one side with a thin conducting film.

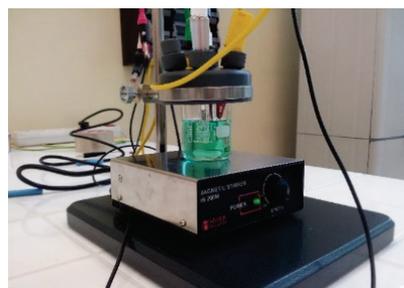
After the application of a conducting layer on the template, the sample is sandwiched in between two insulated tapes, leaving a small opening for the working electrode (WE) surface (Figure 1). Then, the sample is immersed together with a reference electrode (RE) and a counter electrode (CE) in an aqueous solution in a 3-electrode cell configuration (Figure 2). This paper presents another step that was implemented to increase the

experimental reproducibility. This step consists of an electrochemical treatment of the conducting layer that coat the template surface, e.g. an Au thin film in the present case. It has been reported that during the electrochemical treatment applied to Au surface, a high surface diffusion process develops leading to a smoother electrode surface [15-21]. This electrochemical treatment, similar with a thermal annealing process, is performed at room temperature in 50 mM H<sub>2</sub>SO<sub>4</sub> [22-24].

Superconducting Quantum Interference Device (SQUID) technique (MPMS XL from Quantum Design, USA) was used to measure the magnetic properties of the NWs grown in PCTE template. The SQUID device has a high sensitivity and reproducibility (i.e. 10<sup>-8</sup> emu resolution in magnetic moment, maximum field of 7T, 10<sup>-4</sup>T field resolution, and temperature range from 2K to 400K with 10<sup>-3</sup> K stability).



**Figure 1.** Setup configuration for NWs ED sample



**Figure 2** The 3-electrode electrochemical cell

X-ray diffraction (XRD) measurements were performed using an APD 2000 diffractometer (GNR, Agrate Conturbia Novara, Italy) in Bragg-Brentano

configuration, The experiments were performed at 2 $\theta$  with a range from 37° to 82°, a step of 0.02° and a measuring time of 1 s for each step, using the Cu K $\alpha$  radiation ( $\lambda = 1.54 \text{ \AA}$ ), X-ray tube high voltage of 40 kV and tube current 30 mA.

## 2. Experimental

### 2.1. Sample preparation

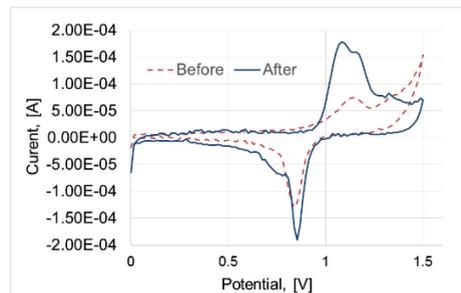
Commercially available polycarbonate track-etched membranes (PCTE, GE OSMONICS INC, USA) with a thickness of 6  $\mu\text{m}$ , a density of  $4 \times 10^9$  pores/ $\text{cm}^2$  and pore diameter of 100 nm, (as quoted by supplier) were used as template. Nickel (II) sulphate hexahydrate ( $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ ), boric acid ( $\text{H}_3\text{BO}_3$ ) and dichloromethane ( $\text{CH}_2\text{Cl}_2$ ) were purchased from Sigma-Aldrich, Germany. The electrolytes were freshly prepared from high purity chemical compounds and ultrapure water (ASTM I, 18  $\text{M}\Omega \cdot \text{cm}$ ).

Electrochemical deposition of Ni NWs was performed using a PARSTAT 4000 Potentiostat/Galvanostat (Princeton Applied Research - AMETEK) equipped with a three electrodes cell setup. A custom working electrode (WE) made from two isolating tapes, copper tape and PCTE template with pore diameter of 100nm, coated with Au on one side (Figure 1) were used. A saturated calomel electrode (SCE) was the reference electrode and a platinum rod was the counter electrode (CE). All reported potentials are with respect to the reference electrode. The electrolyte had the following chemical composition: 44  $\text{gl}^{-1}$   $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ , 40  $\text{gl}^{-1}$   $\text{H}_3\text{BO}_3$  and ultrapure water (ASTM I, 18  $\text{M}\Omega \cdot \text{cm}$ ) for Ni NWs growth and 50 mM  $\text{H}_2\text{SO}_4$  for electrochemical treatment of Au layer.

### 2.2. Sample characterization

After sputtering the gold on the PCTE membrane, the working electrode is produced according to the design presented in Figure 1. Then, the sample is cleaned up

and treated to assure reproducible results. Cleaning is the first step of the electrochemical treatment and consists of 12 voltammetry cycles at a sweep rate of 50 mV/s in 50 mM  $\text{H}_2\text{SO}_4$ . The second step consists of maintaining the potential for 10-15 minutes at a value before the peak oxidation of Au to allow surface diffusion. Figure 3 presents the cyclic voltammograms before and after the electro-chemical treatment of the WE. The difference in the electrochemical behavior clearly indicates that the applied electrochemical treatment (EchT) induces major changes on the Au surface. The EchT allows atoms to rearrange on the surface. Surface diffusion of Au atoms was studied by Hirai et al. [24] using an electrochemical atomic force microscopy (EC-AFM). They reported the filling of the empty sites in the low-level terraces with atoms that decay from the top atomic terraces. Comparable results have are reported at room temperature on the potential-dependent morphologies [22-26].



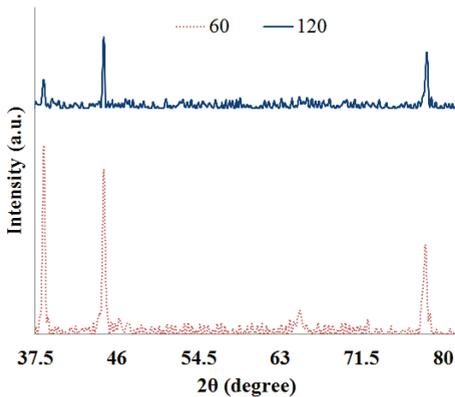
**Figure 3.** Cyclic voltammetry of Au film in 50mM  $\text{H}_2\text{SO}_4$  before and after EchT ( $v = 50\text{mV/s}$ )

During the surface diffusion process at  $\sim 0.9 \text{ V}$ , there are no oxidation/reduction reactions. At this potential, the surface accumulates an excess of positive charge. In consequence, a repulsive force between atoms appears and forces them to have high mobility. This mobility is amplified by the electric double layer that can attract atoms which are at the interface between surface and electrolyte. It results a more uniform crystalline structure and a

smoother surface. Recent reports have shown that a gold substrate can influence the crystal development of the NWs/films grown on it [27].

To investigate this effect on Ni NWs, 2 types of samples (Au films) were prepared. The EchT consisted of 12 CV followed by maintaining the potential constant at 0.85V for different periods of time in 50 mM H<sub>2</sub>SO<sub>4</sub>. The only difference between samples was the duration of applied potential, i.e. 60 and 120 minutes.

On each sample a detailed XRD analysis was performed to measure and calculate the lattice parameter, crystallite size, and the texture coefficient. For all the investigated specimens we performed 3 measurements using same conditions for a better accuracy of the results. The crystalline phase compositions of the investigated specimens were established based on ICDD data files (Figure 4).



**Figure 4.** XRD spectra of Au at different EchT times; EchT was performed through the pores

All the XRD peaks were indexed by face-centered cubic gold phase (ICDD gold card No. 04-0784). The calculated inter-planar distance (*d*) are in accordance with the inter-planar distance (*d*) from ICDD gold card. In the Au face-centered cubic structure, the *d* is related to the lattice constant (*a*) and the Miller indices by the following equation [28]:

$$d_{hkl} = \frac{a}{\sqrt{h^2+k^2+l^2}} \quad (1)$$

The calculated *a* for all investigated specimens are given in Table 1. The *a* values are compared with *a* value from ICDD data card using corresponding (*hkl*) planes and the percentage of variation of *a* is below 1%. Because the differences among inter-planar distances of investigated samples and ICDD data card are less than 1%, the stress in specimens is quite small.

	2θ	FWHM	I/I0	hkl
60	38.4	0.292	100	111
	44.66	0.341	72	200
	78.2	0.612	32	311
120	38.46	0.407	25	111
	44.66	0.226	50	200
	78.26	0.331	100	311
	d (Å)	a	D (nm)	TC (hkl)
60	2.3434	4.05893	31	0.9
	2.0284	4.05679	28	1.3
	1.2219	4.05261	19	0.8
120	2.3399	4.05284	23	0.2
	2.0284	4.05679	42	0.7
	1.2211	4.05	34	2.1

**Table 1.** Calculated parameters from XRD patterns

The peak broadening in the XRD pattern clearly indicates that small crystallites are present in the specimens. Thus, we calculate the average crystallite size (*D*) using the Scherrer equation (Eq. 2):

$$D = \frac{k\lambda}{\beta\cos(\theta)} \quad (2)$$

where *k* is the Scherrer constant and its equal to 0.9,  $\lambda$  is the wavelength of the radiation,  $\beta$  is the integral width expressed in radians,  $\theta$  is the Bragg angle of the peak. The average crystallite size for different (*hkl*) Miller indices, are given in Table 1. The average crystallite size is about 33 nm for the samples treated for 120 minutes, while for the specimen treated for 60 min the average crystallites size is 26 nm.

Using the “texture coefficient” TC (*hkl*), we have estimated the texture of the specimens. TC can be expressed as:

$$TC(hkl) = \frac{I(hkl) / I_0(hkl)}{1/n \sum_n I(hkl) / i_0(hkl)} \quad (3)$$

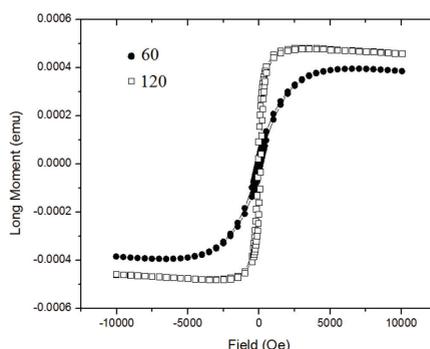
where  $I(hkl)$  is the measured relative intensity of the  $(hkl)$  peak,  $I_0(hkl)$  is the standard intensity assigned to the same  $(hkl)$  planes and  $n$  is the number of peaks used to assess the TC. When  $TC(hkl) > 1$  an abundance of crystallites oriented with  $\langle hkl \rangle$  direction is indicated. The XRD patterns (Fig.4) clearly show that the treated sample at 120 minutes have preferential orientation. The (311) lines of gold treated at 120 minutes are about two times more intense than (111) ones which show that  $\langle 311 \rangle$  is the preferred growth direction. Surprisingly, the specimen treated for 60 min indicate no preferential orientation of the gold crystallites.

After the XRD analysis on samples Ni NWs were electrochemical deposited on the Au substrate through the PCTE pores. To ensure a good homogeneity the electrolyte was stirred with a magnetic stirrer. Deposition was carried out in pulse with a frequency of 10 pulses/s between 0 and -1 V for 20 minutes deposition time.

After the synthesis of Ni NWs the samples were prepared for magnetic characterization. Each sample (array of NWs) was cut in a small rectangular shape with an area of  $\sim 0.9 \text{ mm}^2$ . The magnetic field was applied either parallel or perpendicular to the sample plane. Hysteresis loops taken at 10 K with parallel field are presented in Figure 6. Accordingly, there are clear differences between the two samples (i.e. same EC growth conditions for Ni NWs).

These differences could be induced by the quantity of Ni NWs or by the crystallite sizes. To establish the main effects on the magnetic properties, the amount of Ni in each sample was estimated. First, the number of pores on each sample was calculated based on the sample surface area (i.e.  $\sim 9 \text{ mm}^2$ ), the estimated numbers of pores ( $400 \text{ pores}/100\mu\text{m}^2$ ) and the estimated filling of pores. Calculations were performed by

averaging 10 area measurements and taking into account that at a given electrodeposition time, approx. 40% of pore length is filled. The results are presented in Table 2. According to the above results, a specific magnetization of about 65(9) emu/g is obtained for sample 60 and 67(9) emu/g for sample 120.



**Figure 6.** Magnetic hysteresis loops at 10 K (parallel field) for the samples

Sample	60	120
Area, $\text{mm}^2$	10(1)	11(1)
Nr of pores	37(3)E6	43(3)E6
Ni, g	6(1)E-06	7(1)E-06

**Table 2.** Quantity of Ni in each sample

This results correspond in the error limits to the specific magnetization of Ni (58.6 emu/g). Hence, no difference can be attributed to the spontaneous magnetization between the samples. However, the two samples behave differently concerning both the coercive fields and the saturation field which are larger in sample 60. Since the Ni NWs nucleation and growth are dictated by Au substrate, any changes induced by the EchT on Au would affect the nanowire structure as both Ni and Au have same crystalline structure (i.e. face centered cubic crystals). Also, XRD diffractograms demonstrated the modification of Au structure with the applied EchT. This modification could also induce modifications in magnetic properties of

nanowires. Additionally, between the two samples there is a difference of about 20% between crystallite sizes. It is known that coercivity increases with the crystallite sizes [29, 30].

### Conclusions

The nanowire growth was studied to understand the effects of structural changes on the magnetic properties. The structural changes were induced by room-temperature electrochemical treatment, similar to an annealing process, which is usually performed on samples to clean and improve reproducibility. We demonstrated that the duration of the EchT significantly changes the substrate structure and the properties of NWs grown on that surface. A detailed XRD analysis was used to observe any modification that have taken place in the Au crystallographic structure. After synthesis of Ni NWs, a detailed SQUID analysis was performed to quantify any changes that may occur from the magnetic point of view.

From XRD and SQUID resulted that electrochemical treatment induces certain modifications in the Au film. This modification might have been transmitted to the Ni NWs. This research opened the door for more investigations like the magnetic properties of nanostructural materials are interest for many applications.

### Acknowledgment

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# KrF excimer laser ablation in helium yields the highest amount of SWCNTs over other inert gases

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**Abstract:** The single-wall carbon nanotubes (SWCNTs) were synthesized using the equipment, method and experimental conditions described in [1]. Starting from the results shown in [2] and [3] we studied the influence of inert carrier gas over ablated mass, collected material, conducting character of SWCNTs and diameter distribution of SWCNTs. In our study KrF 248nm excimer laser was used instead of Nd:YAG (532nm) in [2] and four ablation gases: argon, nitrogen, neon and helium were involved. This kind of study, performed in our experimental conditions, was not reported so far. The ablated products were characterized using Raman spectroscopy and thermogravimetric analysis. We observed linear decrease of ablated mass with the increase of carrier gas molecular mass. Also the collected mass follows the same trend. TGA allowed us to calculate the mass of SWCNTs contained in the soot and the highest value was obtained in helium, 10 times more than in argon. Also, it was found the thermal conductivity of the carrier gas has a strong influence upon ablated mass and product deposition. The RBM and G Raman bands analysis have shown no influence of carries gas over the SWCNTs diameters distribution, respectively semiconducting character of SWCNTs, in all cases semiconducting SWCNTs being obtained. Our work concludes that helium is the best ablation gas, being 2 times more expensive than nitrogen but producing 8 times more SWCNTs.

## 1. Introduction

Since their discovery in the early 1990s carbon based nanomaterials, especially single wall carbon nanotubes (SWCNTs) are still captivating the interests of plenty scientific groups and industries all over the world, due to their physical and chemical properties. Among the most important applications of SWCNTs we highlight the fabrication of biosensors [4,5,6], scanning microscope tips [7], third generation solar cells [8] and nano-electronics [9], as well as they being good candidate for hydrogen storage.

## 2. Experimental

The laser ablation experiments was carried out in a custom-designed installation depicted in Fig.1. [1,10, 11]

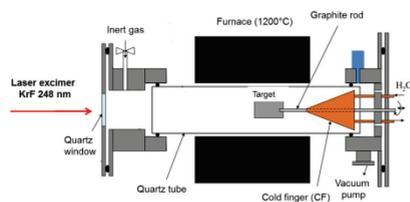


Fig 1. Ablation chamber design

The laser beam coming from the left side of the installation passes through a quartz window entering into a quartz tube and hits the target producing ablation material. Then the inert gas which enters from the left-up side of the installation travels through the 1260 mm long quartz tube and 60 mm diameter, carrying the ablation product to the cold finger where it will be deposited. In this study we varied the

ablation gas types while the other parameters: laser type, laser energy, pulse repetition rate, oven temperature, gas pressure, gas flow rate, and ablation time remained constant (Table 1). The laser ablation experiments were carried out in four different inert gases: argon, nitrogen, neon and helium.

Parameter	Value
Laser type	Excimer KrF, 248 nm
Laser energy	600 mJ
Repetition rate	30 Hz
Pulse period	20 ns
Oven temperature	1100°C
Gas pressure	500 Torr
Ablation time	60 minutes

Laser ablation parameters

We used targets prepared in our laboratory using an own developed method which does not require pressing or hot pressing nor sintering [2,12]. The target was prepared by mixing a graphite cement (GC 8010-B from Metal Forming Lubricants) with metal micro sized powder of Ni and Co (Sigma Aldrich), in the following atomic ratio C:Ni:Co = 98.8:0.6:0.6. The resulting paste was transferred into a Teflon mold (20 mm diameter), treated at 130°C for 4 hours to improve the mechanical strength. It was followed by a 800°C heat treatment in inert atmosphere for one hour to remove all the organic compounds. Finally the target contains only carbon, nickel and cobalt atoms. The target was rotated during ablation with constant speed to get uniform ablation. The cold finger was cooled by a chiller, setup at 12°C. The collected products were investigated using confocal micro-Raman spectroscopy, thermogravimetric analysis (TGA) and SEM.

### 3. Results

We observed a linear decrease of the ablated mass with the increase of carrier gas

molecular mass. Also the collected mass follows the same trend (Fig.2).

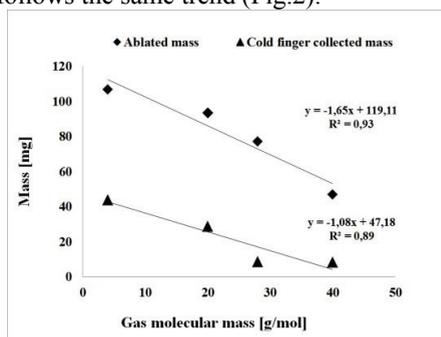


Fig 2. Ablated and collected mass dependence with the ablation gas molecular mass

Also, we found the thermal conductivity of the carrier gas has a strong influence upon ablated mass and product deposition (Fig.3)

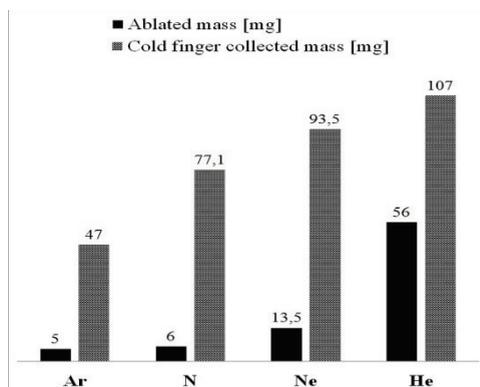


Fig.3 Collected mass dependence with the thermal conductivity of the ablation gas

The presence of the SWCNTs was revealed by confocal micro-Raman spectroscopy analysis using a 532 nm green laser (Fig.4). In the radial breathing mode (RBM) zone we found two peaks whose frequencies are strongly SWCNTs diameter dependent. The diameters of the tubes were calculated in accordance with the following equation:

$$d = c1 / (\omega - c2) \quad (1)$$

$\omega$  - frequency for vibrations in the radial direction [ $\text{cm}^{-1}$ ]

$c1, c2$  – constants [ $\text{cm}^{-1}$ ];

$c1 = 215$  [ $\text{cm}^{-1}$ ]

$c_2 = 18 \text{ [cm}^{-1}\text{]}$   
 $d$  – diameter of the nanotube [nm]  
 Two diameters distribution were found 1.31 nm respectively, 1.47 nm, and proved to be independent over the ablation gas.

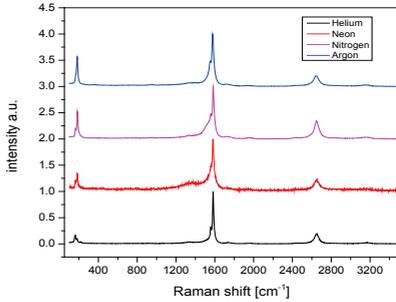


Fig.4 Raman shift dependence with different ablation gases

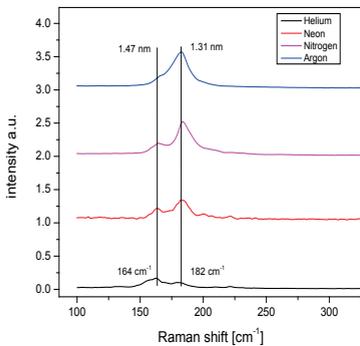


Fig.5 RBM Raman shift dependence with different ablation gases

The G band in the Raman spectra clearly demonstrates a high ratio of  $I_{G+}/I_{G-}$ , proving that in all four inert atmospheres semiconducting SWCNTs were obtained (Fig.6).

TGA analysis performed in air showed that the ablation products contain very little amount of amorphous carbon for all gases (Fig.7), also the products obtained in argon and nitrogen present fractions of fullerenes which burn between  $500\text{-}600^\circ\text{C}$ , while those obtained in helium and neon look very clean (Fig.7 and 8). We estimated the percentage of SWCNTs for each ablation

gas in part as in Fig.8 then using these results we calculated the effective mass of SWCNTs in the raw ablation product (Table.2)

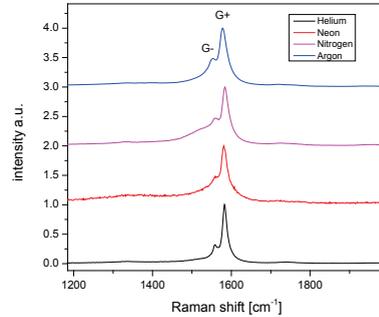


Fig.6 G band Raman shift dependence with different ablation gases

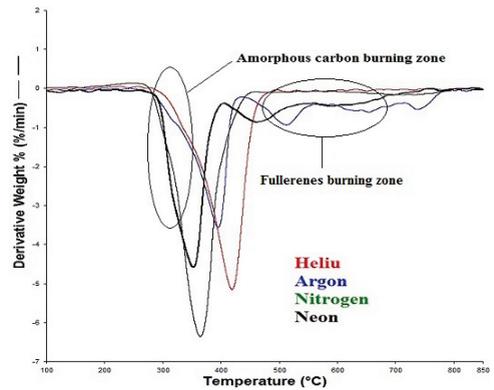


Fig.7 First derivative TGA curves of the ablation product obtained in different inert gases (Gas: air,  $T = 100\text{-}850^\circ\text{C}$ )

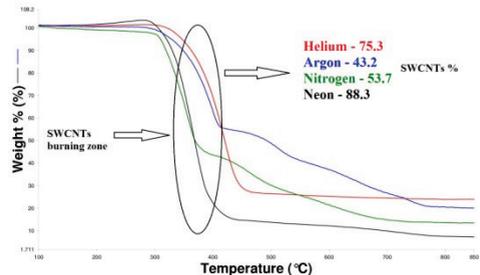


Fig.8 TGA curves of the ablation product obtained in different inert gases (Gas: air,  $T = 100\text{-}850^\circ\text{C}$ )



# Prospects of the Thermoelectricity Based on Organic Materials

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**Abstract:** Thermoelectric properties of existing crystals of tetrathiotetracene-iodide,  $\text{TTT}_2\text{I}_3$ , are modeled in the most complete 3D physical model. The expected values of the thermoelectric power factor and of the thermoelectric figure of merit are determined for crystals with different degrees of perfection and carrier concentration. Optimal values of electrical conductivity, Seebeck coefficient, and electronic thermal conductivity in order to achieve the predicted values of the thermoelectric figure of merit are calculated.

## 1. Introduction

As it is known, almost 90% of world annual energy consumption (which now is around 15 terawatt-years and is expected to be doubled by 2050 [1]) is generated by heat engines that use fossil fuel combustion, oil, natural gas and coal as a heat sources. These engines usually operate at 30–40 per cent efficiency. Thus, an enormous quantity of heat is not used and is lost to the environment. It is natural that there is a significant interest in finding cost-effective technologies for generating electricity from this waste heat. It is expected that namely thermoelectric generators will serve for these goals.

Thermoelectric convertors serve also as refrigerators transforming directly the electrical energy into cold. Thermoelectric generators and refrigerators have evident advantages in comparison with the ordinary ones: no moving parts and high reliability, can be made very compacted, noiseless work. The main parameter that determines the possibility of a material to be used in the thermoelectric convertors of energy is the dimensionless thermoelectric figure of merit  $ZT$ , where  $T$  is the operating temperature. Now the largest commercially applied thermoelectric materials on the base of  $\text{Bi}_2\text{Te}_3$  have  $ZT \sim 1$  near room  $T$ . It is a rather low value. Therefore, now the thermoelectric convertors are used mainly

in special cases, where the comfort is more important than the efficiency. A value of  $ZT$  equal or bigger than 3 would make the solid-state convertors economically competitive with the ordinary used ones.

Harman has been obtained  $ZT \sim 3$  in  $\text{PbTeSe}$  quantum dot superlattices [2], and even  $ZT \sim 3.5$  [3, 4]. However, the technology to obtain such structures is complicated, expensive and can not be applied for large scale production.

In the last years it is observed an increasing effort in the search and investigation of new organic materials for the use in more efficient and low cost thermoelectric generators in order to convert even a part of low-grade waste heat into electricity.

In poly(3,4-ethylenedioxythiophene) (PEDOT) doped by poly(styrenesulphonate) (PSS) thin films a value of  $ZT = 0.42$  at room temperature has been measured [5]. In nanocomposites the highest value of  $ZT = 0.57$  at room temperature was obtained in phenyl acetylene-capped silicon nano particles [6]. A value of  $ZT \sim 15$  at room temperature has been predicted in molecular nanowires of conducting polymers [7]. Even higher values of  $ZT$  were predicted by us in highly conducting quasi-one-dimensional (Q1D) charge transfer organic crystals [8]. However, these high values of  $ZT$  have been predicted in strictly 1D

approximation. As it has been demonstrated in [9] for a 2D physical model, the results of 1D approximation are valuable in not very pure crystals, when the carrier mobility is limited by the impurity scattering and the interchain interaction does not give important contribution. In  $\text{TTT}_2\text{I}_3$  crystals grown from solution [10] with not very high electrical conductivity  $\sigma_{xx} = 1.8 \times 10^5 \Omega^{-1}\text{m}^{-1}$  along conductive chains only  $ZT \cong 0.1$  was really obtained at room temperature [11].

The aim of this paper is to present a more detailed modeling of the thermoelectric properties of  $\text{TTT}_2\text{I}_3$  crystals in a more complete 3D physical model. The values of  $ZT$  expected in this case are determined. The optimal thermoelectric parameters necessary in order to achieve increased values of  $ZT$  are also determined.

## 2. Crystal model

From the structural point of view the Q1D organic crystals are formed from linear chains or stacks of molecules packed into a three-dimensional lattice. The interaction between the molecules along the chains is much bigger than in transversal direction. As a result, the mechanical properties are very anisotropic and the crystals have a needle-like form. In the  $\text{TTT}_2\text{I}_3$  crystals the TTT and iodine chains are separated and only TTT chains are conductive. The carriers are holes. They are moving mainly along the chains where they were created and rarely jump from one chain to another. These jumps determine the kinetic interchain interaction. The physical 3D model is described in [12].

As in the 1D approximation, two electron-phonon interaction mechanisms and also the scattering of carriers on impurities are taken into account. The first mechanism is similar to that of deformation potential and is determined by the variation of the transfer energies  $w_1$ ,  $w_2$  and  $w_3$  of an electron from the given molecule to the nearest ones in three directions, caused by the lattice acoustic vibrations. The three

coupling constants are proportional to the derivatives  $w'_1$ ,  $w'_2$  and  $w'_3$  of  $w_1$ ,  $w_2$  and  $w_3$  with respect to **intermolecular distances**. **The second** mechanism is polaron similar and is determined by the variation, caused by the same acoustic vibrations, of the polarization energy of molecules surrounding the conduction electron. The coupling constant of this interaction is determined by the mean polarization of TTT molecule  $\alpha_0$ .

It is important that under certain conditions, the interference between these electron-phonon interactions is possible. As a result, these two interactions significantly compensate each other for some states in the conduction band. In consequence, the relaxation time as a function of carrier energy takes a maximum for these states. The carriers in these states have increased mobilities. It is favorable for thermoelectric applications, because higher mobilities ensure higher values of  $ZT$ .

The impurities are considered point-like and neutral. The impurity scattering rate is described by a dimensionless parameter  $D_0$  which is proportional to impurity concentration and can be made very small, if the crystal purity is sufficiently high.

## 3. Results and discussions

It is considered that a weak electrical field and a weak temperature gradient are applied along the conductive chains. The linearized kinetic equation takes the form of the Boltzmann one. Near room temperature the scattering processes can be considered elastic. Then the kinetic equation is solved analytically and the expressions for electrical conductivity  $\sigma_{xx}$ , Seebeck coefficient  $S_{xx}$ , thermoelectric power factor  $P_{xx}$ , electronic thermal conductivity  $\kappa_{xx}^e$  and thermoelectric figure of merit  $(ZT)_{xx}$  along chains can be presented through the three-dimensional transport integrals  $R_n$

$$\sigma_{xx} = \sigma_0 R_0, \quad (1)$$

$$S_{xx} = (k_0 / e)(2w_1 / k_0 T) R_1 / R_0, \quad (2)$$

$$P_{xx} = \sigma_{xx} S_{xx}^2, \quad (3)$$

$$\kappa_{xx}^e = 4w_1^2 \sigma_0 / (e^2 T) (R_2 - R_1^2 / R_0), \quad (4)$$

$$(ZT)_{xx} = \sigma_{xx} S_{xx}^2 T / (\kappa_{xx}^L + \kappa_{xx}^e), \quad (5)$$

where:

$$\sigma_0 = (2e^2 M v_{s1}^2 w_1^3 r) / (\pi^2 \hbar a b c (k_0 T)^2 w_1'^2)$$

Here  $e$  is the carrier charge,  $k_0$  is the Boltzmann constant,  $T$  is the temperature,  $\kappa_{xx}^L$  is the lattice thermal conductivity,  $M$  is the mass of TTT molecule,  $v_{s1}$  is the sound velocity along chains,  $r$  is the number of molecular chains through the transversal section of the elementary cell,  $a, b, c$  are the lattice constants,  $w_1'$  is the derivative of transfer energy  $w_1$  with respect to intermolecular distance. The expression for  $R_n$  is somewhat cumbersome. It is presented in [12].

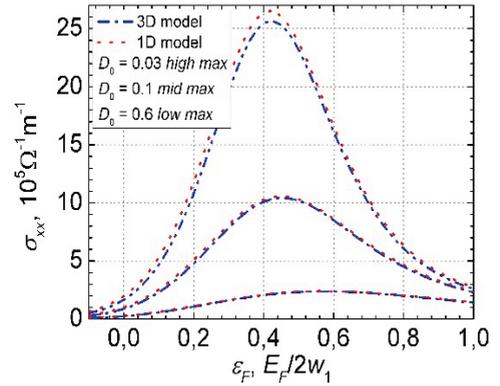
For  $\text{TTT}_2\text{I}_3$  the crystal parameters are:  $M = 6.5 \times 10^5 m_e$  ( $m_e$  is the mass of free electron),  $a = 18.35 \text{ \AA}$ ,  $b = 4.96 \text{ \AA}$ ,  $c = 18.46 \text{ \AA}$ ,  $v_{s1} = 1.5 \times 10^3 \text{ m/s}$ ,  $w_1 = 0.16 \text{ eV}$ ,  $w_1' = 0.26 \text{ eV \AA}^{-1}$ ,  $r = 4$ ,  $k_{xx}^L = 0.6 \text{ WK}^{-1} \text{ m}^{-1}$ ,  $w_2/w_1 = w_2' / w_1' = d_1$ ,  $w_3/w_1 = w_3' / w_1' = d_2 = d_1 = 0.015$ , because the lattice constants  $a$  and  $c$  are very close to each other. The mean polarizability of TTT molecules was taken as in [9]  $\alpha_0 = 45 \text{ \AA}^{-3}$ .

In Fig. 1 the dependences of electrical conductivity along chains  $\sigma_{xx}$  as functions of dimensionless Fermi energy  $\varepsilon_F$  in units of  $2w_1$  at room temperature are presented for different values of  $D_0$ .

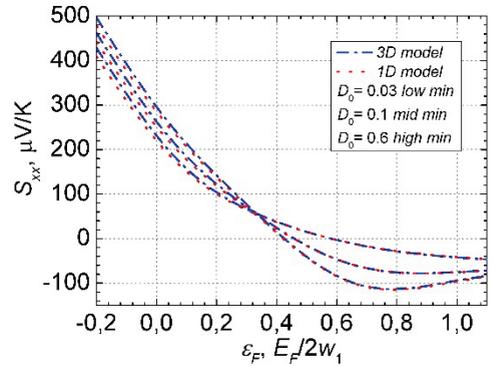
The curves with the lowest maximum ( $D_0 = 0.6$ ) correspond to crystals grown from solution [10] with  $\sigma_{xx} = 1.8 \times 10^5 \text{ \Omega}^{-1} \text{ m}^{-1}$  in the stoichiometric compounds,  $\varepsilon_F = 0.35$ . The curves with the middle maximum ( $D_0 = 0.1$ ) correspond to more perfect crystals grown by gas phase method [13] with stoichiometric electrical conductivity  $\sigma_{xx} \sim 10^6 \text{ \Omega}^{-1} \text{ m}^{-1}$ , and the curves with the highest maximum correspond to still more perfect

crystals with  $\sigma_{xx} \sim 2.5 \times 10^6 \text{ \Omega}^{-1} \text{ m}^{-1}$  not synthesized yet.

It is seen that in the first two groups of crystals the results in the 3D model coincide with those from the 1D model. In this case the carrier mobility is limited by the scattering on impurities. Only in the most perfect crystals a small diminution of  $\sigma_{xx}$  in the 3D model is observed caused by the contribution of weak scattering of carriers on adjacent chains.



**Fig.1.** Electrical conductivity  $\sigma_{xx}$  along chains as a function of Fermi energy  $\varepsilon_F$ .



**Fig.2.** Seebeck coefficient  $S_{xx}$  along chains as a function of Fermi energy  $\varepsilon_F$ .

In Fig. 2 the dependences of Seebeck coefficient along chains  $S_{xx}$  as functions of dimensionless Fermi energy  $\varepsilon_F$  are

presented. It is seen that so as  $S_{xx}$  is the ratio of transport integrals (see (2)), it is less sensitive to the carrier scattering on adjacent chains and therefore the results of 3D and 1D models are very close in the whole interval of  $\varepsilon_F$  variation. For stoichiometric compounds ( $\varepsilon_F = 0.35$ )  $S_{xx}$  weakly depends on crystal purity (parameter  $D_0$ ) and takes values between 45 and 40  $\mu\text{V}/\text{K}$ , near to those that are observed experimentally. But with the decrease of  $\varepsilon_F$ ,  $S_{xx}$  grows considerably and for  $\varepsilon_F = 0.2$  achieves values  $\sim 100 - 150 \mu\text{V}/\text{K}$ , or even  $\sim 300 \mu\text{V}/\text{K}$  for  $\varepsilon_F = 0$ .

The thermoelectric power factor  $P_{xx}$  (2) is an important parameter which determines the possibility of the given material to be used as sensitive element in the thermoelectric detectors of infrared radiation and in systems of night vision. Values as high possible are needed. The dependences of power factor along chains  $P_{xx}$  as functions of Fermi energy  $\varepsilon_F$  are presented in the Fig. 3. It is seen that for not perfect crystals grown from solution  $P_{xx}$  obtains small values in the whole interval of  $\varepsilon_F$  variation. In more perfect crystals grown by gas phase method ( $D_0 = 0.1$ ) the maximum of  $P_{xx}$  is equal to  $79 \cdot 10^{-4} \text{ Wm}^{-1}\text{K}^{-2}$ , or almost two times higher than in  $\text{Bi}_2\text{Te}_3$ . But in the most perfect crystals ( $D_0 = 0.03$ )  $P_{xx}$  is almost six time higher than in  $\text{Bi}_2\text{Te}_3$ .

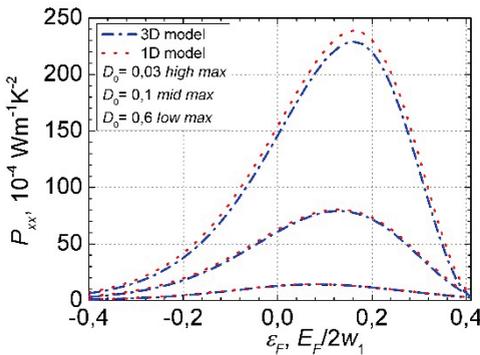


Fig.3. Thermoelectric power factor  $P_{xx}$  along chains as a function of Fermi energy  $\varepsilon_F$ .

The dependences of electronic thermal conductivity along chains  $\kappa_{xx}^e$  as functions

of Fermi energy  $\varepsilon_F$  are presented in the Fig. 4. It is seen that for given degree of crystal perfection the deviations of results for the 3D model are negligible with respect to those of 1D model. But with the increase of crystal perfection the electronic thermal conductivity  $\kappa_{xx}^e$  grows considerable.

However, the maximums of  $\kappa_{xx}^e$  are displaced to higher values of  $\varepsilon_F$  with respect to those of  $\sigma_{xx}$ . It is very important, because it leads to violation of the Wiedemann-Franz law and to diminution of the Lorenz number in the intervals of  $\varepsilon_F$  variation, where an increase of  $(ZT)_{xx}$  is expected.

The dependences of the thermoelectric figure of merit  $(ZT)_{xx}$  along chains as a function of Fermi energy  $\varepsilon_F$  at room temperature are presented in Fig. 5.

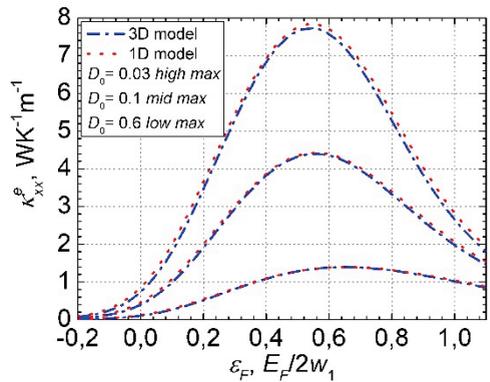


Fig.4. Electronic thermal conductivity  $\kappa_{xx}^e$  as a function of Fermi energy  $\varepsilon_F$ .

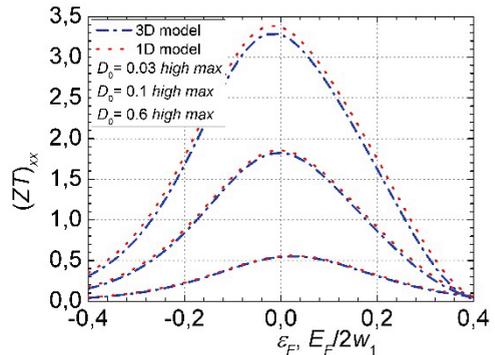


Fig.5. Thermoelectric figure of merit  $(ZT)_{xx}$  along chains as a function of Fermi energy  $\varepsilon_F$ .

It is seen the in stoichiometric crystals  $(ZT)_{xx}$  is very small  $\sim 0.1$  in all crystals presented here and practically does not depend on the degree of crystal perfection. But with the decrease of  $\varepsilon_F$ , or of carrier concentration  $(ZT)_{xx}$  grows. In existing crystals with stoichiometric electrical conductivity  $\sigma_{xx} \sim 10^6 \Omega^{-1}\text{m}^{-1}$  (the curves with the middle maximum,  $D_0 = 0.1$ ) the maximum of  $(ZT)_{xx}$  is predicted to achieve a value of 1.7. The expected crystal parameters in this case are:  $\sigma_{xx} = 8.8 \times 10^4 \Omega^{-1}\text{m}^{-1}$ ,  $S_{xx} = 262 \mu\text{V/K}$ ,  $\kappa_{xx}^e = 0.40 \text{WK}^{-1}\text{m}^{-1}$ .

In still more perfect crystals with stoichiometric  $\sigma_{xx} \sim 2.5 \times 10^6 \Omega^{-1}\text{m}^{-1}$  not synthesized yet (the curves with the highest maximum,  $D_0 = 0.03$ ) the maximum of  $(ZT)_{xx}$  is predicted to be even higher than 3. The expected crystal parameters in this case are:  $\sigma_{xx} = 1.7 \times 10^5 \Omega^{-1}\text{m}^{-1}$ ,  $S_{xx} = 295 \mu\text{V/K}$ ,  $\kappa_{xx}^e = 0.73 \text{WK}^{-1}\text{m}^{-1}$ , very good results. It is important to note that the main contribution to the increase of  $(ZT)_{xx}$  comes from the increase of the power factor  $P_{xx} = \sigma_{xx} S_{xx}^2$ . Thus, in the last case  $P_{xx} = 1.5 \times 10^{-2} \text{Wm}^{-1}\text{K}^{-2}$ , or almost four times higher than in  $\text{Bi}_2\text{Te}_3$ . Still higher values of  $(ZT)_{xx}$  are predicted in more perfect crystals [14].

Of case, in order to achieve these values of  $(ZT)_{xx}$  it is necessary to diminish considerably the carrier concentration. It is possible, because the  $\text{TTT}_2\text{I}_3$  crystals admit non stoichiometric composition with excess or deficiency of iodine. The latter plays the role of acceptors and determines the carrier concentration.

#### 4. Conclusions

It is demonstrated that the highly conductive quasi-one-dimensional crystals of tetrathiotetracene-iodide,  $\text{TTT}_2\text{I}_3$ , are very prospect for thermoelectric applications. Modeling of their thermoelectric properties has shown that after the respective increase of crystal perfection and optimization of crystal parameters, values of the thermoelectric power factor  $P_{xx} = 1.5 \times 10^{-2} \text{Wm}^{-1}\text{K}^{-2}$  are

predicted, or of almost six times higher than in  $\text{Bi}_2\text{Te}_3$ . The thermoelectric figure of merit  $(ZT)_{xx}$  is expected to be higher than 3, of more than three times higher than in the best  $\text{Bi}_2\text{Te}_3$ , the largest commercially applied thermoelectric material.

#### Acknowledgment

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# Modern routes for materials rapid processing

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**Abstract:** Unconventional processing routes-microwave (MW) and/or spark plasma sintering (SPS)-applied for doped MgB<sub>2</sub> and Sr<sub>2</sub>FeMoO<sub>6</sub> (SFMO) type compounds, induce peculiar effects on structural and magnetic properties. MgB<sub>2</sub> with C60 substitutes for B in the MgB<sub>2</sub> lattice during MW synthesis and SPS sintering are possible, while SFMO samples show fine grain size and good magnetic properties. Both methods provide fast processing conditions and therefore considerable low energetic consumption

## 1. Introduction

The manufacture of advanced materials such as oxide and ceramic composites, as well as non oxide materials with improved properties by new modern routes as microwave sintering (MW) and/or spark plasma sintering (SPS) techniques, have certain advantages as follows:

- Both are fast, clean and energy efficient, and generally speeds up the synthesis and sintering processes (short dwell and processing time within a few minutes)

- MW processing originates from the interaction of the electromagnetic field with induced or permanent molecular dipoles and/or ions; the adsorbed energy is distributed all over the material, while energy loss occurs only at the surface (sample is hotter inside, colder at the surface)

- SPS technique implies pulse DC current passing through the graphite die as well as the sample, which facilitates high heating and/or cooling rate (up to 1000 K/min)

-Both MW and SPS are sintering methods with low energetic consumption which allows a good ratio quality/price of

the products manufactured by applying these techniques.

## 2. General

Improving the grain size and mechanical and thermal properties as well impose the use of new reliable technologies capable to protect the environment and save energy at the same time. Therefore our work has focused on adapting new techniques to MgB<sub>2</sub> and Sr<sub>2</sub>FeMoO<sub>6</sub> compounds synthesis and sintering.

Magnesium diboride (MgB<sub>2</sub>) [1] has several advantages over other HTS (high temperature superconductors) type superconductors as it is composed of two elements arranged into a layered hexagonal structure, has low anisotropy, is non-toxic, inexpensive, and has a relatively high  $T_c$  of 39K.

MgB<sub>2</sub> has been manufactured by various synthesis routes but the most promising results were achieved by the SPS processing [1-3]. In the case of MgB<sub>2</sub>, rapid synthesis is a useful mechanism because leads to an increased number of grain boundaries through the suppression of grain growth. A higher density of grain boundaries is well known to positively contribute to the

enhancement of pinning and, hence, to increase  $J_c$  in  $\text{MgB}_2$  superconductor.

The  $\text{Sr}_2\text{FeMoO}_6$  (SFMO) double perovskite is very attractive due to the appreciable low-field magnetoresistance in granular form and a relatively high Curie temperature (410–450 K) [4–8]. Taking into account very weak values of magnetoresistance in single crystals, the role of grain boundaries has been extensively studied [9–13]. The intergrain magnetoresistance of polycrystalline  $\text{Sr}_2\text{FeMoO}_6$  is known to depend on its grain size and the amount of insulating nonmagnetic  $\text{SrMoO}_4$  impurity formed during fabrication [14].

One of the main problems during synthesis of SFMO is the excessive reduction of  $\text{Fe}^{3+}$  producing  $\text{Fe}^{2+}$  species and even metallic iron, which can increase saturation magnetization [15]. Another problem is the phase stability at ambient conditions. In general, the method and synthesis conditions must be chosen carefully for preparing pure double perovskite with small antisite defects concentration during the reducing step as evidenced by deviation from the theoretical saturation magnetization at low temperature (4.0  $\mu\text{B}/\text{f.u.}$ ).

### **$\text{MgB}_2$ processing by MW and SPS unconventional routes**

$\text{MgB}_2$  doped with fullerene ( $\text{C}_{60}$ ) was performed in a single-mode cavity microwave (MW) furnace, meaning only one mode of microwave propagation is permitted and hence the field pattern is well defined so the material can be positioned accordingly. It is worth mentioning that previous work reported in literature on conventional powder-in-tube processing was not successful in carbon chemical doping of  $\text{MgB}_2$  when using  $\text{C}_{60}$  [16] while unconventional Spark Plasma Sintering (SPS) produced excellent carbon substituted samples [17]. Expectations are that the influence of the MW electromagnetic field may generate positive chemical doping

effects. Table 1 presents some data of the pellets obtained by MW (B5 and B6) compared with other (B7) prepared by SPS route. As shown in Table 1, lower density (73 and 85%) is obtained for the MW samples than for the SPS (>90%). We note that data presented previously in literature on MW synthesized samples were likely obtained in most cases by using adapted commercial multimodal microwave furnaces [17–20], while we used a single mode furnace built in the lab. MW processing allows the formation of the  $\text{MgB}_2$  phase (PDF 01-072-7019) as the main phase (Figure 1). Impurities are present, and their amount is similar or smaller than that previously reported [17] on MW synthesis. The main impurity phase is  $\text{MgO}$  (PDF 01-1235). Another impurity phase with the main peak located at  $2\theta = 44^\circ$  (Figure 1) was assigned to the presence of the  $(\text{MgB}_{19.615})_{0.971}$  phase (PDF 01-070-8720). Because the effects of carbon substitution in  $\text{MgB}_2$  are missing when using  $\text{C}_{60}$  when conventional technologies are performed [20], it is obvious that the use of unconventional methods promotes the substitution.

**Table 1**  $\text{MgB}_2$  doped with fullerene processed

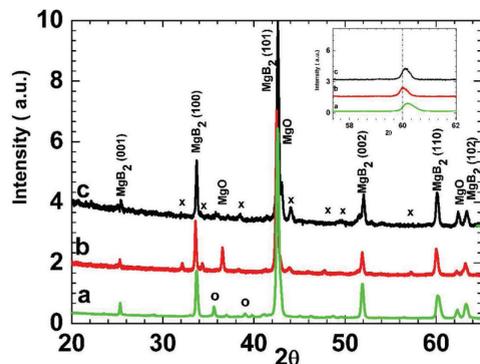
Starting materials and synthesis route	$T_{\text{sint.}}$ [K]	Density [ $\text{kg}\cdot\text{m}^{-3}$ ]/[%]
Mg+2B (elements) – MW; B5	1223	2190/83.2
Mg+1.95B+0.05C (elements+ $\text{C}_{60}$ -fullerene) –MW; B6		1930/73.3
$\text{MgB}_2$ +0.05C (commercial powder+ $\text{C}_{60}$ -fullerene) –SPS; B7	1423	2450/93.1

by SPS and/or MW routes

### **SFMO obtained by conventional and SPS route**

The double perovskite  $\text{Sr}_2\text{FeMoO}_6$  (SFMO) was prepared by two ways consisting of conventional solid-state reaction and SPS method. The powders from mixed oxides precursors were processed by the classic

powder metallurgy route starting from the oxides mixture followed by sintering in conventional furnace tube and the unconventional Spark Plasma Sintering (SPS) route.



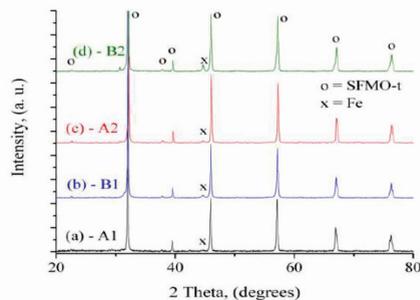
**Figure 1.** X-ray diffraction patterns for  $\text{MgB}_2$  samples: (a) B7 ( $\text{MgB}_{1.95}\text{C}_{0.05}$ ), SPS-doped with C60; (b) B5 ( $\text{MgB}_2$ ), MW; and (c) B6 ( $\text{MgB}_{1.95}\text{C}_{0.05}$ ), MW-doped with C60. The inset shows the (110) peak of  $\text{MgB}_2$ : samples to which C60 had been added have the typical shift when C substitutes for B in the crystal lattice of  $\text{MgB}_2$ . The notation of impurity phases is as follows: x, ( $\text{MgB}_{19.615}$ )<sub>0.971</sub>; and o,  $\text{MgB}_4$ .

This is likely due to the specific processes activated by the field (electrical or MW) in the unconventional methods

The structural and microstructural properties of the double perovskite SFMO powders as-prepared and ceramics were compared showing microstructures consisting of very fine grains (0.5-0.8  $\mu\text{m}$ ) and a crystalline perovskite structure. Tetragonal SFMO pellets were prepared from the two powders by classical sintering at 1200°C, 2h in 5% $\text{H}_2/\text{Ar}$  and also, by SPS at 1100°C followed by annealing at 1200°C, 2h in 5% $\text{H}_2/\text{Ar}$ .

Figure 2 shows the XRD diagrams of the sintered pellets, named as follows: sample A1-pellet prepared from gel powder and classic sintered at 1200 °C, 2h in 5% $\text{H}_2/\text{Ar}$ ; sample B1-pellet prepared from powder synthesized by conventional method and classic sintered at 1200°C, 2h in 5% $\text{H}_2/\text{Ar}$ ; sample A2-pellet prepared from gel powder

and sintered by SPS at 1100°C, 6 min at 50 MPa and then annealed at 1200°C, 2h in 5% $\text{H}_2/\text{Ar}$  and, B2-pellet prepared from powder synthesized by conventional method, sintered by SPS at 1100°C, 6 min at 50 MPa and then annealed at 1200°C, 2h in 5% $\text{H}_2/\text{Ar}$ . The XRD analyses revealed the formation of tetragonal  $\text{Sr}_2\text{FeMoO}_6$  (space group I4/mmm) [21] in all samples.



**Figure 2.** XRD patterns of SFMO pellets

Small quantities of impurity phases were also detected, among which Fe is the most prominent. In sample A1, the amount of Fe is close to the detection limit of the measurement. The XRD data were processed by Rietveld refinement using TOPAS. The main goal was to assess the iron concentration in each sample in order to correlate with the magnetic properties of the material. The resulted values of reciprocal Fe-Mo substitution in the sites were used in the theoretical estimation of magnetization.

### 3. Properties

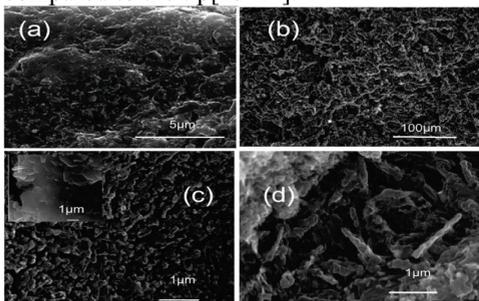
The structure analysis of both type compounds processed by new routes revealed peculiar properties by comparison with those obtained by conventional methods. The main results are presented below

#### 3.1 $\text{MgB}_2$

Scanning electron microscopy shows that the SPS sample (Figure 3a) has grains that are smaller than those of the C60-doped

MW sample (Figure 3b–d). We could not observe

significant differences between the morphology of the doped and undoped MW samples. However, MW samples have a quite specific microstructure. Figure 3b shows a microstructure composed of regions of dense structure and regions of low density with open porosity. A closer look at a higher magnification indicates the presence of compact sintered blocks (Figure 3c, inset) that resemble the morphology of SPS samples (Figure 3a), and a porous dendrite matrix partially sintered. Dendrites are composed of sintered equiaxial particles ( $2.5\text{--}4.5 \times 10^{-7}$  m), often with round edges. Some dendrites have a one-dimensional-like shape of a needle with a length of up to  $5 \times 10^{-6}$  m (Figure 3d). One end, i.e., the base that is in contact with the sample, has a larger diameter than the tip. To the best of our knowledge, such one-dimensional (1D) morphology was not observed in samples obtained by other methods, including SPS (Figure 3a). It is possible that the atypical heating in the MW process, from inside out, generates the right thermal gradient conditions for the formation of a 1D needle. In other words, MW heating through the induced thermal gradient with a low temperature at the tip of the needle promotes 1D dendrite formation. A higher temperature at the base also explains the larger diameter at the base of the needle compared to the tip[23-24].

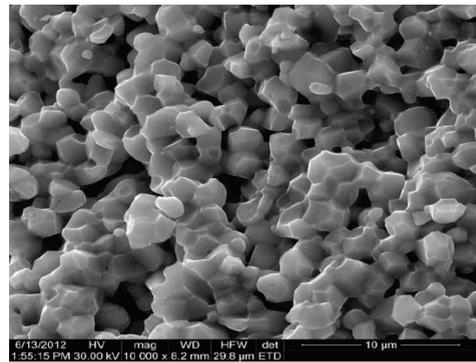


**Figure 3.** SEM images for (a) the B7 reference sample ( $\text{MgB}_{1.95}\text{C}_{0.05}$ ) obtained by SPS and (b-

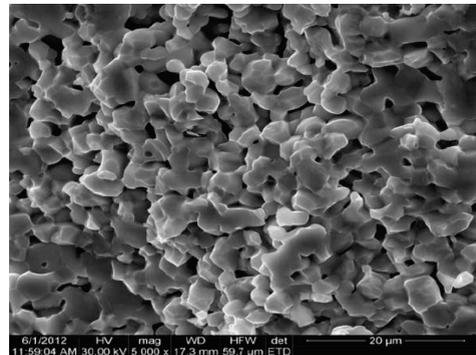
d) the B6 sample ( $\text{MgB}_{1.95}\text{C}_{0.05}$ ) obtained by MW.

### 3.2 SFMO

Compared with the morphology of  $\text{Sr}_2\text{FeMoO}_6$  pellets obtained by classical sintering, the pellets sintered by SPS presents a more homogeneous morphology, a smaller grain size and a higher densification degree (figs. 4 and 5). The pellets sintered by spark plasma sintering shown density  $>97\%$  pt, while the pellets sintered by the conventional technique 94% pt.



**Figure 4.** SEM micrographs for SFMO pellets A2 sintered by SPS at 1100°C



**Figure 5.** SEM micrographs for SFMO pellets B2 sintered by SPS at 1100°C

The pellets presented different magnetic characteristics. The saturation magnetization of the samples prepared by sol-gel is higher than those prepared by conventional synthesis method, for the same method of sintering and, the pellets sintered by conventional method shown higher

saturation magnetization values than the ones sintered SPS.

It has been demonstrated that the magnetization of SFMO depends strongly on the order parameter of the structure, which is influenced by the thermal processing conditions (temperature, time and atmosphere for heat treatment) [24]. Assuming one unpaired electron contributes approximately 1  $\mu\text{B}/\text{f.u.}$ , ordered SFMO samples should have a saturated magnetic moment of 4 $\mu\text{B}/\text{f.u.}$  This value is derived from the high spin  $\text{Fe}^{3+}$  ion ( $S=5/2$ ) coupled antiferromagnetically with the minority spin of the  $\text{Mo}^{5+}$  ( $S=1/2$ ) [25].

The obtained values of the total magnetic moment, listed in Table 2, correspond to the saturation magnetization of the samples. These values are lower than the theoretical one (4 $\mu\text{B}$ ) and this fact is due to the Fe/Mo antisite disorder existing in the double perovskitic structure. Iron location on both crystallographic positions leads to the formation of metal clusters, generating a distribution of ferrimagnetic couplings.

**Table.2** Total magnetic moment calculated for SFMO sintered samples measured at 5K in a 5T applied magnetic field

Sample.	$M_{\text{sat}}$ (emu/g)	$\mu_{\text{exp}}/\text{f.u}$
A2	35.47	2.70
B2	35.09	2.69

#### 4. Conclusions

MgB2 bulk samples undoped and doped with fullerene were synthesised using a single-mode laboratory microwave furnace. The microstructure of MW samples is less uniform than that of the SPS samples. MW samples are composed of dense sintered blocks along with a unique dendrite matrix. Some dendrites have 1D acicular shape with a large diameter at the base and are formed likely because of the particular MW heating conditions, i.e., heating developed from the inside out. Structural and superconducting properties strongly support the idea that

C60 substitutes for B in the MgB2 lattice during

MW synthesis. This result is similar to that of the field-activated method, SPS, but differs from that of conventional synthesis for which C substitution did not occur when C60 is added to MgB2. We believe that field-activated processes promote substitution.

Tetragonal SFMO pellets were prepared from mixed oxide powders and sol-gel precursors by classical sintering at 1200°C, 2h in 5% $\text{H}_2/\text{Ar}$  and, by SPS at 1100°C followed by annealing at 1200 °C, 2h in 5% $\text{H}_2/\text{Ar}$ . The SPS sintered pellets showed higher density than the pellets sintered by the conventional technique. X-ray diffraction and transmission electron microscopy have evidenced the formation of tetragonal SFMO as major phase and small amounts of Fe segregated which influences the magnetic properties of the samples prepared by various processes. The results of magnetic measurements indicated that the saturation magnetization of the samples prepared by sol-gel is higher than those prepared by conventional synthesis method, for the same method of sintering. Also, the pellets sintered by conventional method shown higher saturation magnetization values than those sintered by spark plasma sintering.

#### Acknowledgment

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# Composite Materials with Complex Compositions used in Vehicle Brake System: a Review

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**Abstract:** Desirable performance requirements for vehicle brake friction materials that work in normal and especially in heavy-duty conditions should have highly physical, mechanical properties and service characteristics such as: (a) stable and high friction coefficient in various conditions, including high temperatures (b) very good wear resistant material and implicit very good durability in service; (c) good strength at elevated temperatures; (d) high specific heat and thermal conductivity; (e) high corrosion resistance; (f) smooth braking assurance, (g) reduced vibration (judder) and noise, (h) do not damage the counterface (brake disc). The brake friction materials have a complex composition that includes both metallic and non-metallic components. In this paper brake pads composite materials, typically comprising of binders, lubricating components and frictional additives, are reviewed. It is important to note that the research efforts during the years include the development of non-toxic compositions /ingredients of materials used in the transport industry (including vehicle brake system) and, if possible, to minimize their weight, while satisfying the required characteristics for which they were designed.

## Introduction

In the last decade, the worldwide trend was to obtain materials increasingly lighter and sustainable [1] at a cost as low as possible. The environmental policies are focus on products with low impact on environment, by finding solution to increase vehicle fuel efficiency and to lower gas emissions. The efforts include the development of non-toxic compositions /ingredients of materials used in transport industry and, if possible, to minimize their weight (Fig. 1), while they satisfy the required designed characteristics. The researches in this direction include the development of composites materials with complex compositions that can work in safe

conditions at high specific loads and speeds [2-7].

The friction parts (brakes, clutches, etc.) from vehicle brake system are composed by a pair of materials in direct contact: the friction materials (brake pads) and the counterparts (brake disc) by which is realized the necessary fretting transmission of torsion or brake moment [4, 8].

The friction materials used in the past were high toxic asbestos or synthetic resin based and as counterparts they still use heavy cast iron disc. Nowadays, as brake friction materials we used composites with metallic (ferrous or non-ferrous base) or carbon composites, as new candidates against the older one synthetic resin based

[2-7]. Also, for reducing fuel consumption of vehicle, for conterface (disc brake) the producers use the lightweight aluminium based composites as A356/25SiCpAl MMC [9, 10] or titanium-based materials [11] and

as brake pads composites they use the ferrous (iron and its alloys) and non-ferrous based materials (copper, aluminium) as matrix or ceramic (carbon) composites [2-7].

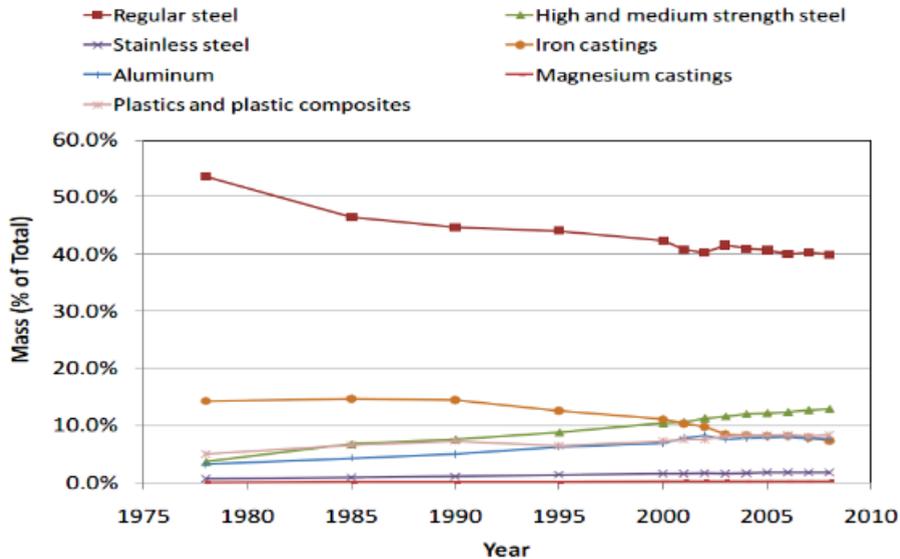


Figure 1. Vehicle Material Composition by Percent Mass [6]

**History**

The first reference on metal-ceramic (composites) friction materials can be found in the technical literature and belongs to the third decade of this century [3, 4].

Sintered friction materials (SFM) have found practical use until after the Second World War when it was necessary to solve the problem of oversized aircraft landing on small areas of the track, which was coupled with the need beneficial materials to realize the brake linings to withstand high temperatures up to 600-650°C [4,13].

The wider use of these materials and other fields of economic activity reached only after 1945 [3, 4, 13]. In the years 1945-1950 was performed design of a modern tram car at one of braking systems to be located based MFS seal that is produced (with minor changes) and export and currently in a range countries. In other areas

of industrial activity such materials have imposed a greater extent during the years '60-'62 when they were introduced in the manufacturing process fundamental types namely: bronze-graphite materials and graphite iron materials.

During 1972-1975, in Romania, at Metallurgical Research Institute of Bucharest was studied and development of iron-based sintered friction materials (SFM) designed for aircraft brake discs, and in 1992-1994 they continuous research, in order to get appropriate new types of SFM requirements [3]. Using this friction type has gradually expanded at heavy braking systems mechanisms, in aircraft and in the electromagnetic coupling, at transmission elements and heavy transport trucks.

Although introduced in industrial production since 1965, first in the US and then in other countries [3,10-13], sintered friction materials are still highly topical,

they form the subject of extensive research and patents, with increasing requirements in terms of (i) their ability to absorb and transmit energy, (ii) durability in extreme operating conditions and (iii) expanding their use in military and aerospace equipment [3-17]. Because of the need to protect trade secrets in literature was a gradual reduction in scientific and technical information about SFM, starting with the '80-'85 (in particular concerning the nature of materials components) although clearly there are focused in creating the new generations of SFM with industrial applications [3, 4].

Nowadays [1, 2, 6] the researchers are concerned of the economic efficiency and environmental impact by replacing traditional materials with lightweight materials (light Al /Mg / Ti alloys or light metal or plastic matrix composites). These materials are environmentally friendly and economically efficient simply because it takes less effort (mechanical work) to accelerate / move an lightweight object more easily and therefore decrease the fuel consumption (economic benefit) or decrease gas emissions (CO<sub>2</sub>) during life cycling phase of the vehicle. In Fig. 2 are presented a comparison of air pollution impact by replacing the cast iron brake rotors with particle reinforced aluminium matrix composite (PMMC), according with LCA study [2].

We can see that the trends indicates a better environmental performance of the PMMC rotors in comparison with traditional ones.

**Materials types used as friction materials for vehicle brake system and the characteristic of their**

Desirable performance requirements for vehicle brake friction materials that work in heavy-duty conditions should have highly physical, mechanical properties and service characteristics as : (a) stable and high friction coefficient (according to SAE J899a) in various conditions, including at high temperatures (b) very good wear

resistant material and implicit very good durability in service; (c) good strength at elevated temperatures; (d) high specific heat and thermal conductivity; (e) high corrosion resistance; (f) smooth braking assurance (g) reduced vibration (judder) and noise (h) does not damage the counterface (brake disc) [4, 12].

Weighted comparison - air pollution

Activities Elements	Factor	Processing	Transport	Use	Reproc.	Total
<b>Cast iron brake rotors</b>						
CO	0.0059	0.02	0.02	217.12	0.02	217.17
HC	1.00	0.08	0.06	368.00	0.08	368.22
NO <sub>x</sub>	9.89	0.08	0.79	1087.79	0.08	1088.74
CO <sub>2</sub>	32.62	0.52			0.52	1.04
<b>PMMC brake rotors</b>						
CO	0.0059	0.0	0.01	216.03	0	216.04
HC	1.00	0.07	0.02	366.00	0	366.04
NO <sub>x</sub>	9.89	1.31	0.2	1087.79	0.28	1089.09
CO <sub>2</sub>	32.62	153.97			0.39	154.36

Solid waste not included / Pollution from SiC production not included  
Transport involves rough estimates

**Figure 2.** Impact on air pollution by replacing the cast iron brake rotors with PMMC [2].

The brake friction materials have a complex composition that includes both metallic and non-metallic components. Also, brake pads typically comprise the binders, the lubricating components and frictional additives [4, 8]. The purpose of a binder is to maintain the brake pads' structural integrity (to hold the components of a brake pad together) under mechanical and thermal stresses. The binders could be synthetic resins, metallic ingredients or mixture of metallic and organic ingredients. The synthetic resin based friction materials is cheap to produce, but it has as a disadvantage that, in high-energy braking applications (operating up to 370–450°C) [4] when the induced temperature can be high enough, the material decomposes or breaks down. As a result, the friction coefficient with the brake disc is compromised leading to decreasing road safety [8, 9]. In case of using metallic binders as iron, cooper, aluminum and their

alloys, we can improve the wear resistance, thermal diffusivity and strength of the brake friction material. The lubricating components have the objective to: (i) stabilize the developed friction coefficient during braking, particularly at high temperatures, (ii) decrease wear of counterparts and also (iii) increase gripe resistance [2–15].

The frictional additives, determine the frictional properties of the brake pads. Also the frictional components increase and stabilize the friction coefficient values, respectively increase the wear resistance [2–13].

Cooper and Cu alloys are chosen mainly to (i) improve the thermal conductivity at the friction interface (ii) good mechanical strength and (iii) for sustaining the level of the coefficient of friction at elevated temperatures by producing copper oxides at the friction interface [2,9]. Other advantages include very good compressibility and easy to sintering. As copper alloying elements are Sn, Zn, forming solid solutions with copper during sintering process in the presence of liquid phase. Copper powders obtained by electrolysis of aqueous solutions are the most widely used due to their advantages compared to other methods: high purity powder, good technological characteristics associated with good compressibility and sintering behavior. The used dimensions of the copper particles are up to 150 micrometers and the specific shape of electrolytic copper powder is the dendritic ones. Electrolytic copper powder obtained has the dendritic particle form (favorable to the inclusion of non-metallic components with fine grain at homogenization process). The major disadvantage of this material is that it is a poor and expensive material and presents high specific weight.

Aluminum or Al alloys are used in frictional materials or disk brake because of lightweight and good thermal diffusivity [13,17–19]. Both nonferrous Al and Cu composites have high specific capacity,

corrosion resistance and compatibility with SiC reinforcements as reinforcements [20, 21] but these composites have been used at low loads (<100N) and low sledding speeds (<4 m/s). At heavy duty conditions, the temperature increase on the surface of the Al or Cu composites, and become soft, and in the extrem case could melt, with undesired consequences on strength speed of the materials, and for thar reasons, these non-ferrous matrix are not proper to use for race cars, trains, trucks or aircraft brakes (in high energy braking applications) [22, 23].

For high speed and load conditions are used ceramic composites as C/C or C/SiC composites, Ti based composites reinforced with hard ceramics materials , respectively iron/steel based composites.

The friction composite materials based on Ti or Titanium alloy has high strength at high temperature, heat resistant , resistance at abrasive wear , a high young modulus and capacity for stable retention of high friction coefficient, but is expensive [24].

The carbon based composites have low density, excellent wear resistance friction stability and high thermal stability, but they have the disadvantage to be high production costs multiple reinfiltration steps, low depositions efficiency and poor oxidation resistance above 450o C , poor surface porosity, extreme sensitivity to the humidity and temperature (implicit instability of friction coefficient), and most important, the carbon composites pollute environment caused by organic brake dust [25].

Composites with iron/steel matrix and ceramic reinforcements used like friction materials bring new possibilities in the production of wear resistant materials because they provide good wear resistance and maintain friction effectiveness at elevated temperature [4, 8, 16], they have a high melting point, high work hardening rate, better strength, weldability, machinability and in comparison for instance with Cu based composites has the low cost. Iron could be alloyed with Cu, Cu–Sn–(Zn), Ni, Mo, Al, Co, Mn, W, Cr,

etc. for improving strength of the metallic matrix [4, 8–16]. Thus, at the alloying with the copper or Cu-Sn-(Zn) elements in the course of the sintering process, the liquid phase is formed. This serves to filling the voids (pores) of material and better densification of the sintered material, thereby increasing the material's mechanical characteristics. Secondly, copper contributes to increasing the thermal conductivity of the material, leading to better heat dissipation during braking. The additions of phosphorus (P) formed phosphorous eutectic at 900°C, which allows the rigid joint between the metallic and non-metallic particles at this temperature. Iron powder is obtained by water atomization of melt steel, thermo-chemical treated. The proportion and granulation of these components, was and still is the subject of numerous investigations in various countries in order to achieve the optimal characteristics of brake friction materials.

Lubricating components contribute to a smooth brake, it increases the gripping resistance and decrease wear of the material, in particular of the counterpart.

The characteristics that must accomplish the lubricating components are: (a) high capacity lubrication; (b) does not decompose complete at sintering temperatures and in environments currently used in practice. The disadvantage of using too much lubricant is that they produce decreasing of the friction coefficient of the brake system and decreasing of mechanical properties.

Among the most used solid lubricant components (solid lubricants) are: graphite, molybdenum disulfide, barium sulphate, and bismuth (less used today because it is harmful for human body). There are also used as solid lubricants, barium fluoride, calcium or zinc. Graphite has the following roles: (a) lubricant in the compaction process of powder mixture; (b) reducing any traces of existing oxides on the surface of metal powder particles;(c) basic

participant at formation of skeleton of the material (in the case of iron);(d) solid lubricant in the friction process. The quality of the graphite greatly influences the properties of the friction material and the parameters of the sintering process. MoS<sub>2</sub> is used in high temperature solid lubricant. It reacts with oxygen at temperatures above 500°C to form the molybdenum and sulphur trioxide. This makes it suitable as a lubricant instead of graphite, under the same conditions, by chemical reaction with oxygen forming carbon monoxide, a toxic gas, polluting the atmosphere. BaS<sub>x</sub> is recommended by some authors [4, 13] as due to its feature to ensure the stability of the friction coefficients and increased wear and gripping resistance due to the formation of a superficial film, which provides a gloss friction surface without a burr. Bismuth has low toxic effects in comparison with lead and has a low melting temperature[4, 10-13].

Friction components may have the following components: (i) high melting and dissociation temperatures; (ii) lack of polymorphic changes in the temperature range from ambient up to the sintering temperature; (iii) good mechanical strength; (iv) wettability properties to the base metal matrix or for the possibility of adhesive bonds creation with it to the consumption of mechanical work at maximum friction separation of hard particles in the metal matrix. Traditional non-metallic materials used for friction role are: SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub> or others oxides (simple or complex oxides), and also carbides, nitrides, silicides, or borides. SiO is a friction component that meet him in the form of natural quartz sand. Fine particles uniformly distributed SiO<sub>2</sub> and creates areas of discontinuity in the base network, as numerous as SiO<sub>2</sub> density is lower. Al<sub>2</sub>O<sub>3</sub> - is a component of friction that you encounter in crystalline powder. It has stability at temperatures above 1000°C to carbon and nitrogen [3-13]

The processing of brake friction materials is realized by a diversity of

methods [7, 13, 18-19] including powder metallurgy (P/M) techniques. The brake pads made of a metal matrix composite reinforced with a high content of ceramic particles are not resistant to shock and as a result, require different methods of attachment / joining of steel metal (steel backing) to give it strength [18].

As a result, iron/steel or Ti based composite friction materials has mainly a duplex structure – a sintered friction lining on a steel backing, intended to increase strength of the lining and to facilitate the assembling of the friction elements by welding, riveting or diffusion process during pressure sintering, to assure a high quality brazing [18].

Today is still studying the possibility of improving adhesion of composite friction material on steel back plates. Another problem encountered when manufacturing these brake friction composites is to analyze complex phenomena and mechanisms that occur in both, manufacturing process and especially in service, during friction on surface sliding, as a result of adhesion and deformation of roughness. For that reasons, much efforts has been applied to find the mechanism for numerous friction induced phenomena, especially at atomic scale, by measuring the friction force with nanodevices. The analysis of tribological phenomena at the sliding interface becomes more complicated when a composite is involved as a sliding component, due of multiple ingredients [19].

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# Identification of the Roll Response for the Cessna Citation X Business Aircraft Engine

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**Abstract:** The Research Aircraft Flight Simulator was designed and manufactured by CAE Inc., which is a very well known internationally Aerospace Company in Aircraft Modeling and Simulation Technologies. This simulator was designed following specific requirements of the Laboratory of Applied Research in Active Controls, Avionics and AeroServoElasticity LARCASE team at ETS in Montreal with the aim to be used for research purposes. The authors are the members of the team. This simulator is equipped with a Flight Dynamics Level D open source code, thus it will be used as a Flight Certified Bench Test with the idea to validate Flight Dynamics Models new codes and methodologies. The Cessna Citation X is the fastest today business aircraft available on the market. The authors used this simulator in order to establish a new methodology for the identification of the roll response.

## 1. Introduction

The Cessna Citation X business aircraft flight dynamics model was identified and validated as explained in [1, 2]. Various optimal control methodologies have been studied for the Cessna Citation X in [3, 4, 5]. The engine of the Cessna Citation X was identified in [6, 7].

The main objective of this research was to determine the variation of main parameters of the Cessna Citation X, with initial angle of attack and Mach numbers during the Roll response mode. These parameters include the aerodynamic derivatives such as the rolling moment due to roll rate  $L_p$  and  $l_p$ , and the  $L_{\delta_a}$  (Rolling moment due to aileron deflection  $L_{\delta_a}$  and  $l_{\delta_a}$ ).

## 2. Methodology

The Roll response, as mentioned in the literature, is a lateral mode of an aircraft. During the roll of the aircraft, it is known that the difference in lift caused by the wings creates a moment that tends to bring the airplane back to equilibrium. The roll rate  $p$  and roll angle  $\varphi$  may be modeled for the deflections of the aileron angle  $\delta_a$ .

Both approaches were used in this research, the time domain or state space representation, and the frequency domain or the transfer function modeling.

The Roll response is a lateral mode of an aircraft. Here, the aircraft rolls, where the wing that descends has an increase angle of attack while the other behaves oppositely. The difference in lift caused by the wings creates a moment that tends to bring the plane back to equilibrium. The roll rate ( $p$ ) and roll angle ( $\varphi$ ) were modeled for a deflection in aileron angle ( $\delta_a$ ).

The time domain and frequency domain approaches were both used in this project. The time domain approach used a steady state representation to model the roll response mode whereas the frequency domain approach used transfer functions.

It has been chosen to perform a set of roll response flight tests using the JJ10 protocol. The aircraft was made to roll in one direction around 10 seconds, hold its position for 5 seconds, then roll to the other end in 20 seconds, then hold for 5 seconds before returning back to its initial position in 10 seconds. During these tests, only one

rudder was considered. The following diagram illustrates this change, where rudder 1 is the lighter colored line.

In order to use the *Time Domain* approach, the `flighttest.ident.ls` function was used to estimate the derivatives of aerodynamic coefficients using the Least Squares method. Hence, given the independent and dependent variables, the derivatives with respect to the independent variables were calculated.

The following combination gave the best results using the time domain approach. A combination of trial and error based also on literature findings was done in order to find the following equations where the coefficients  $L_p$ ,  $L_{\dot{\alpha}}$ ,  $N_p$  and  $N_{\dot{\alpha}}$  are the coefficients to be determined:

$$L = L_0 + L_p p + L_{\dot{\alpha}} \dot{\alpha} + L_v v + L_r r + L_{\dot{r}} \dot{r} \quad (1)$$

$$N = N_0 + N_p p + N_{\dot{\alpha}} \dot{\alpha} + N_v v + N_r r + N_{\dot{r}} \dot{r} \quad (2)$$

The `tfest` function estimated the continuous-time transfer function in the frequency domain. The coefficients have been estimated based on the input and output data, initial conditions and sampling period. The FAA criterion was taken into account for the Roll response mode value  $p$  that would depend on the difference between the model and experimental roll rate  $p$ .

All the estimated coefficients during validation tests were interpolated using their initial angle of attack and Mach number, and they were further introduced into the state space/transfer function representation to produce the modeled roll rate  $p$  and roll angle  $\phi$ .

### 3. Results

It has been noted that the frequency domain approach gave much better results than the time domain approach. Graphs were traced for the model identification and validation, successful and failed tests for both approaches. Results were obtained for the identification and validation of tests 1 and 2 for the variation of the roll rate  $p$  and roll angle  $\phi$  with time, where model

simulated data were compared with experimental flight test data. As previously mentioned, the FAA criteria for a successful Roll response test was demanding. Recalling, the difference between the modelled and experimental roll rates had to be within 10% or 2°/sec. In other words, if only all the points in the two graphs obeyed the criteria, the particular test was a success.

Results were obtained using the two different time and frequency domain approaches. A number of 263 identification tests and 10 validation tests were performed.

The flight envelope shown below gives the Gross weight GW and Centre of gravity CG 13 points used to perform the tests. For each point, a number of 21 tests were conducted at different altitudes and CAS, thus 263 points were obtained.

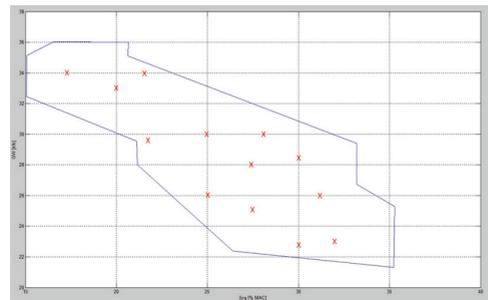


Figure 1. Flight Envelope

These tests were performed at different altitudes and Calibrated Air Speed CAS values for different aircraft weights and center of gravity positions. The successful identification and validation ratios were both much better in the frequency domain than in the time domain. The successful identification ratio was 81.4 in the frequency domain, while its value was 46.1 in the time domain. The successful validation ratio was 40 in the frequency domain, while its value was 60 in the time domain.

The number of tests considered in the Time Approach methodology for which more than 90% of the points respected the

FAA criteria was 209 in the time domain and 254 in the frequency domain. Because on the frequency domain approach, 254 out of the 263 tests belonged to the FAA criteria, it meant that this frequency approach better than the time domain approach. The time domain gave also a very good number in this category (209 out of 263), that confirmed that this approach was also an adequate one.

In the following Figures 2 and 3, the envelope was represented with continuous line, the successful identification tests were presented with crosses (+), the successful validation tests were represented with circles and the failed validation tests were presented with x.

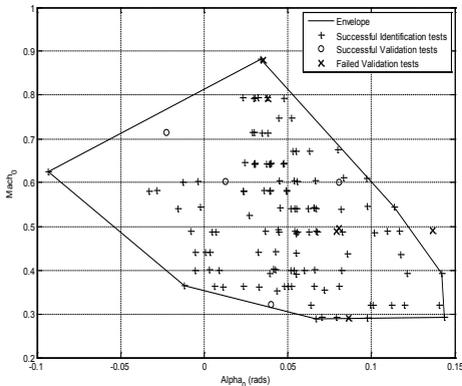


Figure 2. Envelope versus Successful Validation, Successful Identification and Failed Validation Tests (Time Approach)

As shown in Figure 2, there are two points outside the envelope, and for this reason, these points were not validated.

As shown in the next Figure 3, the frequency domain approach had only 4 failed validation tests.

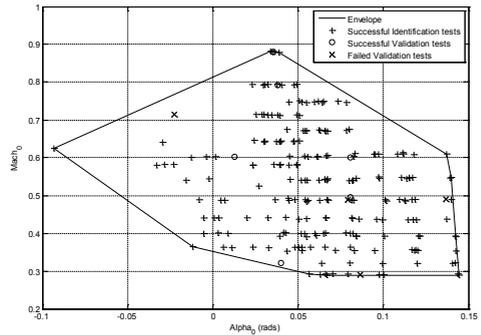


Figure 3. Envelope versus Successful Validation, Successful Identification and Failed Validation Tests (Frequency Approach)

The next Table 1 shows the closeness of the failed validation tests to the successfully validated tests. The % is giving the number of test points that respect the FAA criteria. Three (3) out of the four (4) tests from the frequency domain approach were above 99%. This means that only few points have not respected the FAA criteria, and therefore failed validation tests were obtained instead successful validation tests.

Experiment No.	Time Domain	Frequency Domain
1	88.2	100
2	100	100
3	93.38	98.34
4	86.24	99.62
5	100	100
6	100	99.62
7	0	99.36
8	100	100
9	96.69	100
10	0	100

The identified coefficients for the  $L_p$  and  $L_{\delta_a}$  are shown in the next Figures 4 and 5:

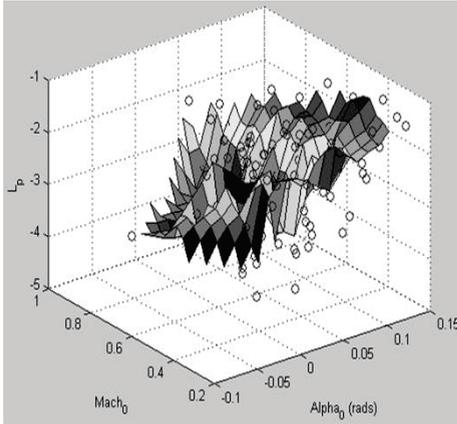


Figure 4.  $L_p$  versus Mach number and angle of attack

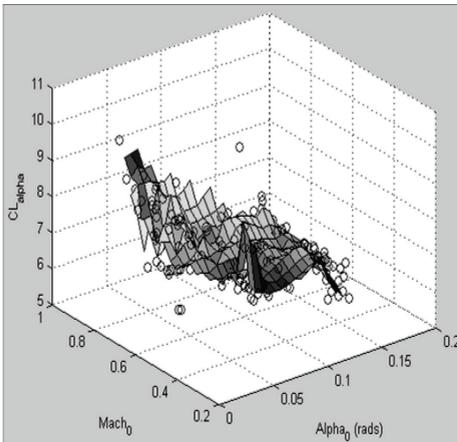


Figure 5. The aerodynamic derivative of lift coefficient  $C_{L\alpha}$  with the angle of attack versus Mach number and angle of attack

$C_{L_p}$  is related to  $C_{L\alpha}$  by the following relationship;

$$C_{L_p} = \frac{-4C_{L\alpha}}{Sb^2} \int_0^{b/2} cy^2 dy \quad (3)$$

$C_{L\alpha}$  is positive and decreases with angle of attack.

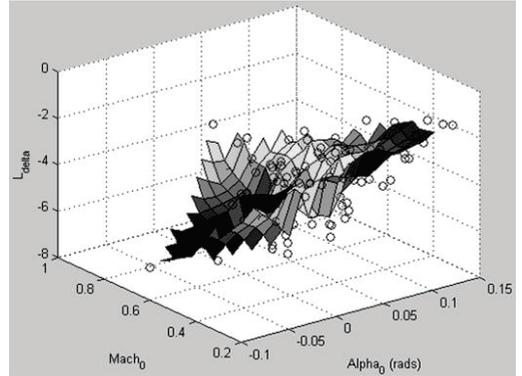


Figure 6.  $L_{\delta\alpha}$  versus Mach number and angle of attack

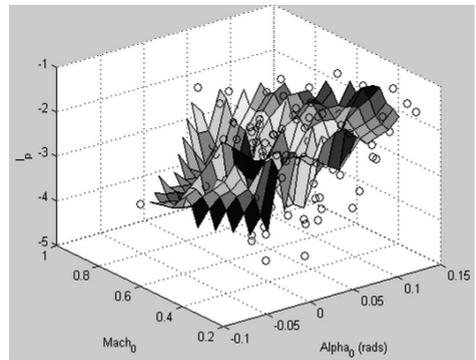


Figure 7.  $I_{\delta\alpha}$  versus Mach number and angle of attack

As the angle of attack increases, a decrease in the magnitude of  $L_{\delta\alpha}$  can be observed in Figure 6. The control effectiveness of the ailerons tends to decrease with high angles of attack that could be attributed to this trend.

At high angles of attack, the roll moment created by certain deflection in aileron decreases while there is no relationship between  $L_{\delta\alpha}$  and the Mach number. The variation of the aerodynamic coefficients  $l_p$  and  $I_{\delta\alpha}$  with Mach number and angle of attack is shown in Figures 6 and 7.

### Conclusion

The results obtained through the frequency domain approach were better than the

results obtained using the time domain approach.

In the frequency domain method, it is possible to separate modes while modeling. In this particular case, the frequency domain approach was able to model the roll response mode without the interference of the Dutch roll and spiral modes.

A flight envelope with points from all extremities was chosen in order to test the roll response mode for many different flight cases.

As future work, a higher number of flight tests from available spaces in the flight envelope maybe conducted to increase the database and improve the accuracy of the results.

The validation results obtained from the frequency domain method were good according to the FAA criteria, therefore the model used proved to be a suitable one to model the roll response of an aircraft.

The identified coefficients produced trends with angle of attack and Mach number that were effectively explained in the previous section. It is important to be able to interpret these patterns in order to validate the results obtained.

Finally, both methods satisfied the objectives successfully. These two methods were a good mode of comparison of the results obtained.

Other identification methods for the engine or aircraft are described in [8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22].

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# The influence of climatic factors on the performance of photovoltaic panels

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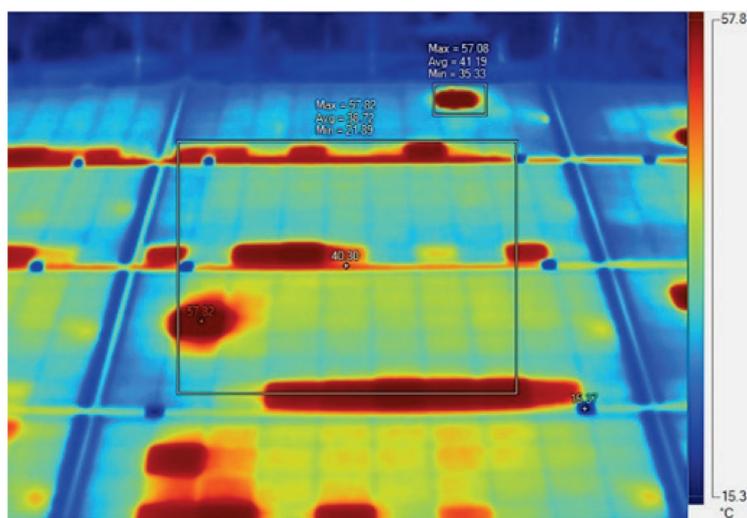
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**Abstract:** Solar energy is a clean energy, environmental friendly, abundant and also free. There are various commercially available forms to capture solar energy such as photovoltaic panels (PV), solar thermal electricity and solar panels. Due to high energy consumption in the buildings and to the laws imposed by European Union to reduce the energy consumption, PVs are ideal solutions for residential houses and commercial buildings in regions with a high solar irradiation levels. This paper presents a case study of the influence of environmental factors (i.e. ambient temperature, snow and dust) the PV performance. The evaluation consists in temperature measurements, infrared (IR) images taken with a thermovision camera and visual inspections of PV. Measurements performed on the PV system were recorded during one year period.



IR mapping of the heat dissipation in a PV module.

## 1. Introduction

In our century, the energy has become more valued since the energy from conventional source is about to deplete sooner than we expected. At the same time energy consumption increases dramatically worldwide, especially in tertiary and residential sector [1, 2]. For this reason the number of photovoltaic panels installed in the world has increased. Buildings are the key part in the expansion of PV system. They can be applied on the facade surface, roof or installed next to the building in the parking lot [3, 4].

By the end of 2013 worldwide installed PV had a total production of 140 GW. European Union is holding a leading position with 57% (i.e. 80.7 GW), followed by Asia and USA [5]. The first five countries in Europe that produce solar photovoltaic energy are United Kingdom (3.4 GW), Germany (3.3 GW), Italy (1.6 GW), Romania (1.1 GW) and Greece (1 GW) [5].

The total global output power of PV in 2014 was ~160 TW/h (terawatt per hour) estimated by International Energy Agency (IEA), which means 0.85 % of the total energy demand in the world [6]. The IEA predicted that by the year 2020, the global PV production would increase to 379 TWh/year [7, 8].

Therefore, it is important for PV systems to operate at the maximum design capacity to provide a constant and reliable power delivery over their estimated lifetime.

Environmental parameters such as ambient temperature, wind, dust and snow can influence the PV system performance. This paper discusses how the environment factors reduce the PV performance.

## 2. Presentation of PV system

Study of PV systems was performed on 13 PVs that were installed on the roof of a residential building located in the University "Politehnica" of Bucharest

(UPB). The PVs have a south orientation and a 15° tilt angle. These PV are made of polycrystalline solar cells with an efficiency of 13.4% have a nominal power of 230.7 W/PV, a surface area of 1.67 m<sup>2</sup> /PV, with a total area of 21.75 m<sup>2</sup> for the 13 panels. PV modules are connected to an inverter that transforms direct current (DC) into alternative current (AC). The surplus energy produced by the PV system is introduced in a local electricity grid of Politehnica University.

The specification for the polycrystalline PV used for this study are listed in Table 1 below.

**Table 1.** PV specifications

Parameter	Value
Short-circuit current [A]	$I_{SC} = 8.24;$
Open-circuit voltage [V]	$V_{OC} = 36.7;$
Current at nominal power [A]	$I_{mp} = 7.55;$
Voltage at nominal power [V]	$V_{mp} = 29.8;$
Maximum power [W] $P_{max} = V_{mp} \cdot I_{mp}$	$P_{max} = 225$
Tension/ temperature coefficient [V/K]	$K_v = -0.33;$
Current/ temperature coefficient [A/K]	$K_i = 0.04;$
Number of cells in series	$N_s = 60;$
Temperature at Standard Test Conditions [°C]	$T_{STC} = 25^\circ C$
Irradiance at STC [W/m <sup>2</sup> ] at AM=1.5 spectrum	$G_{STC} = 100W/m^2$

The technical data sheet of the PVs list the operating temperature of the PV module, which is between - 40 °C and + 85 °C. On the roof of the house is installed one sensor of temperature and one pyrometer that measures the solar radiation that falls on the surface of the PV module. Climate conditions play an important role in the energy production of photovoltaic panels. In Bucharest summers are very hot with temperatures up to 40 °C and in winter temperature drops down to -15 °C.

## 3. Result and discussion

### 3.1 Analysis of PV performance

The energy delivered by the PV system using data collected from the 13 PV modules installed on the roof of the UPB residential house over one year was recorded.

Figure 1 presents the maximum energy produced by the PV system. During the month of July, 225.10 kWh/month has been produced, while the month of November showed the minimum energy produced by PV, i.e. 19.50 kWh/month. The total energy delivered by the PV system over one year is 1433.45 kWh/year.

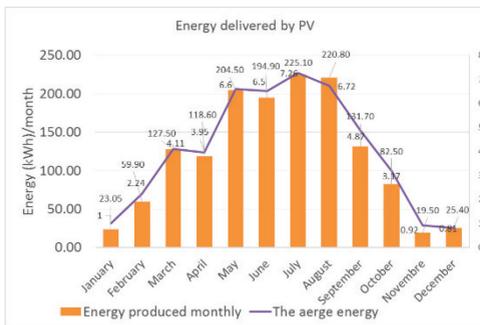


Figure 1. Energy produce by the PV system.

Figure 1 shows that the energy produced by PV in winter months from November to February 2014 decreases drastically due to the low solar radiation. Figure 2 shows an example of a typical solar radiation in January, which correlates well with the power output for that period of time. The power generated by the PV system depends on the solar radiation. When the solar radiation is below 100 W/m<sup>2</sup>, the power of PV tends to zero. In spring and summer months, we have an increases in energy delivered by PV.

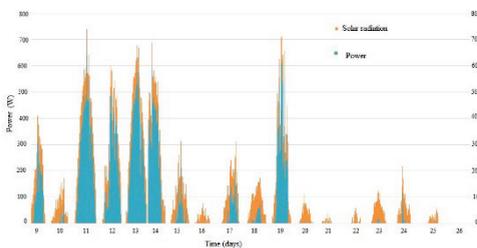


Figure 2. Solar radiation and power output of PV in period of 9-26 January 2014

### 3.2. Analysis of PV module with infrared (IR) thermovision camera

The IR analysis is based on the property of materials to emit electromagnetic radiation and depend on the temperature of materials [9]. In other words, when the objects have a higher temperature than temperature T= 0 K, they emit energy in the form of radiation [10]. Depending on wavelength, the radiation can be of several types:  $\gamma$  radiation, X-rays, ultraviolet, visible, infrared and radio (microwave). Thermal radiation is the result of transforming the internal energy of bodies in energy with wavelengths between 0.1÷ 100  $\mu$ m, including a portion of the ultraviolet and visible radiation entirely and infrared spectra [10].

This property of objects to emit the radiation is explained by several laws such as: Stefan-Boltzmann, Planck’s and Wien. For example the Stefan-Boltzmann relation express the total power output emitted by a black body which is proportional with temperature [10].

$$E_0 = \sigma_0 S T^4 = C_0 \left(\frac{T}{100}\right)^4 [W/m^2] \quad (1)$$

Where:

$$\sigma_0 = 5.67 \cdot 10^{-8} \quad ; \quad C_0 = 5.67 [W/(m^2 K^4)] - \text{black body coefficients [10].}$$

For a gray body which not absorb all the incident radiation and not emits as much of energy like black body, is characterized by emissivity,  $\epsilon < 1$ .

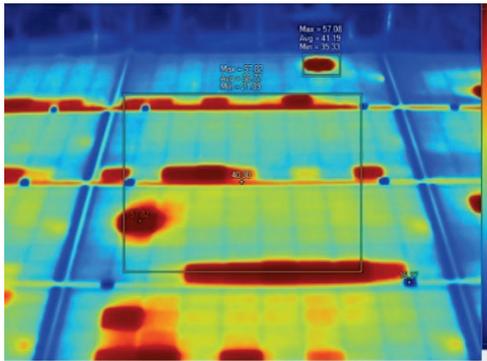
$$E = \epsilon(T) E_0 = \epsilon(T) C_0 \left(\frac{T}{100}\right)^4 [W/m^2] \quad (2)$$

$\epsilon(T)$  - represent the total emission factor of body [10].

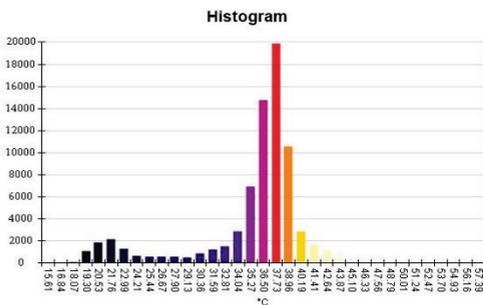
The infrared images on PV system help diagnosticate defect in a PV module and identify the solar cells that are working at a higher temperature than normal.

Figure 3 presents an IR image of a panel, which was obtained with a thermovision camera. In this image, the hot areas are red-brown and the cold areas are blue (Figure 4). The solar cells with a higher temperature are called “hot spot” in

the literature. The hot spot represents an area of a PV panel that has a high temperature. This temperature could damage the cells efficiency, since the efficiency of cell decreases with the increase temperature. For instance if the temperature rise with 1°C then losses of energy is 0.5% in a crystalline PV model [4].



**Figure 3.** IR image with thermovision camera of a portion of the PV panel.



**Figure 4.** Graphical representation on IR temperature histogram on pixel.

The specification of IR image used for this study are listed in Table 2.

appearance in a PV module [9] could be the deposition of dust, partial shadow and bad connection between cells. Also, causes for hot spots are, shortcuts or certain cases when the PV modules were not placed at a minim distance of 25 mm from the roof surface and thus they overheat due to poor ventilation [11, 12].

Shadow or dusts on a solar cell causes a loss in efficiency due to the fact that the energy is consumed as heat instead of being produced as electricity [9, 13].

**Table 2.** Image Info IR

Background temperature	22.00°C
Emissivity	0.95
Average Temperature	35.74°C
Image Range	15.37°C to 57.82°C
Camera Model	Ti200
IR Sensor Size	200 x 150 (pixels)

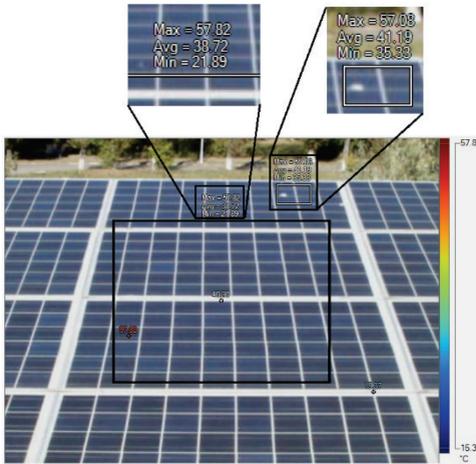
The principal cause of the hot spot On the other side, solar cell that operates at a higher temperature then the rest of the cells is considerate an error in the fabrication of PV module. For this reason the solar cell with high temperature can damage the efficiency of PV system even if the system is operating for a short period of time.

Figure 5 presents an image of the PV panel (in visible light). On this panel there is bird dirt that induces solar cell overheat. Correlating the visual observation with the IR image in Figure 3, it can be easily notice that the location where the bird dirt was observed has a maximum temperature of about 57.08°C, average 41.19°C and the minimum 35.33°C.

M.A. *Munoz et al.* [9] analyzed the early degradation of Si PV modules and explained the causes of certain failures in the PV module. The methods used for determination of failure detection was:

- a) Visual inspection;
- b) Indoor and outdoor power measurement;
- c) Infrared images (IR);
- d) Lock at thermography (LIT);
- e) Electroluminescence (EL) and photoluminescence (PL) imaging techniques;

f) Resonance ultrasonic vibrations (RUV) technique.



**Figure 5.** PV examined in visible field

All these methods give information on the causes generating defects such as yellowing and browning; delamination, bubbles, cracks in the solar cells; defects in the anti-reflective coating (ARC), hot spots, etc. [9].

Claudio Ferrara and Daniel Philipp [14] have studied the climatic stress that affects the PV module such as solar irradiation, UV irradiation, humidity, wind, snow, rain, hail, high/low temperatures, temperature changes, salt, sand and dust. The result of this study [14] shows that the climate tests represent the most rigorous test in the current standards.

Abhishek Rao et al. [15] performed a study on the influence of the dust deposited on the PV surface on the performance of PV. In their experiment, two PV modules were set up on the roof, where one PV was clean and the other one was covered with dust. The performance of the

PV modules was analyzed by recording the I-V curves under different solar radiation [15]. The result of this experiment was that the dust deposition on the PV surface does not affect the open circuit voltage of the panels. Instead, the power loss of the dusted panel was 5 to 6% of the maximum power output. Losses recorded on the dusted panel depended on the density of dust deposited on the panel [15]. For example, if the dust surface density is  $1.4 \text{ g/m}^2$ , then the loss of PV power is 5-6%, while the power loss is between 45-55% if the dust density is  $7.1 \text{ g/m}^2$ .

#### 4. Conclusion

This research work was focused on the study of photovoltaic panels that generate energy over one year for a residential house in Bucharest, Romania. The result of the measurements performed in real time showed that the power output is closely related to the solar radiation and varies depending on the season.

From the IR imaging, we realized that the PV module analyzed in this work has solar cells exhibiting a higher temperature compared to the others. The results show that the high temperature solar cells lose energy by heat and actually consume energy instead of producing. The main cause found in this case is due to the dirt and dust deposited on the surface of PV. To have a longer lifetime, the PV must be maintained clean in summer, and to be washed and cleaned of snow in winter.

#### Acknowledgment

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# Optimization of Engine Model Parameters Gain and Time Constant for the Cessna Citation X Business Aircraft Engine

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**Abstract:** The Research Aircraft Flight Simulator was designed and manufactured by CAE Inc., which is a very well known internationally Aerospace Company in Aircraft Modeling and Simulation Technologies. This simulator was designed following specific requirements of the Laboratory of Applied Research in Active Controls, Avionics and AeroServoElasticity LARCASE team at ETS in Montreal with the aim to be used for research purposes. The authors are the members of the team. This simulator is equipped with a Flight Dynamics Level D open source code, thus it will be used as a Flight Certified Bench Test with the idea to validate Flight Dynamics Models new codes and methodologies. The Cessna Citation X is the fastest today business aircraft available on the market. However, its engine model is unavailable. For this reason, the authors used this simulator in order to obtain, validate and optimize the main parameters of the engine model such as the time constant and gain variations with altitudes and Mach numbers.

## 1 Introduction

The main objective of this research was to determine the variation of both Gain and Time Constant parameters for the Rolls-Royce AE3007, which is the Cessna Citation X engine, in terms of Mach numbers and altitudes. These parameters included the Gain and Time constant of the engine. The Cessna Citation X business aircraft flight dynamics model was identified and validated as explained in [1, 2]. The flight cases are explained in detail in these references. Various optimal control methodologies have been studied for the Cessna Citation X in [3, 4, 5].

### 1.1 Gain Definition

The ratio between the output 'Net Thrust  $T$ ' and the input 'Thrust Lever Angle (TLA)' was modeled using the following first order transfer function, as shown in [6, 7]:

$$\frac{N.T}{TLA} = \frac{G}{\tau s + 1} \quad (1)$$

where the time taken for the  $T$  to drop to 63.2% of its initial value is defining the time constant  $\tau$  in the previous equation (1).

The gain is defined as the  $T$  variation resulting from a change in the inlet pressure. The effects of Mach numbers and altitudes on the gain values are described in the following subsections.

### Effect of Mach number on the gain

The Net Thrust can be found by the following equation:

$$N.T = [\dot{m}V_j + A_j(p_j - p_{atm})] - \dot{m}V_i \quad (2)$$

from which:

$$N.T = \dot{m}(V_j - V_i) + A_j(p_j - p_{atm}) \quad (3)$$

Where  $\dot{m}$  is the mass flow rate,  $V_j$  is the exit speed,  $V_i$  is the inlet or aircraft speed,  $A_j$  is

the propelling nozzle area,  $p_j$  is the static pressure across the propelling nozzle and  $p_i$  is the atmospheric pressure.

As shown in eq. (3),  $N.T$  depends on the difference between the exit and inlet air speeds  $V_j$  and  $V_i$ . As the aircraft speed  $V_i$  increases, is evident that the speed difference  $(V_j - V_i)$  decreases.

Thus,  $N.T$  decreases, as seen in eq. (3), with the increase in aircraft speed  $V_i$ , and therefore Mach number  $M$ .

**Effect of altitude on the gain**

It is known that the air pressure, density and temperature decreases with an increase in altitude. The gain decreases due to the decrease in mass flow as the air pressure and density decrease. The mass airflow increases with the decrease in the air temperature. At troposphere altitudes above 36.000 ft, the net thrust  $N.T$  is dependent only on the pressure as temperature remains constant.

**Time constant**

**Effect of Mach number on the time constant**

The time for the  $N.T$  to drop, and therefore the time constant decreases with the increase in Mach number.

**Effect of altitude on the time constant**

Depending on the altitudes values, there are low and high altitudes considered. At low altitudes, an increase in altitude causes a decrease in ambient air pressure and temperature resulting in the thrust reduction. At high altitudes, the drop in  $N.T$  decreases as the temperature drop decreases.

**1.2 Methods used in the code**

Various engine tests were done, modeled and analyzed. The initial estimation of the parameters was performed in the frequency domain. For example, the *Tfest* function was used to estimate a continuous time transfer function in the frequency domain. Thus, the gain and time constant were

estimated for given input and output data, initial conditions and sampling period.

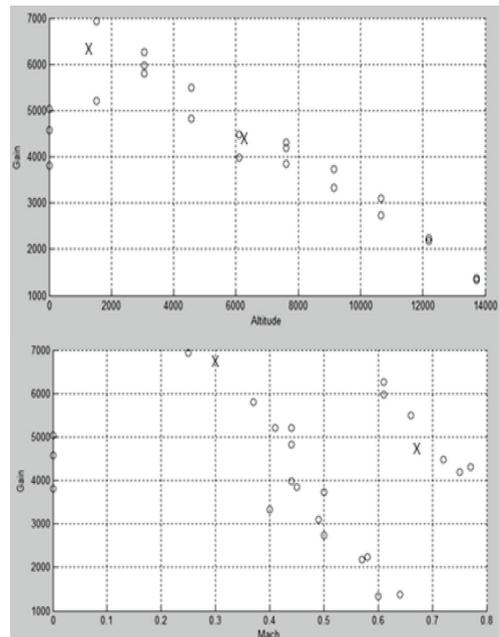
The *Fminsearch* function was used as an optimization algorithm in which the cost function was minimized. This cost function estimates the sum of squares errors between all the experimental and modeled  $N.T$  values.

**1.2 Validation Technique**

Two validation points were selected in order to have a cloud of points around them; these validation points have been manually chosen from the identification points.

The gain and time constant of these validation points were further interpolated from the graphs of identification points of the *Gain versus Mach number and Altitude* and from the graph of the *Time constant versus Mach number and Altitude*. These values were then introduced into the  $N.T$ .

The chosen validation points are shown as crosses on the plots below.



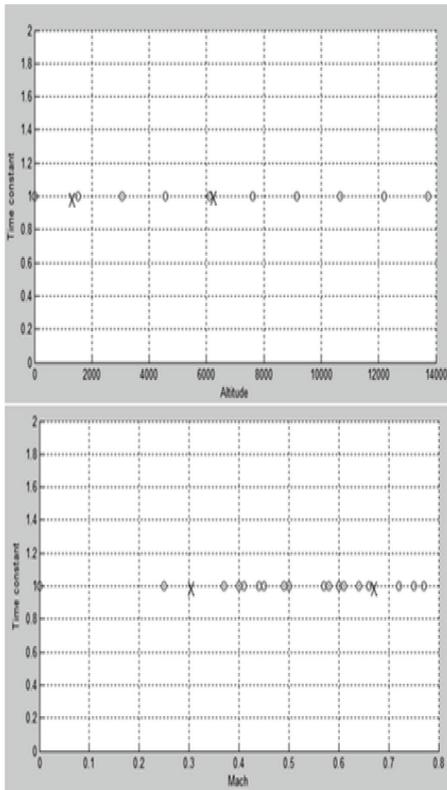
**Figure 1.** Validation points on the Gain versus Mach number and altitude graphs

**2. Results**

The *tfest* function had to be adjusted in order to produce very good estimates of the first order transfer function. Its adjustment was achieved by specifying certain initial conditions and limits to confine the function's estimates. The *gradient descent search method* was used for the estimation, which is a first order optimization algorithm that finds a function's local minimum by taking steps proportional to the negative of the gradient.

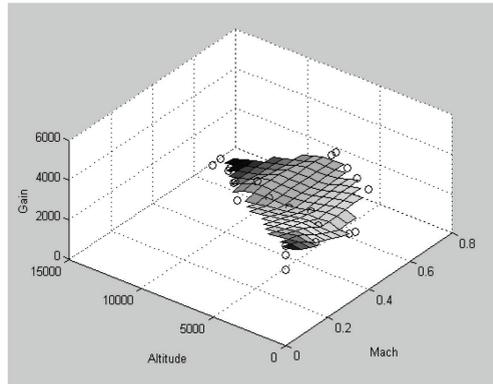
The maximum error was calculated for each test with the aim to analyze the estimation versus the optimization results.

The two following graphs show the variation of time constant and gain with Mach number and altitude *before optimization*.

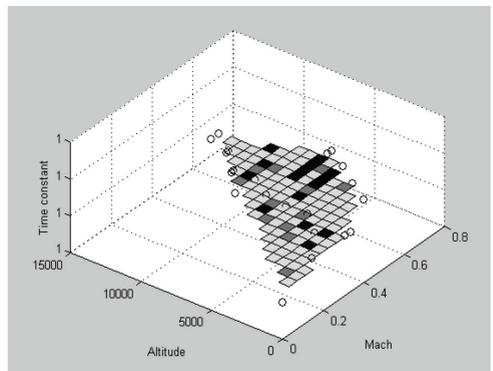


**Figure 2.** Validation points on the Time Constant versus Mach number and altitude graphs

The time constant had no variation with Mach number and altitude. All engine tests produced a time constant of 1s through the estimation algorithm. Even with various alterations to the *tfest* function, the time constant did not change. The gain on the other hand produced an inverse proportional relationship with the altitude. As expected, the obtained results were much better after optimization. Less absolute errors were obtained.



**Figure 3.** Variation of the gain with the altitude and Mach number before optimization

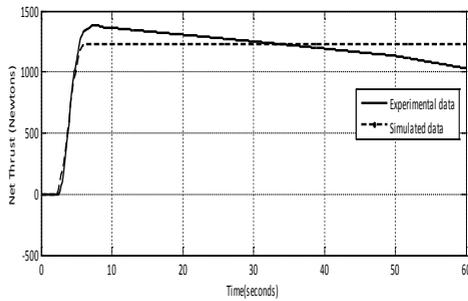


**Figure 4.** Variation of the time constant with the altitude and Mach number before optimization

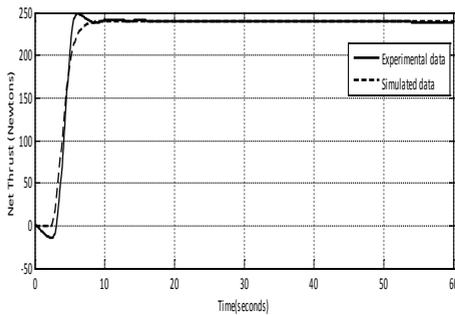
The following Figures 5 and 6 show the comparison between the experimental and simulated Net Thrust *N.T.* variation with time for two tests. The experimental flight

test data are represented with continuous lines, while the simulated results were represented with lines with discontinuous lines.

**2.1 Identification tests**



**Figure 5.** Test 1 Identification (Net Thrust variation with time) with maximum absolute error = 197.68 N



**Figure 6.** Test 2 Identification (Net Thrust variation with time) with maximum absolute error = 35.82 N

**2.2 Validation tests**

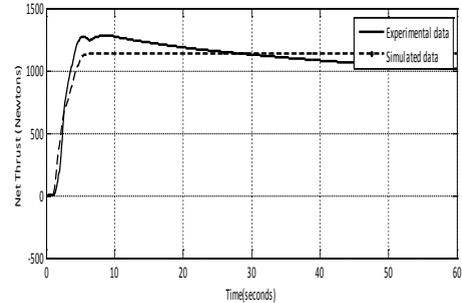
Following the validation of these two tests, two sets of results are presented in next Figures 7 and 8.

The two identification tests are the ones with the highest and lowest maximum initial errors. The highest case showed a 58.98% decrease in error, while the lowest case showed only a 3.02% decrease in error.

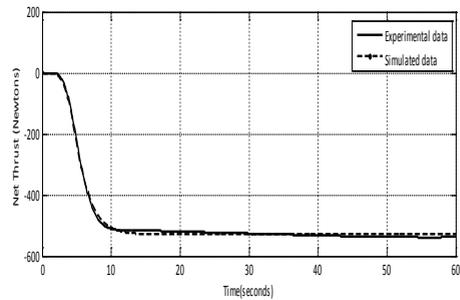
The reason for the low decrease in error of the worst case can be attributed to the fact that before optimization, the resulting error

was already low, therefore the optimization algorithm did not have a major impact.

The percentage decrease in error for the validation tests was considerable as result of the optimization algorithm.



**Figure 7.** Test 1 Validation (Net Thrust variation with time) with maximum absolute error = 210.37 N



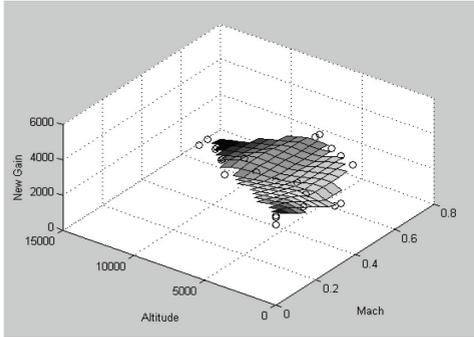
**Figure 8.** Test 2 Validation (Net Thrust variation with time) with maximum absolute error= 16.32 N

Since good validation results are essential for a successful model, this optimization algorithm was proven to be very important.

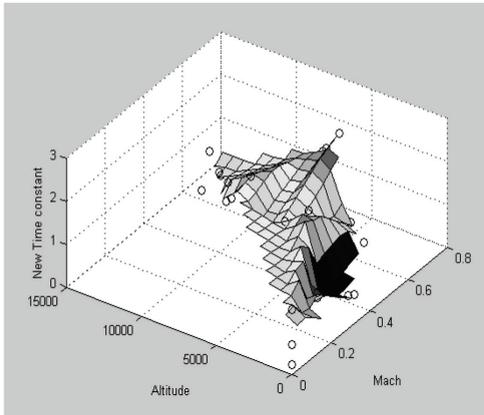
The variations of the time constant and the gain with altitude and Mach numbers were improved after optimization as seen in following Figures 9 and 10.

The new optimized gain was almost unaltered as compared to its initial non-optimized value. Similar relationships of the new optimized gain with Mach number and altitude can be observed, while the new optimized time constant does not vary with Mach number. The new optimized time

constant decreases with altitude for altitudes higher than 6,000 m.



**Figure 9.** Gain variation with altitude and time improvement after optimization



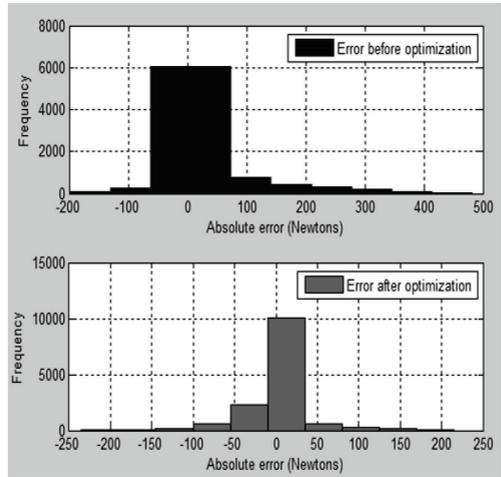
**Figure 10.** Time constant variation with altitude and time improvement after optimization

**2.3 Analysis of errors**

In Figure 11, it can be seen that the error after optimization was much smaller than the error before optimization, thus our new optimization method gave good results.

Hence, the first order transfer function model was suitable for the Rolls-Royce AE3007 engine. The estimation and optimization combined algorithms have accomplished the objectives of this project, and gave excellent results.

Other identification methods for the engine or aircraft are described in [8, 9, 10, 11, 12, 13, 14, 15].



**Figure 11.** Gain variation with altitude and time improvement after optimization

**Acknowledgment**

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# Electrodeposition of Thermoelectric Films Co<sub>x</sub>Ni<sub>(1-x)</sub>Sb<sub>3</sub> and Co-Sb<sub>x</sub>Te<sub>(1-x)</sub> in Citrate Solutions

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**Abstract:** Skutterudite compounds were studied as new potential candidates for thermoelectric applications. CoSb<sub>3</sub> showed good electrical properties and doping this material with nickel and tellurium would improve the thermoelectric properties. In this work the mechanisms for the electrodeposition of cobalt, nickel, antimony and tellurium in citrate solutions on a nanostructured gold template was studied. Comprehensive deposition-stripping experiments have been performed in order to understand the mechanism of the co-deposition of cobalt and antimony, as well as of the Ni and Te dopants. The results showed that there were two mechanisms operating in this system, i.e. the deposition of Co and Ni is controlled by the electrochemical reaction at the Au electrode, while Sb and Te depositions are controlled by diffusion. Although the experiments were performed in an electrolyte that contained citrates to form Sb and Te complexes and to increase the solubility of Sb<sub>2</sub>O<sub>3</sub> and TeO<sub>2</sub>, the deposition of Sb and Te is still controlled by diffusion due to their low solubility.

## Introduction

Driven by the high price of crude oil and global efforts to reduce carbon dioxide emission, the research on alternative and renewable energy sources has been shown a great development. In addition to their applications in electronic refrigeration for the ever smaller computer chips and circuit boards, thermoelectric materials can be used to extract energy from waste heat and convert it to electricity. Thermoelectric materials directly convert heat to electricity based on the Seebeck effect [1].

Cobalt triantimonide, CoSb<sub>3</sub>, shows promising thermoelectric properties at intermediate temperatures (400 - 700 °C), with most research focusing on reducing lattice thermal conductivity by introducing large heavy atoms into the skutterudite structures. The efficiency of a thermoelectric material is determined by its dimensionless thermoelectric figure of

merit, ZT, that can be expressed by eq. 1 [1, 2]:

$$ZT = \frac{S^2 \cdot \sigma \cdot T}{\kappa} \quad (1)$$

where,  $S$  is the Seebeck coefficient,  $\sigma$  is the electrical conductivity,  $\kappa$  is the thermal conductivity and  $T$  is the absolute temperature. Thermal conductivity property is a result of both electronic ( $\lambda_E$ ) and lattice conductivity ( $\lambda_L$ ) contributions. A good thermoelectric material should possess a large power factor ( $S^2 \sigma$ ) and a low thermal conductivity, so that the temperature difference between the heat source and the cold side is maintained constant.

Skutterudites, especially of n-type conductivity, are of special interest due to their excellent electrical transport properties and large Seebeck coefficient. Unfortunately, the thermal conductivities of the binary skutterudites are too large for thermoelectric applications. In order to optimize conflicting electric and thermal

properties such as those required by thermoelectric materials, a variety of compositional, structural and dimensional modifications are required [3].

The effects of doping with various donor impurities on the thermoelectric properties of polycrystalline  $\text{CoSb}_3$  have been extensively studied [4]. The analysis of the transport properties suggests that the electronic properties depend strongly on both the donor impurities (either fillers or dopants) and the carrier concentration, which control not only the electronic transport properties but also the scattering mechanisms of phonons in heavily doped n-type  $\text{CoSb}_3$ . The substitution of Co or Sb in  $\text{CoSb}_3$  with different dopants can influence the electronic structure and the electrical properties, in particular by changing the carrier masses. Furthermore, doping affects the lattice thermal conductivity due to phonon scattering on impurities. Dopants such as Ni, to replace Co, and Te, to replace Sb, can be used to further optimize the electrical conductivity and effectively scatter phonon [2, 4, 5].

### Experimental procedure

Electrochemical experiments were performed in a conventional three-electrode set up. The counter electrode was an Au wire and the reference electrode was a Ag/AgCl electrode (3M NaCl). All potentials are relative to Ag/AgCl (+0.210V vs standard hydrogen electrode). A computer-controlled potentiostatic (model AFCBP1, Pine Instrument Company) was used for cyclic voltammetry, deposition-stripping experiments and potentiostatic cathodic electrodeposition. The Aftermath software (National Instruments, TX, USA) was used to control the potentiostat.

Gold sputtered polycarbonate track-etched (PCTE) membranes (GE Water & Process Technologies, PA, USA) were used as substrates for deposition. The PCTE template is 10  $\mu\text{m}$  thick, and the pore diameters are approximately 400 nm

in average. One side of the PCTE membranes was sputtered with Au. The area occupied by the pores for the 400 nm membranes was 12.57%.

The Au-coated, PCTE template was then placed on a copper tape and mounted in between two plastic masking tapes, one of them with a circular cut-out, exposing the Au coated side of the PCTE membrane. The circular cut-out had an area of 0.3846  $\text{cm}^2$ . Figure 1 shows the schematic sample setup configuration of the working electrode.

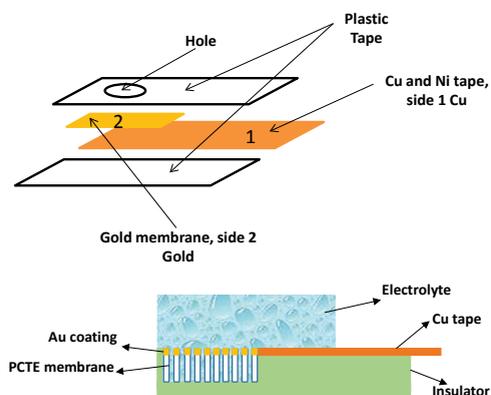
The electrochemistry experiments were performed in aqueous electrolyte solutions containing the chemicals of interest, i.e.  $\text{Sb}_2\text{O}_3$  (99.99%),  $\text{CoSO}_4 \cdot 7\text{H}_2\text{O}$  (>99%),  $\text{C}_6\text{H}_7\text{KO}_7$  (potassium citrate monobasic) (>99.5),  $\text{C}_6\text{H}_8\text{O}_7$  (citric acid) (>99.5%) and/or  $\text{TeO}_2$  (99.995%). All the chemicals were purchased from Sigma-Aldrich. Various aqueous solution were prepared with different concentrations as shown in Table 1

**Table 1:** Composition of different citrate solutions

Solution	Description
(1)	0.125 M $\text{C}_6\text{H}_7\text{KO}_7$ + 0.196 M $\text{C}_6\text{H}_8\text{O}_7$ + 0.003 M $\text{Sb}_2\text{O}_3$
(2)	0.125 M $\text{C}_6\text{H}_7\text{KO}_7$ + 0.196 M $\text{C}_6\text{H}_8\text{O}_7$ + 0.172 M $\text{CoSO}_4$
(3)	0.125 M $\text{C}_6\text{H}_7\text{KO}_7$ + 0.196 M $\text{C}_6\text{H}_8\text{O}_7$ + 0.001 M $\text{TeO}_2$
(4)	0.125 M $\text{C}_6\text{H}_7\text{KO}_7$ + 0.196 M $\text{C}_6\text{H}_8\text{O}_7$ + 0.172 M $\text{NiSO}_4$
(5)	0.125 M $\text{C}_6\text{H}_7\text{KO}_7$ + 0.196 M $\text{C}_6\text{H}_8\text{O}_7$ + 0.003 M $\text{Sb}_2\text{O}_3$ + 0.172 M $\text{CoSO}_4$
(6)	0.125 M $\text{C}_6\text{H}_7\text{KO}_7$ + 0.196 M $\text{C}_6\text{H}_8\text{O}_7$ + 0.003 M $\text{Sb}_2\text{O}_3$ + 0.170 M $\text{CoSO}_4$ + 0.002 M $\text{NiSO}_4$
(7)	0.125 M $\text{C}_6\text{H}_7\text{KO}_7$ + 0.196 M $\text{C}_6\text{H}_8\text{O}_7$ + 2.97 mM $\text{Sb}_2\text{O}_3$ + 0.172 M $\text{CoSO}_4$ + 0.03 mM $\text{TeO}_2$

Before electrodeposition experiments, an electrochemical treatment of the Au surface was performed to clean the surface and to ensure reproducible results during the electrochemical studies [6-10]. This treatment consists of cleaning the surface by cycling the potential between 0 to 1.5 V for 20 times followed by an electrochemical annealing for 20 min at 0.9

V. The electrochemical treatment is carried out in 50 mM H<sub>2</sub>SO<sub>4</sub> aqueous solution at room temperature.



**Figure 1:** Schematic 3D (top) and cross section (bottom) of the set up and working electrode.

Deposition-stripping experiments were performed for each element of interest in its own solution to determine their deposition rates. Deposition was carried out at different potentials between -0.2 and -1.2 V for 5 or 10 min followed by stripping. Solutions were magnetically stirred during deposition at a rate of 500 rpm.

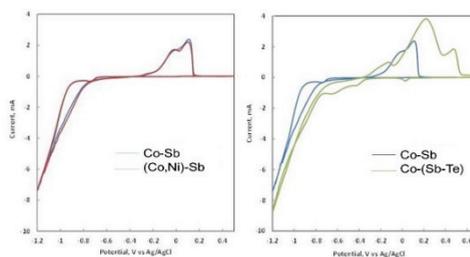
## Results and Discussion

### Cyclic Voltammetry

In order to better understand the electrochemical co-deposition and doping, cyclic voltammetry was recorded for Au in Co-Sb solutions containing nickel and tellurium, and compared to those obtained in Co-Ni-Sb solution. Figure 2 shows the cyclic voltammograms of Au in solution 6 (Co, Ni and Sb) and 7 (Co, Sb and Te), and compared to solution 5 that contains only Co and Sb. Cyclic voltammograms of Au in a given solution were recorded at a sweep rate of 5 mV/s from -1.2 V to 0.5 V for solution 6 and from -1.2 V to 0.7 V for solution 7.

Cyclic voltammograms of Au in Co-Sb and (Co, Ni)-Sb show two oxidation peaks

and no clear reduction peak. Electrochemical deposition of Co and Sb from their solutions was already published by our group [10, 11]. Hydrogen evolution is significant for this system and may overlap with the deposition peak(s). Adding Ni ions in the electrolyte does not visibly affect the CV. Ni and Co form solid solutions over the entire concentration range and this may be the reason why the two CVs are similar. Unlike Ni, the addition of Te ions drastically changes the CV, i.e. additional deposition and stripping peaks appear. The potential range for CV in Te-containing Co-Sb solution was extended in the positive direction from 0.5 to 0.7 V, to allow for the deposit to be removed from the surface during stripping. As Figure 2 shows for solution 7, stripping currents are much larger compared to solution 5 and shift to more positive values, suggesting a more complex deposition process in the presence of Te ions. Also, by comparison, Te has a significant impact on the deposition of Co-Sb compared to Ni, since Te deposits first, before Sb [9, 12, 13].

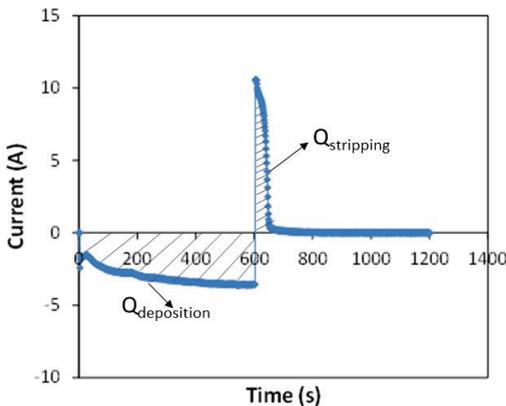


**Figure 2:** Cyclic voltammetry of Au in Co-Sb, Co-Ni-Sb and Co-Sb-Te solutions at 5 mV/s.

### Deposition-stripping experiments

In order to assess the deposition rate of each element of interest, i.e. Co, Sb, Ni, and Te in their individual solutions, a novel deposition-stripping experiment has been designed and performed. Figure 3 shows a typical plot of the current recorded during the deposition performed at a given potential within the potential range from -

0.55 V to -1.2 V, and the current recorded during the stripping performed at 0.4 V i.e. the potential where stripping of the entire deposit is concluded [11]. In Figure 3, a negative current indicates a reduction (deposition) process at the working electrode while a positive value means oxidation (stripping). Electrochemical deposition starts with a very short period of nucleation followed by growth, as indicated by a sharp increase in current followed by stabilization. At the negative end of the potential scanned, the total current is a combination of charge transfer due to both hydrogen evolution and material deposition. During stripping, the current increases rapidly until it reaches a maximum value, as the material that was deposited is removed, and then the current drops to zero.



**Figure 3:** Typical plot of current during deposition-stripping experiment at a certain potential

In the absence of hydrogen evolution, the two charges associated with deposition and stripping should be equal. Obviously,  $Q_{\text{deposition}} > Q_{\text{stripping}}$  due to the hydrogen co-deposition with each metal. In any occurrence, the total charge associated with stripping should reflect the amount of metal deposited since hydrogen would actually evolve and not strip. Therefore, the area under the I-t stripping curve ( $Q_{\text{stripping}}$ )

corresponds to the total charge transferred during metal deposition. Using Faraday's Law (eq. 3), the amount of the material removed during stripping can be obtained as follows:

$$m = \frac{Q \cdot M}{F \cdot z} \quad (3)$$

where  $m$  is the mass of the material removed during stripping,  $M$  is its molecular weight,  $F$  is the Faraday's constant (96,485 C/mol) and  $z$  is the valence, which in this case is  $z = 2$  for Co and Ni, 3 for Sb and 4 for Te. Since the amount of the material removed during stripping is equal to the amount of solid materials deposited, the average amount of solid material can be calculated as follows:

$$Q = i \cdot t \quad (4)$$

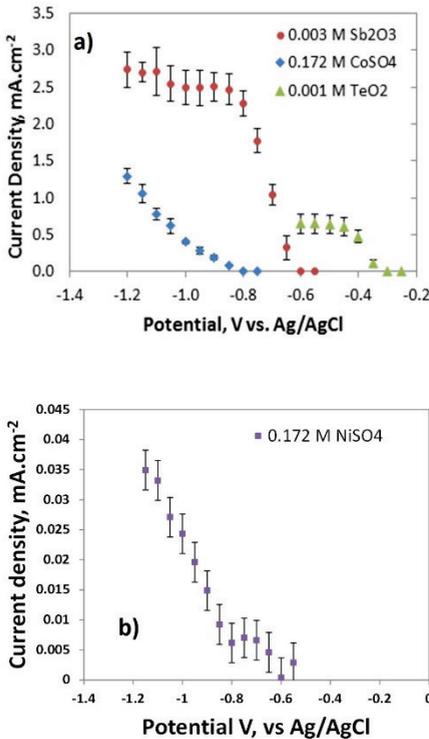
where  $i$  is the current density ( $\text{mA}/\text{cm}^2$ ) and  $t$  is the time (s).

Figure 4 shows the current density due to the deposition of Co, Ni, Sb and Te in their respective citrate solutions, i.e. solution 1, 2, 3 and 4. The deposition of Te does not start until the potential is more negative than -0.3 V. Te deposition rate increases quickly as the potential reaches about -0.45 V, and then remains constant. Results show that when Te was deposited at a potential more negative than -0.6 V, the Te film could not be completely stripped off even when the stripping potential was increased from +0.5 to +0.7 V and held for a more than 10 minutes. Since the stripping data directly affects the calculation of current density during deposition, only results from -0.2 to -0.6 V are shown for Te in Figure 4.a.

For Sb, the deposition starts around -0.65 V and increases quickly as the deposition potential reached -0.8 V. For potentials more negative than -0.8 V, the current density for Sb did not change much and the current stabilized around  $2.58 \text{ mA}/\text{cm}^2$ .

The deposition of Co in a citrate solution containing 0.172 M  $\text{CoSO}_4$  started around -0.85 V. The deposition current

steadily increases as the deposition potential becomes more negative. Same results were observed for Ni, Figure 4.b. The electro-deposition of Ni starts at potentials more positive than Co but more negative than Sb or Te. The main difference between Ni and the other elements is that the current density is much smaller than the current density obtained for Co, at the same concentration of the electrolyte. Because the current densities for Ni deposition are much lower compared to Co, Sb or Te, the results for Ni are shown in a separate chart (Fig.4.b).



**Figure 4:** Deposition rates of Co, Sb, Te, a) and Ni b) in citrate solutions

In the potential range used in this study, the deposition of Co appears to follow the Butler-Volmer equation (eq. 5), and increases with the overpotential increase:

$$i = i_0 \left[ e^{\frac{(1-\beta)\eta F}{RT}} - e^{-\frac{\beta\eta F}{RT}} \right] \quad (5)$$

where  $i$  is the deposition current,  $i_0$  is the equilibrium exchange current,  $\beta$  is the symmetry factor,  $\eta$  is the overpotential,  $F$  is the Faraday's constant,  $R$  is the ideal gas constant and  $T$  is the temperature.

Although the Butler-Volmer equation predicts an increase in the magnitude of the deposition current with overpotential, the reaction rate cannot increase indefinitely with the applied potential because at some point, the diffusion of cations, or complexes containing depositing cations, cannot keep up with the reduction reaction at the electrode. When that instance occurs, the deposition rate is constrained by the diffusion of cations/depositing species and is independent of the deposition potential or overpotential. In this case, the limiting current ( $i_L$ ) is described as :

$$i_L = \frac{z \cdot D \cdot F \cdot C^0}{\delta} \quad (6)$$

where  $z$  is the valence,  $D$  is the diffusion coefficient of the cation,  $\delta$  is diffusion length,  $F$  is the Faraday's constant and  $C^0$  is the concentration of the cation in the electrolyte far away from cathode.

At a given temperature and concentration, the deposition current cannot be greater than the limiting current. This behavior can be seen in Figure 4.a where the current density for Te and Sb remains constant at a large overpotential, which means that Sb and Te deposition are controlled by diffusion.

### Conclusions

Electrochemical studies of Co-Sb doped with tellurium and nickel in citric acid solutions have been performed to better understand the electrochemical doping in these systems.

Electrochemical experiments were carried out to better recognize the deposition of each element of interest in

this system, and the co-deposition of 2 or more elements. The results show that the deposition of Co and Ni is controlled by the electrochemical reaction at the cathode, while Sb and Te depositions are controlled by diffusion. Although the electrolyte contained citrates that form Sb and Te complexes to increase the solubility of  $\text{Sb}_2\text{O}_3$  and  $\text{TeO}_2$ , the deposition of Sb and Te is still controlled by diffusion due to their low solubility. When both Co(II) and Sb(III) are combined in the same citrate solution, their electrochemical behaviors preserve the same characteristics as in single solutions although the relative content of Co is slightly lower. This is probably due to interactions between Co and Sb that give rise to a higher kinetic barrier for the deposition of Co. Deposition of nickel occurs at smaller current densities than other elements and is also controlled by surface reaction.

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# New Method for Encapsulation of Oregano Essential Oil into Carbon Nanotubes

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**Abstract:** In this paper it is proposed a new method of encapsulation of oregano essential oil (EO) into carbon nanotubes, singlewalled (SWCNTs) and multiwalled (MWCNTs). Multiwalled carbon nanotubes were functionalized by oxidation methods to obtain carboxylated carbon nanotubes MWCNT-COOH and aminated carbon nanotubes MWCNT-NH<sub>2</sub>. The effect of encapsulating matrix on protection and delivery of oregano essential oil was studied. We will refer to preparation by encapsulation of carbon nanotubes with oregano essential oil in order to improve characteristics that can be used in biomedical applications. EO was encapsulated in carbon nanotubes by physical immersion and the samples were ultrasonated for 2 hours at 37°C. After the treatment of carbon nanotubes with oregano essential oil, these varieties of materials were inserted into a collagen gel and lyophilized in order to obtain collagen matrices. The structure of the new functionalized carbon nanotubes immersed in a collagen matrix was identified using infrared spectroscopy (FTIR analysis) and morphological features were studied by transmission electron microscopy (TEM) and scanning electron microscopy (SEM).

Keywords: carbon nanotubes, oregano oil, TEM, FTIR.

## Introduction

Oregano is an aromatic plant from Mediterranean countries widely used as food ingredient due to its specific flavour. Moreover, oregano oil is a strong antioxidant [1] with very good antimicrobial properties being a good alternative for food preservative. The use of EO as health promoting substance is directly related with some components of oregano such as carvacrol and thymol.

Microencapsulation is the technique that allows sensitive ingredients to be entrapped in every kind of homogenous or heterogeneous matrix but the choice of

material is an important key for the success of encapsulation process.

Carbon nanotubes (CNTs) [2,3] were widely used because possess exceptional electrical, thermal and mechanical properties and is not being degraded in human body; they can be used to deliver small organic drug molecules into the diseased cells thus preventing normal tissue damages. Due to the chemical oxidation CNTs can be very easy functionalized and they can be used as targeting materials in combination with cisplatin (potent anticancer agent). Single wall carbon nanotubes (SWCNTs) potential can be

exploited by uploading the form of anti-neoplastic compound shell at the external tube by a covalent bond. The drug was then released as active form as the reduction reaction in acidic endosomes and lysosomes.

## 2. Experimental methods

### 2.1. Materials and Reagents

High-purity SWCNTs were purchased from Sigma Aldrich. These SWCNTs were produced by a chemical vapor deposition process yielding particle external diameters of less than 2 nm with lengths ranging from 0.5 to 40 microns and a purity > 90%.

Multiwall Carbon Nanotubes (MWCNTs) were purchased from Sigma Aldrich having more than 90% carbon basis and D x L 10-15 nm x 0.1-10  $\mu\text{m}$ , produced by Catalytic Chemical Vapor Deposition (CCVD). Oxidation was made using a mixture of 98% sulfuric acid (Merck).

### 2.2. Equipment

FTIR spectra of functionalized MWCNTs were registered on a Perkin Elmer, Spectrum 100 equipment in 400÷4500  $\text{cm}^{-1}$  range with 4  $\text{cm}^{-1}$  resolution and 32 scans.

Nano-sized particles were investigated using TEM analysis with a microscope Philips EM-410, 60kV and by SEM using a SU8230 microscope.

### 2.3 Procedure

Multiwalled carbon nanotubes were functionalized with carboxil -COOH, cisplatin -CDDP and amino -NH<sub>2</sub> groups.

#### Functionalization of MWCNTs with -COOH groups:

MWCNTs (2.0 g) were dispersed in 98% concentrated sulphuric acid under ultrasonication at 50°C for 6 h to produce oxidized carbon nanotubes (MWCNT-COOH) [4]. The samples were washed with ultrapure water and dried at 50 °C for 12 h.

#### Obtaining of MWCNTs with -CDDP

CDDP (5 mg) was added to MWCNT-COOH solutions in 1 ml saline solution.

They were ultrasonicated for 48 hours at 50° C and filtered.

#### Functionalization of MWCNT-NH<sub>2</sub>

Dried MWCNT-COOH (0.1 mg) was reacted with excess SOCl<sub>2</sub> (25 mL) at room temperature for 30 minutes. The residual SOCl<sub>2</sub> was removed by washing with tetrahydrofuran THF and filtered with ultrapure water.

The MWCNTs were dried for 20 minutes at the room temperature.

The new functionalized nanotubes MWCNT-SOCl<sub>2</sub> (10 mg) are added in etilendiamine in excess for 10 hours at the room temperature. The mixture was washed with THF and filtered. The nanotubes were dried at 80°C /10 hours [5].

#### Encapsulation of oregano essential oil

The encapsulation of oregano essential oil consists of adding 5 ml of EO into samples that contain carbon nanotubes (functionalized and nonfunctionalized, single or multiwall), under ultrasonication for 2 hours at 37°C.

We will refer to 5 types of samples such as:

- sample 1: SWCNTs+EO;
- sample 2: MWCNTs+EO;
- sample 3: MWCNT-COOH+EO;
- sample 4: MWCNT-CDDP+EO;
- sample 5: MWCNT-NH<sub>2</sub>+EO.

After that encapsulation the samples was characterized by TEM and FTIR.

Type I collagen of bovine origin was extracted by the currently used technology as previously described [6]. The collagen (Coll) was obtained as gel in native form with fibrillary structure with an initial concentration of 2.11%, pH 2.5 and free of fat and ash. Glutaraldehyde (GA) was supplied by Sigma-Aldrich (Germany) and sodium hydroxide from Merck (Germany). All the chemicals used in this work were of analytical grade and the water was distilled. The obtained functionalized carbon nanotubes encapsulated with oregano essential were added to collagen gel with ratio 1:10 (reported to dry collagen). The composite gels based on collagen as such

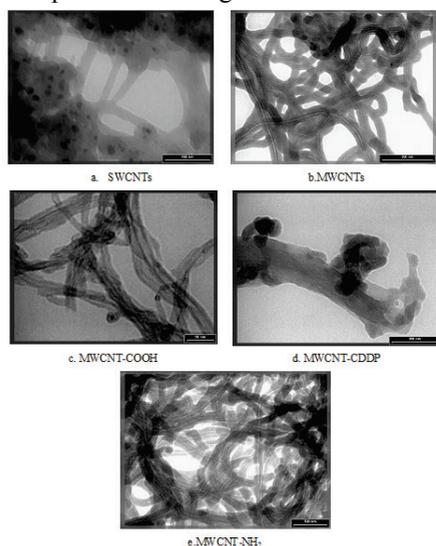
(reference sample) and collagen with CNTs were adjusted at physiological pH (7.2 – 7.4), 1.2% collagen (dry substance) and then cross-linked with 0.5% GA. The cross-linked gels were frozen at  $-40^{\circ}\text{C}$  for 12 hours and then freeze-dried according to the method previously described [7] using the Christ Model Delta 2–24 LSC freeze-dryer (Germany). 3D spongy composites were obtained and characterized as by SEM.

### 3. Results and discussions

#### 3.1 TEM analysis:

Nanostructured composite morphologies are investigated using a transmission electron microscope EM-410, 60kV. The morphologies obtained for every sample are presented in figures 1.

For the first sample (fig. 1a) the morphology is specified for single-wall carbon nanotubes. The structure is uniform and tubular distributed on the surface of a cooper grid. The average diameter of SWCNTs nanotubes was measured with ImageJ program and the value is almost  $1.2 \pm 0.2$  nm. From place to place, it is visible on the TEM micrographies, the encapsulation of oregano oil into SWCNTs.

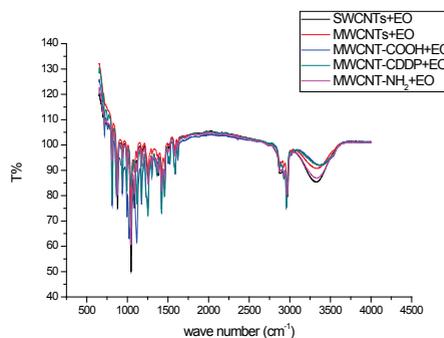


**Figure 1.** TEM micrographies for samples encapsulated with oregano essential oil

The encapsulation of EO into MWCNTs is put in evidence in fig. 1b. The net of nonfunctionalized multiwalled carbon nanotubes is very dense and encapsulation takes place at the ends of carbon nanotubes, at the extremities. The average diameter of these kinds of carbon nanotubes was also measured with ImageJ soft and the value is almost  $9 \pm 1$  nm. The encapsulation of oregano essential oil it is also very well put in evidence in images 1c, d and e.

#### 3.2 FTIR determinations:

The samples were analyzed using FTIR and infrared Microscopy Spectral data were recorded by an ATR Perkin-Elmer equipment. In figures 2 are presented the FTIR of super reposed of individual spectra of 1÷5 samples.



**Figure 2.** FTIR for samples encapsulated with oregano essential oil

The  $-\text{COOH}$  and  $-\text{NH}_2$  functionalization is put in evidence by FTIR measurements.

FTIR has been used to map the chemical distribution of carbon nanotubes SWCNTs, MWCNTs, acid treated MWCNT-COOH, MWCNT-CDDP and MWCNT- $\text{NH}_2$ .

FTIR spectra for the super reposed of 1÷5 samples show a broad peak at  $3406\text{ cm}^{-1}$ , which refers to the O-H stretch of the hydroxyl group which can be ascribed to the oscillation of carboxyl groups.

Carboxyl groups on the surfaces of MWCNTs could be due to the partial oxidation of the surfaces of MWCNTs during purification by the manufacturer,  $1626\text{ cm}^{-1}$  and is associated with the stretch

mode of carboxylic groups ( $\text{O}=\text{C}-\text{OH}$  and  $\text{C}-\text{OH}$ ), as observed in the IR spectrum of MWCNT-COOH.

Carboxylic groups are formed due to the oxidation of carbon atoms on the surfaces of the MWCNTs by sulphuric acid. The peak at  $1878\text{ cm}^{-1}$  can be associated with the  $\text{O}-\text{H}$  stretch from strongly hydrogen-bonded  $-\text{COOH}$ . The peak at  $1592\text{ cm}^{-1}$  is related to the carboxylate anion stretch mode. The peak at  $1629\text{ cm}^{-1}$  can be associated with the stretching of the carbon nanotube backbone. The peaks at around  $2870$  and  $2927\text{ cm}^{-1}$  correspond to the  $\text{H}-\text{C}$  stretch modes of  $\text{H}-\text{C}=\text{O}$  in the carboxyl group.

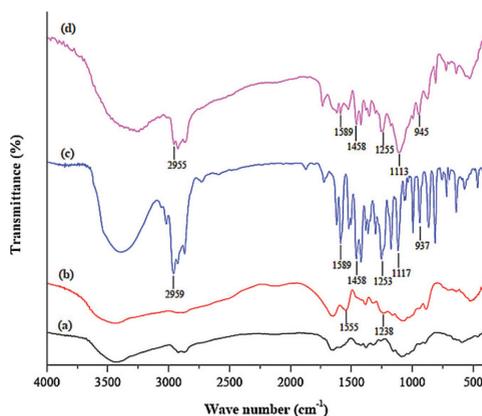
For MWCNT-CDDP present a peak at around  $868\text{ cm}^{-1}$  specific for  $-\text{CDDP}$ .

For MWCNT- $\text{NH}_2$  the bands at  $2929$  and  $2873\text{ cm}^{-1}$  represent asymmetrical and symmetrical stretching of  $\text{CH}_2$  groups. The  $\text{C}-\text{N}$  stretching vibration and the scissoring in-plane  $\text{N}-\text{H}$  distortion of free primary amine group are observed at  $1047\text{ cm}^{-1}$  and  $1622\text{ cm}^{-1}$ , respectively. The broad band at  $3355\text{ cm}^{-1}$  is attributed to the  $\text{NH}_2$  stretching.

We supposed that any other peaks presented in individual spectrum of each sample are specific for oregano essential oil encapsulation.

The addition of EO resulted in a markedly increased in intensity of the  $\text{CH}$  stretching peak at  $2867\text{--}2955\text{ cm}^{-1}$ , indicating an increase in the content of ester groups, which might come from EO molecules. The peak at  $2961\text{ cm}^{-1}$  is due to the presence of  $-\text{CH}$  stretching, the peak at  $1594\text{ cm}^{-1}$  represent the  $\text{N}-\text{H}$  bending, at  $1459\text{ cm}^{-1}$  is  $\text{CH}_2$  bending, at  $1255\text{ cm}^{-1}$  and  $1121\text{ cm}^{-1}$  is put in evidence the  $-\text{C}-\text{O}-\text{C}-$  stretching and  $936\text{ cm}^{-1}$  is specific for  $\text{C}-\text{H}$  bending.

Figure 3 present some literature results for FTIR spectra [8].



**Figure 3.** Literature: (c) spectrum is for oregano oil [8] and (d) is for oregano oil+chitosan - seems similar with ours spectra

### 3.3. SEM morphology

The morphological aspects of the samples surface, with CNTs and EO into the collagen matrix and the pore interconnectivity were determined by Scanning Electron Microscopy, using a Hitachi SU8230 microscope at 5.0 kV. The morphology is presented in figure 4.

The SEM investigation offer information about the morphology and distribution of the particle to/at the collagen matrix.

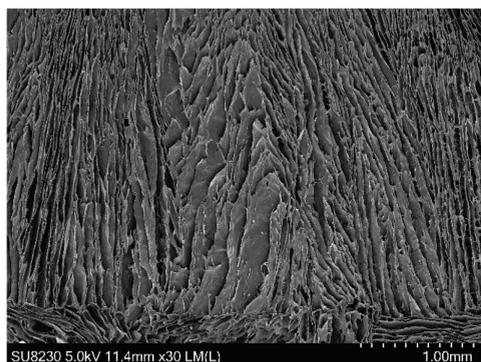
In figure 4a is presented the morphology of the composite that involves SWCNTs, oregano oil and collagen.

The figure 4b presents the morphology of the composite made by MWCNTs, oregano oil and collagen.

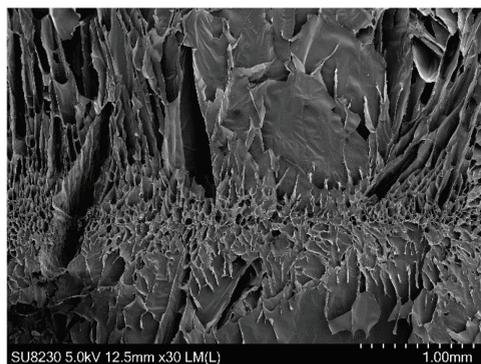
Both pictures show some similarities. The structure is a porous one.

The morphological results by SEM analysis revealed a differentiated homogeneity and pore interconnectivity in our composites.

The walls of the collagen network appear to be thicker for the composite containing single-wall carbon nanotubes than for the composite that contain multiwall carbon nanotubes.



a)



b)

**Figure 4.** SEM image of the collagen based matrix: a) with SWCNTs; b) with MWCNTs

#### 4. Conclusions

Results show that both kind of carbon nanotubes, single or multiwalled were encapsulating quite well the oregano essential oil. The SEM images of the composite revealed a high porous structure, common in all samples. This kinds of materials encapsulated further in a collagen matrix seems to be very promising for

biomedical applications. More tests will be proceed in order to study the biocompatibility of our composites based on collagen matrix.

#### Acknowledgment

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# A Digital Charge Amplifier Model for Hysteresis Reducing of Piezoelectric Actuators

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**Abstract:** The piezoelectric actuators have high resolution, wide operating frequency and low power consumption, but they suffer hysteresis which affects their linearity. In this paper are presented comparatively the analog and digital techniques for improvement (reducing) of nonlinear behavior of this type of actuators using charge amplifiers. First an analog charge amplifier and its performance analysis are presented. Then a model of digital charge amplifier with linearity performance considerably improved (91% reduced), but which shows a pronounced drift is presented. In the last section several methods for drift reducing are presented and analyzed, one of them having a reduction with 87%. A number of functional diagrams and response graphs for the developed techniques and methods are presented.

## Introduction

The application area of the piezoelectric actuators has been spectacular developed, especially due to their remarkable qualities. Compared to other nano-positioning actuators, these have high resolution, high force, wide operating frequency and low power consumption. It is enough to mention some of their applications [1, 2, 3]: in micro and nano-devices for mechanical positioning with below micrometric accuracy (optical and electronics microscopy, high precision cutting devices (error correction), robotics and positioning of magnetic heads and optical recording-playback); in deformable mirrors (adaptive optics systems); in ultrasonic motors; in the impact controlled on/off devices; in fuel injectors of diesel engines etc.

But, the piezoelectric materials have important non-linear characteristics determined by the existence of hysteresis and creep, which can reduce the positioning accuracy of a piezoelectric actuator.

When it is applied to a piezoelectric actuator a sudden voltage, the length will quickly respond then it will change slowly

due to the creep effect. Creep is the polarization result of the piezoelectric actuator which continues to change after the applied voltage reaches its final value. Commonly, this effect is an issue at low frequencies and it is not important for higher frequencies [4].

Hysteresis is another undesired effect: when the input voltage is gradually increased, the actuator displacement is different from when the voltage is decreased for the same voltage value applied.

For hysteresis reducing, many techniques have been implemented: the model-based control [5]; the displacement feedback control [6]; the charge control [7].

Without going into details, it is worth mentioning that, none of these techniques do not provide an acceptably hysteresis diminution to allow the piezoelectric actuators to do the very high precision displacement.

In this paper, a model of digital charge amplifier is presented. By this model, a significant reduction of the piezoelectric actuators nonlinear behaviour is obtained.

In the following sections we present this digital model.

**The analog charge amplifier**

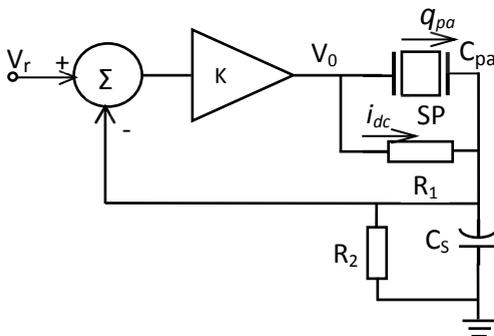
To make the transition to digital charge amplifier, we present a simple analog charge amplifier in this section.

In Figure 1(a) the circuit diagram of this analog charge amplifier is shown. It contains a comparator ( $\Sigma$ ) and amplifier ( $K$ ), a stack piezoelectric ( $SP$ ) with capacity,  $C_{pa}$ , a sensing capacitor with capacitance,  $C_s$ .  $R_1$  is used to model the operational amplifier (OA) input terminal leakage, and  $R_2$  is due to the leakage of the sensing capacitor. The circuit feedback loop is used to equalize the reference voltage,  $V_r$ , with the actual voltage across the sensing capacitor. If the OA,  $SP$  and sensing capacitor would be ideal,  $R_1$  and  $R_2$  can be removed and ideal Laplace transfer function would be:

$$H(s) = \frac{q_{pa}}{V_r} = C_s \tag{1}$$

where  $q_{pa}$  is  $SP$  charge.

But,  $OA$ ,  $SP$  and  $C_s$  are real and  $R_1$ ,  $R_2$  must be introduced. The real transfer function becomes:



(a)

$$H(s) = C_s \frac{s}{s + 1/R_1 \cdot C_{pa}} \tag{2}$$

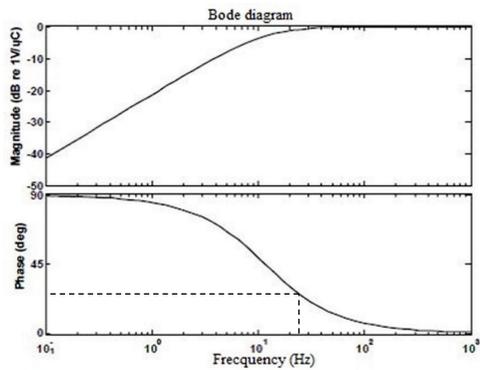
Analysing the function from "(2)", we observe that it represent a high pass filter with the following cut off frequency:

$$\omega_c = \frac{1}{R_1 \cdot C_{pa}} \tag{3}$$

If frequency is below  $\omega_c$ , the load impedance is much higher than  $R_1$  and because the impedance DC is not infinite, a DC current ( $i_{dc}$ ) passes through  $R_1$  which applies DC compliance voltage,  $V_0 = R_1 i_{dc}$  [7] across  $SP$ .

Using this model to a  $SP$  type AE0505D44H40 from Nek with  $C_{pa}=3.4\mu F$  and limiting the DC current to 10mA, for the maximum DC offset voltage across  $SP$ ,  $R_1=4k\Omega$  is needed. For this example, Figure 1(b) shows the frequency response of this analog charge amplifier.

Analysing of Figure 1(b), we can observe that at frequencies of less than 25Hz, the phase lead exceeds about 25 degree (24 degree measured) which causes unacceptable distortion for precision tracking applications.



(b)

**Figure 1.** A standard analog charge amplifier: (a) – Circuit diagram; (b) - Frequency response.

**The digital charge amplifier**

The circuit diagram of the digital charge amplifier model is shown in Figure 2. It is

in feedback loop, too. It contains a Digital Signal Processor (DSP), a digital to analog converter (D/A), an analog to digital

converter (A/D), an analog power amplifier, a piezoelectric actuator (SP). A shunt resistor  $R_{sh}$ , is connected in series with SP and in parallel with resistor  $R_p$  of the protection circuit for protecting the DSP from high voltage.

This circuit measures the charge across the SP and by using the closed-loop control system, it tries to equalize the desired input charge signal value  $D_{ch}$ , with the actual charge value  $A_{ch}$ , obtained from actual charge measured on SP,  $q_{pa}$ . But, the charge measured value of SP is obtained by integrating the current which passes the SP,  $i(t)$ , and is given by:

$$q_{pa} = \int i(t)dt \quad (4)$$

Because the protection resistor,  $R_p$ , and input impedance of DSP,  $R_{iDSP}$ , are in series

and together they are in parallel with shunt resistor,  $R_{sh}$ , the equivalent total resistance,  $R_T$ , is given by:

$$R_T = \frac{R_{sh}(R_p + R_{iDSP})}{R_{sh} + R_p + R_{iDSP}} \quad (5)$$

The piezoelectric actuator current is given by:

$$i(t) = \frac{V_{sh}(t)}{R_T} \quad (6)$$

where  $V_{sh}(t)$  is the voltage across shunt resistor.

Substituting "(6)" in "(4)" results the value of the piezoelectric actuator charge, given by the expression:

$$q_{pa} = \int \frac{V_{sh}(t)}{R_T} dt = \frac{1}{R_T} \int V_{sh}(t) dt \quad (7)$$

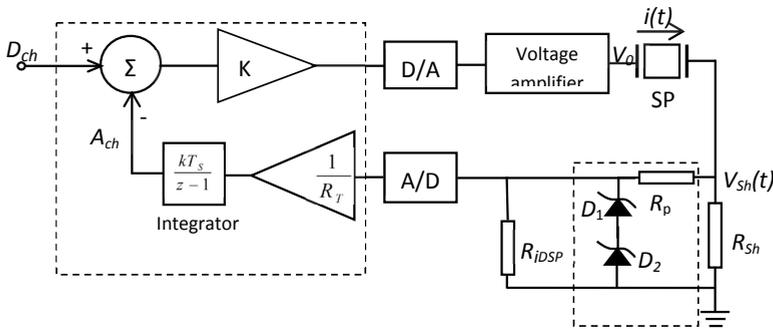


Figure 2. Circuit diagram of the digital charge amplifier model.

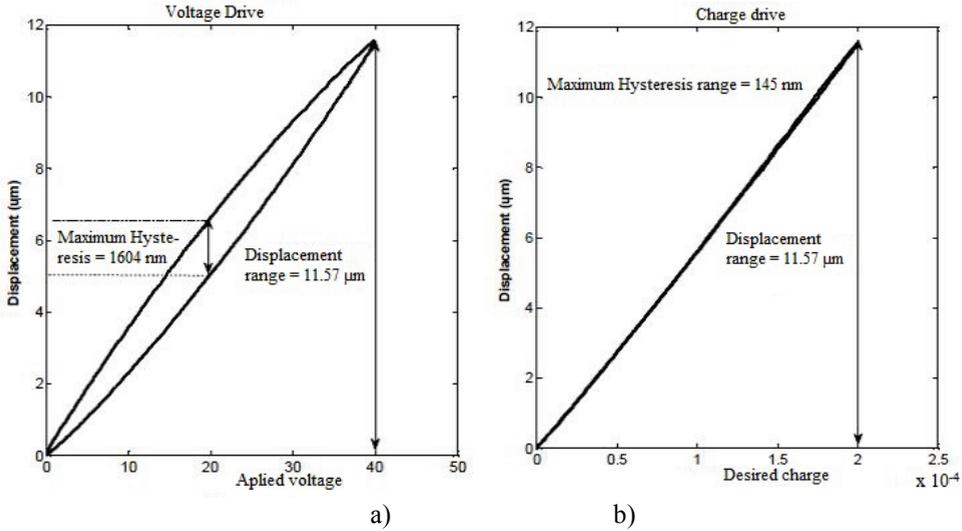
Analyzing "(7)" we observed that the charge across the piezoelectric actuator is equal to the integral of the voltage across the shunt resistor divided by the total resistance,  $R_T$ .

The comparison between linearity offered by the circuit structures of standard voltage amplifier and digital charge amplifier is presented in Figure 3(a) and 3(b). By analyzing diagrams of those two responses, we can observe the major improvement in linearity offered by the digital charge amplifier model from Figure 2. Though, the displacement range of those two circuits was the same,  $11.57\mu\text{m}$ , the digital charge amplifier offers  $145\text{nm}$

maximum hysteresis, while, the standard voltage amplifier offers  $1604\text{nm}$ , more than 11 times higher. The hysteresis reducing of the digital charge amplifier model presented in Figure 2 is about 91% and it is a considerable reduction. It is to be mentioned that the displacement of the stack piezoelectric actuator was measured using a strain gauge.

Analyzing the circuit structure from Figure 2, it can be shown that the discrete transfer function from the input desired charge,  $D_{ch}$ , to the output actual charge measured is given by:

$$H(z) = \frac{z-1}{z-1} = 1 \quad (8)$$



**Figure 3.** Response of an AE0505D44H40 stacks piezoelectric actuator to a 10Hz sine wave driven by: (a) - a voltage amplifier; (b) - the digital charge amplifier model.

Therefore, unity gain, up to the Hyquist limits of the A/D rate and loop rate of the controller is significant.

But the big problem in using this technique is the drift dimension, and how we remove drift. We try to present this problem in the next section.

**The drift removal methods**

The analog to digital converter (A/D) is not ideal and it suffers from current leakage. This can determine a bias voltage,  $V_B$ , in the input and this voltage is the main reason for the drift in charge which is given by:

$$q_{pa} = \frac{1}{R_T} \int (V_{Sh}(t) + V_B) dt \quad (9)$$

The bias voltage can determine miscalculation of the actual charge across the piezoelectric actuator. Thus, the voltage

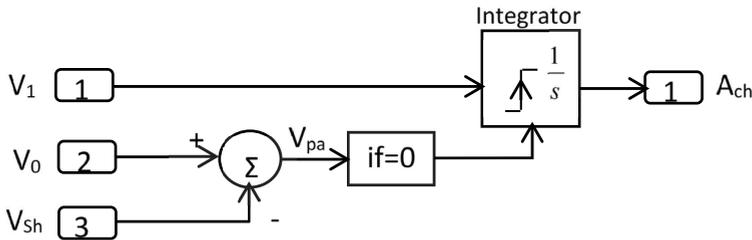
applied to the piezoelectric actuator will drift and saturated in final.

**Drift removal by integrator reset**

In [8], the author uses an analog initialization circuit to reset the circuit in order to avoid drift. A switch is used to short out the sensing capacitor and set the voltage across it to zero and thus, the circuit restarts periodically.

In this paper, a similar idea is used in the digital implementation, but here it does not happen periodically. This method is schematic presented in Figure 4.

When the voltage across the piezoelectric actuator,  $V_{pa}$ , is equal to zero, the integrator will be restarted. This process being implemented in the DSP, additional hardware in circuit is not necessary.



**Figure 4.** Block diagram of resetting integrator method.

The result of this reset process is showed in Figure 5. Watching carefully the figure, can be observed that there is a small signal distortion when the piezo-actuator across charge passes through zero value.

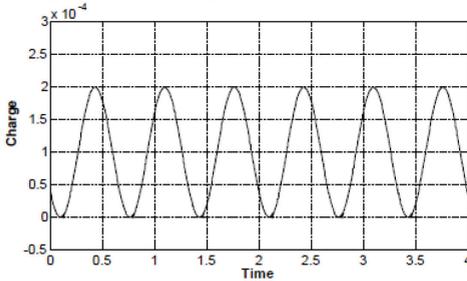
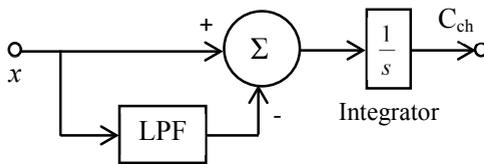


Figure 5. Response of an integrator reset.

**Using of Low Pass Filter bias estimator**

To estimate the bias value, it is easier to use a low pass filter (LPF) and then the bias removes from the original signal. The block diagram of a LPF bias estimator is schematically showed in Figure 6(a).

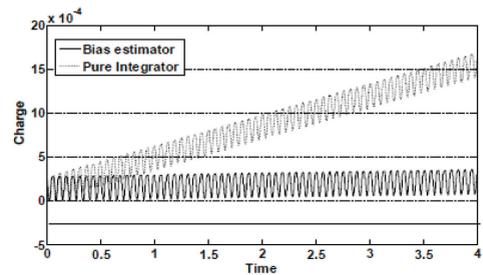


(a) A LPF bias estimator (LPF). Block diagram.

The response of a LPF bias estimator and pure integrator is presented in Figure 6(b) for a sine wave of frequency 100 rad/s and a DC bias of 100μC. Watching this figure, can be seen that pure integrator has much more drift in comparison to the bias estimator. Thus, after 4 seconds, the pure integrator has over 1500μC error (1527μC measured), while the bias estimator has about 200μC (196μC measured). A simple calculation shows that, using this method, the drift was reduced with over 87%.

**Using a modified integrator**

For the drift removing from the output of an integrator, a usually solution is to replace the integrator with a first order low pass filter. But, especially, at frequencies lower than the cut off frequency, using a LPF can generate errors in the phase and magnitude. For solving this deficiency, in [9] a modified integrator presented in Figure 7 was used.



(b) Response of a LPF bias estimator and pure integrator to a 100 rad/sec input sine wave with DC offset 10<sup>-4</sup>C

Figure 6.

Because the feedback loop gain is zero at high frequencies, the transfer function behaves like a low pass filter and, at low frequencies, the feedback loop acts to remove the DC drift [9].

The transfer function will be as a pure integrator, when the output signal does not exceed the limitation level in the saturation block. But if the input signal reaches the limiting level, the output signal will be given by:

$$H(s) = x \frac{1}{s + w_C} + z \frac{w_C}{s + w_C} = y \quad (10)$$

Using this method, the problem of pure integrator can be solved, but the difficulty is to know the limitation of the applied charge.

In Figure 8 is showed the response of a pure integrator and of modified integrator from Figure 7, at 5rad/s input sine wave with 100 μC DC offset.

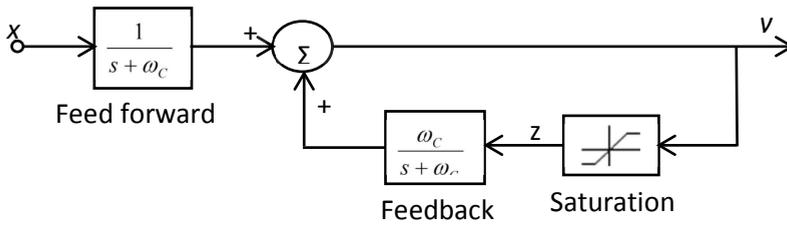


Figure 7. A modified integrator block diagram.

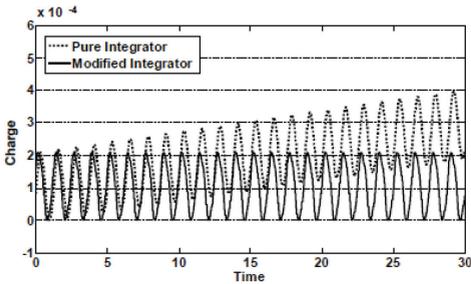


Figure 8. Response of a modified integrator and of pure integrator at a 5 rad/sec input sine wave with DC offset  $10^{-4}C$

Watching the figure we can observe that in the case of modified integrator, the drift was removed.

By comparatively analyzing of the above presented techniques, can be asserted that the modified integrator technique has less drift, but it has the same signal distortion at high frequency. The LPF bias estimator presents a bigger drift, but it has a simpler implementation.

In dynamic applications, if it is known that the signal crosses zero in each period, the best method is integrator reset presented in paragraphs 4.1, because it can completely remove the drift and the distortion is minimal.

**Conclusions**

The model of digital charge amplifier presented above reduces the nonlinear behavior of a piezoelectric actuator. The hysteresis is reduced with 91% and by developed techniques, the drift can be reduced with 87%.

According to the comparative analysis of analogue and digital techniques, we can conclude that the digital method shows higher performance and can be used with much more efficiency.

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# Science with Tendency

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**Abstract:** The phrase “*art with tendency*” is accepted and utilized in various branches of creative activities. The expression “*science with tendency*”, proposed in this paper by linguistic analogy, describes false demonstration approaches of arbitrary theses, under violation of well-established research principles. In a general context, characterized by several disputes on recognized scientific and cultural values, some demystification attempts can be easily described as science with tendency procedures. Examples of such false scientific demonstrations are given related to the most prominent myth of the Romanian culture, the national poet Mihai Eminescu. A case study of the famous poem *La steaua* [To the star] reveals, through examples, the lack of a real scientific analysis in certain authors’ aim to “prove”, by any means, their beliefs or assumptions.

An original model for the evolution of the myth is proposed in this paper. This model facilitates a well-balanced attitude in analysing representative works, according to the ancient principle “*sine ira et studio*” and honest research rules. Science without tendency is the real basis for a proper evaluation of our national values and preservation of our identity in the new globalized world.

## 1 Introduction

The paper presents tendencies that affect the scientific approach to the study of symbols of identity. As such, in the second section, the tendency of dismantling the myths is treated, with reference to the Eminescian myth and to the masterpiece *La steaua* [To the star]. The third section is devoted to the tendency of linking to the myth, which can bring image benefits to those who practice it, but seriously affect the outcome of research. The fourth section exemplifies, using the same Eminescian model, the fast approach of science without other tendency than the service of the truth.

In the fifth section, a mathematical model of the evolution of symbols of identity is proposed. The main advantage of the model is that it allows understanding the myths as phenomena of resonant perception and comparing them regardless of their location in real historical time.

## 2 The tendency of demythification

The history teacher L. Boia is famous for being a national demythifier [1]. This is a

fact, although the distinguished author is convinced of the strength and the inevitable presence of myths and of their role in setting high goals at individual or community levels. [2]. The deconstructive impulse, motivated by the non-reality of myths, could not stop before the high emotional representation of the Eminescian myth. Surprisingly, but in a credible manner, L. Boia says that he feels the poetry of the Romanian classic poet and that he knows many of his lyrics by heart. However, the admiration of the historian is limited to Eminescu the poet, without covering Eminescu the ideologist. According to L. Boia, Eminescu's ideology was, is and will be promoted by nationalists, from who the demythifier keeps apart.

However, when demythifying Eminescu, the historian attacks the poet, probably because the ideological shortcomings seemed too obvious. Unfortunately, critical demonstration is under a fake seal, which envisages the tendency of demythification at any price: the cover presents the classic

Romanian car parked on the opposite lane, near a no-parking sign (Figure 1). Perpendicular to the street, a horse harnessed to the cart chews the grass placed near the car illegally parked. One may accept that on a side street in a small town, a cartman feeds his horse. However, more bizarre than the position of the harness and of the car is the fact that the driver sits impassively in the car. Fake is obvious.



**Figura 1.** The illustration with tendency on the volume cover [2].

However, the tendency and the sufficiency of the author appear in the treatment of the Eminescian particular myth. It is stated that "literary speaking, *La steaua* is an average poem, rather schoolish". Considered an unoriginal work, "only a process, and even a simple translation from German, after *Der Stern* by Gottfried Keller", Eminescu's jewel could not count as "supreme mixture between science and literature." The truth is that *La steaua* is clearly superior to Keller's poem, who, however, had the first idea of comparing the physical phenomenon of light propagation to the more-complicated psychical reality. The difference between the two creations corresponds to the shift from a reasonable poet (Keller) to a great poet (Eminescu). Scientifically speaking, by introducing a new stanza as compared to the German poem, *La steaua* includes a full and separate description of the three phases of the existence of the star (birth, activity and death). In addition, the description is more rigorous: light propagation time is finite ("thousand years"), not infinite

("Ewigkeit"). In prosodic terms, Eminescu's poetry flows smoothly, with a double rhyme in each stanza. Keller's poetry is tiresome ("dein Aug'," "o, Lieb' ") and only provides a simple rhyme. But the weakest point of the German poem is the last stanza, in which the physical phenomenon is mixed with the psychological message: the girlfriend is predicted that she would die before the poet. In the case of Eminescu, it is not about the bodily death but the death of the feelings. There are things that L. Boia does not see, since he is driven by the tendency of demythification.

### 3. The tendency of linking to the myth

The vicious attempt to link oneself to the Eminescian myth could not be more evident in [3]. The volume could be accepted, however, with the ordinary meaning of a "science-fiction comment", as the subtitle sounds. Nevertheless, the author pretends that his text is purely scientific, the fantastic character arising only from extraordinary truths which he reveals: "para-normal is something normal in development", "many are still sleeping but some are starting to wake up ...".

So urgent is the tendency of linking to the myth, that even the saying of the poet is censured if it would somehow harm the mythical aura. Thus, after reproducing "the renewed pleasure of reading" the four stanzas of *La steaua*, I. Câmpan writes: "In one place, he (Eminescu) confesses that he wrote this poem to imitate a certain G. Keller. Others believe he was inspired by a German version of a book published in London in 1834, written by Ch. Bell. (...) We do not know if the assertions truly belong to Keller, Bell or Eminescu". Placing himself against the great critic G. Călinescu, who allegedly "could not" understand "physical theories" of the Eminescian texts, the physics professor Câmpan states: "In the first three stanzas, there is a perfect clarity and absolute correctness of relationships in space-time continuum, fully valid even today." In fact, the first three stanzas of *La steaua* are based

on a single scientific truth, namely that the propagation speed of light is finite. Much too confident in his scientific competence ("I am aware that this study cannot be understood even by everyone."), the high-school teacher presents Eminescu as a senior scientist: "He is not he a scientist in the strict sense, but in a much broader and more essential sense".

To say more about the logical and linguistic deficiencies in the comments of this author is useless. We highlight, however, two ways in which I. Câmpan attaches to the Eminescian myth. One is based on numerology: "From the circle of Eminescu, Caragiale was born in 1852 and I in 1952, on January 1. I do not take the comparison further. I was born Tuesday, Capricorn, and Eminescu was also Capricorn (...) I turned 50 on Tuesday, and he 152 on Tuesday, as well. See the figures 50-52." "In another attempt to get closer, the author exploits his name:" Where do I want to get? We know that Veronica Micle as a maiden was named Ana Câmpan, like her mother, a midwife etc."

The tendency of linking to the myth of the national poet can be found in a somewhat sophisticated form at the doctor V. Ene. He aims to identify "scientific predictions in the work of Eminescu" [4] and even to confront the poet, in terms of science, with the scientist A. Einstein [5]. The last scientific prediction "discovered" by Dr Ene in the Eminescian writings is the "imaginary time", introduced by the astrophysicist Stephan Hawking. Thus, in the novel *Sărmanul Dionisos* [Poor Dionysus] where Eminescu imagines a travel back in time to the days of Alexander the Good, the doctor is convinced that his talent for reciting serves him to "unravel the mysteries of Eminescu", and he believes that he found the prediction of the concept of imaginary time. He imagines that the content-empty phrase of the imaginary time ("We called this time imaginary time for something like that was never thought by any mortal until Eminescu, nor afterwards")

allows a regression in time (why not in real time?) to facilitate, as a "memoirist", a meeting between Eminescu and Einstein. The pages in question could be read in the science-fiction register. In such a context, even the scientist's delighted amazement at the meeting with Eminescu could be accepted ("Einstein: Extraordinary! You really are a great poetic genius, but also a great scientific genius! You amazed me! I hope we meet again.") We emphasize that it is Einstein who is speaking, who, after the actual interview with Nobel laureate Rabindranath Tagore, said: "the dialogue with Tagore was a disaster ..." It is understood that Eminescu, who became for the memoirist "my friend", does not know how to thank for "the idea of meeting during this imaginary time": "Eminescu: My dear, you're right! It was me! Your imaginative view can be envied. You can tell the world what you have found, because it correspond to the truth!" The wonder is that, beyond clumsy expressions, V. Ene seems to be convinced of the reality of time travel, as well as of the value of his discovery: "...I am satisfied that we have achieved this meeting, over centuries, in imaginary time, which will remain an important Eminescian prediction discovered by the under-signed."

It is not the place to analyse the psychological substrate of the tendency of linking to the myth. We are pleased to see that the two cases present an increase in self-esteem and in the consideration of the peers. Certainly, Eminescu has no guilt and no gain from such overbidding of the myth. Moreover, a definite Eminescian prediction appeared just in such circumstances: "High above the rest, a pygmy will then set out to discourse, / Not to emphasize your merits but to praise his own, of course; / For your name is just a pretext." [Translated by Leon Levitchi]

#### 4 Science without tendency

The lack of any tendency except for revealing the truth is the nature of what we

call science without tendency. Compliance with the classic dictum "*sine ira et studio*" and the honesty of the critical approach can be found in many papers regarding the particularity of the myth of Eminescu, as discussed above. Thus, as a proof of evidence, in [6] the compared creations are presented in full compared, both *La steaua* and the poem of G. Keller. It is worth noting the seemingly minor fact that the German "Romance" is presented under the correct title *Siehst du den Stern?*, and not simply and inaccurately, *Der Stern*, as in many other cases.

Exemplifying with lyrics from both creations, M. Dragomirescu shows in [7] how Keller's honourable poem becomes a masterpiece in Eminescu's vision. A meaningful analysis envisages "destructive capital defects" of German opera, including the "tactlessness" of the poet in predicting that his beloved would die before him. In the same rigorous vein falls P. Caraman's comparative analysis [8]. After revealing the "ultra-specific state of individualization" of Keller's poetry, the critic shows that in the case of Eminescu "the generalization process is perfect". As shown in the manuscripts of the poet, the final form in four seemingly simple quatrains ("schoolish?") of the masterpiece *La steaua* resulted from a laborious process of concentration since "the trial versions have each eight quatrains."

An ample and provocative critical contribution of the Eminescian myth, focused on the time interval (1870-1900) is brought by I. Costache in [9]. Classified within the meaning of G. Călinescu, under the genre musical romance, *La steaua* is doomed to the "negotiation of the maximum degree of accessibility", that is, "it concerns a public for which the lachrymatory tendency is crucial". Is this the case? Considered as "full of original and fertile ideas", the book also highlights the great expressive dexterity of the young author. Thus, *La steaua* is shown as a "philosophical poem", "a poetic text with a

bipolar configuration, which is not however in the nature of the traditional romance: one pole equipped with an elevated and meditative expression, and another pole built on a sensitive model, etc." Reading these texts, undeniably elevated, one may nevertheless have the feeling that they are placed as a semi-opaque veil over the crystal clarity of the work analysed.

The most recent title to illustrate genuine literary criticism without damaging tendencies, of the Eminescian case, is due to A. D. Rachieru [10]. The demanding surveillance of the expression, characteristic of the style of this author, does not hinder reading. Analysing the Eminescian myth, the critic finds "under the pressure of globalization, and the plight of the national canon, subject to deconstruction from the inside", i.e. demythifications of all kinds. The canonical Grama followers, "hoping to remain in the history at least as denigrators, reserve themselves a sad glory". On the other hand, the "idolatrous eruptions" manifested especially at anniversaries are disapproved of. In the author's conception, for the myth of Eminescian identity "the real test remains reading".

### A model for the evolution of the myth

To express the momentary power,  $P$ , of a symbol of identity like the myth, we propose a formula inspired by the theory of the resonant electric circuits:

$$P = \frac{P_r \cdot Q \cdot t_r}{\sqrt{1 + Q^2 \cdot (t_r - \frac{1}{t_r})^2}} \quad (1)$$

where:  $P_r$  represents the lasting power of the symbol,  $Q$  is the index of the resonance and  $t_n$  is the normalized time,  $t_n = t/T$ . Please note that  $t$  denotes real physical time and  $T$  is the time required for the identity symbol to reach the maximum of visibility through a process of resonant reception. Using the normalized time instead of physical time has the advantage of facilitating comparisons of the evolution of various symbolic powers.

It may be proven that the power of the symbol, according to the relation (1), reaches the peak

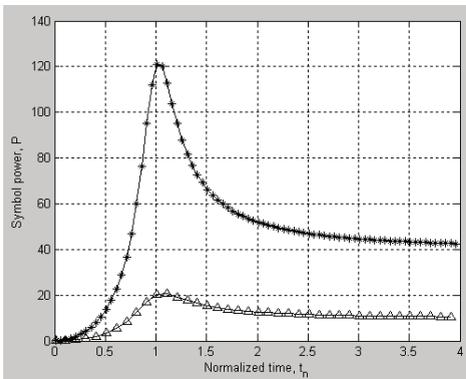
$$P_{max} = 2P_r \cdot \frac{Q^2}{\sqrt{4Q^2-1}} \quad (2)$$

at the normalized time

$$t_{nmax} = \sqrt{\frac{2Q^2}{2Q^2-1}} \quad (3)$$

It results that  $t_{nmax}$  is slightly over-unity. Accordingly, for  $Q=3$  and  $P_r=40$ ,  $t_{nmax} \cong 1,029$  and  $P_{max} \cong 121,7$  while for  $Q=2$  and  $P_r=10$  the following values are obtained:  $t_{nmax} \cong 1,069$  and  $P_{max} \cong 20,6$ . The significance of the resonance index becomes clear if the relation is observed:

$$Q \cong P_{max}/P_r \quad (4)$$



**Figure 2.** Evolution of the symbolic power in t he cases of M. Eminescu (\*) and P. Cerna (Δ).

It is known that a model is the simplified and approximate representation of a reality. It is also known that any attempt to catch in rigorous mathematical relations, the phenomena of human nature, loaded with subjectivity, is audacious.

What relevance can have the fact that based on the relationships proposed above, for  $Q=3$  and  $P_r=40$ , the evolution of the power of the Eminescian symbol of identity shown in Figure 2 can be obtained? What meaning can have the fact that for  $Q=2$  and  $P_r=10$  results the evolution of the symbol of identity of the poet P. Cerna, also represented in Figure 2? The answer is that

a picture speaks more than a lot of words. The alignment to the start of various symbols of identity, regardless of their position in real historical time and the use of normalized time on abscissa allow the comparison of different myths. The model clearly expresses the idea that myth is the result of a resonant reception linking the symbol of identity to its era.

It would certainly be an abuse of interpretation to read in the graph the mathematical ratio between the powerful Eminescian myth and the frail symbol of poet Cerna. Nevertheless, the model clearly shows that the Eminescian symbol is resonant and has unequalled, if not unrivalled powers.

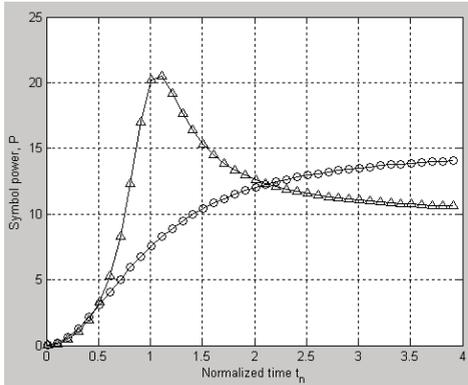
The resonant reception [11] justifies in the case of Eminescu the formulations: "full expression of the Romanian soul" (N. Iorga), "the complete man of the Romanian culture" (C. Noica) or "the national poet" (G. Călinescu, [12, 13]. To consider these phrases "intemperate and hostile to the critical spirit" [14] denotes lack of understanding of the resonance phenomena.

However, the proposed mathematical model suggests the possibility of an identity symbol whose development has not had a resonant reception. Indeed, for  $Q = 1/\sqrt{2}$   $t_{nmax}$  is infinite. If  $Q$  decreases even more,  $t_{nmax}$  becomes an imaginary time (radical of a negative number). For example, Figure 3 shows besides the discussed case of the poet Cerna, the graph for  $Q=0,5$  and  $P_r=15$ . It describes adequately the case of I. Budai-Deleanu, the author of *Tiganiada*, whose recognition, increased over time, surpassed the power of the Cerna symbol, without ever having an age for resonant reception

### Conclusions

The paper presents two tendencies that affect the process of critical research of myths of identity: the tendency of demythification and the tendency of linking to the myth. In parallel, the approach of science without tendency is considered. All these critical approaches are applied to the

most powerful Romanian myth of identity, that of the national poet.



**Figure 3.** Evolution of the symbolic power in the cases P. Cerna ( $\Delta$ ) and I. Budai-Deleanu (o).

The paper also proposes a mathematical model of the myth of identity as phenomenon of resonant reception. The model has the advantage of allowing comparison of different symbols of identity; it explains the naturalness of some phrases otherwise difficult to accept and the continuous evaluation of symbolic powers.

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# Micro Expressions and Graphology in Education

## A psycho-educational analysis model

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### Abstract

During last years the communication topic between student and teacher become very important. The aim is to make the learner to become aware about him, during the educational program and to adjust teacher behavior to accomplish his mission. The self-knowledge and self-control usefulness of the actors involved in the educational process is visible within a known and controlled training process and within socio-cultural relationships. The teacher competence to attract attention regarding his profession depends on his professional experience. In case when the educational context requires, teacher guides by words the learner about his activity. Nevertheless the guidance by words is not a single tool able to strength the relation of communication and to train the learner. So teacher has to use another ways to facilitate the behavioral self-regulation of his learners. Teachers could use some tools he often ignores them because during his own training these were not presented as fundamental. We observed systematically micro expressions and handwritten texts from a relevant group of subjects having different ages and we analyzed learners and teacher's reactions, and relationships between pupils and teachers. Results of this research demonstrate that learners involved in an educational process can control an optimized communication that improve their relationships and strengths their knowledge and self-knowledge if they are involved in training process in micro-expressions and graphology fields.

Key words: relationships, communication, education, micro expressions, graphology, self-knowledge

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### General considerations

Our interest in writing this article is focused on the education and training field. The strength of this research consists in investigation of the handwritten works of over than 1.000 students (from high school and university level, from rural and urban area) and in observing and evaluating micro expressions of about 150 students during their classroom diverse activities.

We intend to promote graphology and micro expression as tools able to support the

teacher's psycho-pedagogical professional training. The aim of this kind of training is to base the relationships between teachers and students on comfort [1]. We consider this contribution a starting point also for the wider training field in different domains, because the thoroughgoing study of the direct or indirect communication relationships is an opportunity to adjust them and to make them to develop properly.

The ministry of education as a regulatory institution has to follow values able to sustain quality of the teacher training

process in order to improve the social relationships development.

Our faculty is interested in discovering and define those factors involved in improving relationships between educational actors. Research events such workshops (*Expertize in the field of graphology – theory and practice, Emotions evaluation in different contexts* focused on micro expressions organized within The Experimental Applied Psychology National Conference – EAPSI 18-20), master dissertations or doctoral thesis were oriented on this topic during the last year. The satisfaction feedback received from the participants determined the association of the two evaluation tools in a single article – openness through knowledge and self-knowledge.

The **time** concept is the linkage between handwritten and micro expressions. This concept is conceived from the point of view of:

- Immediately expressing of thoughts, knowledge, emotions;
- Storing data that will be expressed after a long or a short term and will generate emotions.

The human writing (hand written especially) is adjusted during the writing process itself or during the reading process by:

- The reception time of the message by a subject (receiver);
- The emotions determined by the message received – inside, invisible, perceived only by the subject himself or outside, visible for the others;
- The brain activity through the iconic memory (100 milliseconds), echoic memory (200 milliseconds), and facial mimic (1/25-1/15 from a second).

The iconic memory let’s to be expressed the letter shape that corresponds in echoic memory to its harmonic vibration of the sound stored in brain [2]. On the other side emotions determine the handwriting pressure, direction, size, space between letters or rows, etc.

The handwriting shape and size of the letters relive the vibrational charge of the sound corresponding to a phoneme, its translation from the abstract to the concrete state through the semantic dimension. The space between letters offers the opportunity to the graphologist to know the handwriting message author and to correlate its meanings with micro expressions generated during the writing process.

The depth study of these tools transferred in to the teaching practices could improve learning results of the students, especially during compulsory education. Also through reading human being receives information about his own emotions being affected by them [3].

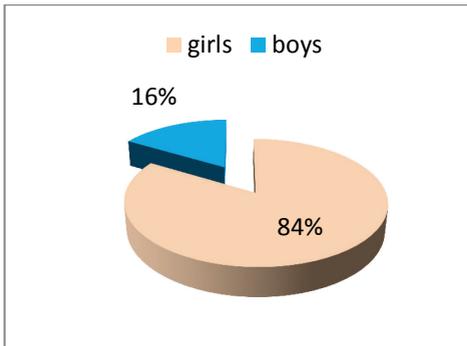
The following question requires an answer: *Why the written tests (during the current learning activities in the classroom or during the national examinations) should be holograph?*

**Investigation description**

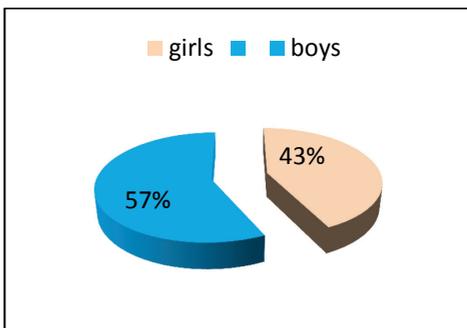
The target group consists in subjects from urban area (94,49%) and rural area (5,51%), age between 15-45 years old, having a distribution described in Table 1 and figures 1, 2, and 3.

**Table 1.** Subjects tested photographically, filmed, with polygraph, and biofeedback

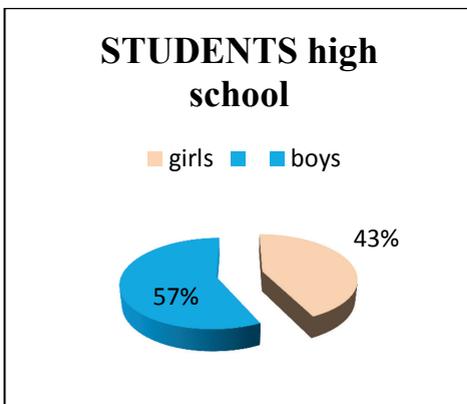
		Girls	Boys
Students from university	960	825 (85,93%)	135 (14,06%)
Students from high school	56	2 (42,86%)	32 (57,14 %)
Total by categories		849 (83,56%)	167 (16,44 %)
Total		1016	



**Figure 1.** Total number of participants (1016) distributed by gender



**Figure 2.** Total number of participants from university (960) distributed by gender



**Figure 3.** Total number from high school (56) distributed by gender

It is necessary to explain that all subjects participated in graphological evaluation, and for the next steps they were distributed

for: polygraph – 50%, biofeedback – 30%, filmed – 10%, photography – 10%.

Initially we separated the investigation stage into: a) graphology stage, b) micro expressions stage, c) the combination of a) and b).

Regarding the graphology, we followed the next steps:

a.1. Firstly, a group of students were required to write from dictation on A4 sheets a cheerful text, with a high speed. Even if the text was known by students, they skipped some words because of the high speed. The aim was to not allow a careful writing.

a.2. Secondly, another group of students was required to write from dictation a sad text, maintaining the context.

a.3. The third group of students was required to write from dictation a neutral text, maintaining the context.

At the end the tests were collected. Immediately subjects passed to solve exercises focused on micro expressions. The aim was to make subjects familiar with each features type of emotion perceived or expressed.

A supplementary step was to require a student to read one text written from dictation reacting contrary to the text content and maintaining his face to his colleagues.

All the observers noticed such incoherence, a controlled movement determined by the effort of changing the authentic fillings. It was possible to measure the difference between the duration of the thinking process and the duration of the expression. This difference is corresponding with the distance between letters, words and rows from a handwritten text. This is the necessary period of time to pass from abstract to concrete.

Additionally, during a different moment of the investigation another student

participating in the graphology evaluation was required to write down in his own pace:

- The same text written with high speed,
- The modified version of the initial text – from the cheerful text into a sad one, from a passive text into an active one.

Another student was required to identify the initial (original) text. Even if the original text was known by all the students, our intention was to reveal the incoherencies in the modified text.

### Conclusions

These measurements demonstrate that high performances in learning results are possible gradually and observable during the learning process. For teachers as practitioners the learning progress is possible using also biofeedback. If the subject writes a text generated by his prior learning during the polygraph and biofeedback evaluation this demonstrates logical coherence of the content and also of the written aspect. Using the biofeedback in testing emotional reactions added new information about the new tested subject ideas – from the depth knowledge or from improvisation.

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# Adaptive Coding in Visual Cortical Circuits

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**Abstract:** Understanding the rules by which brain networks represent incoming stimuli in population activity to influence the accuracy of behavioral responses remains one of the deepest mysteries in neuroscience. We have embarked on a set of projects to investigate the real-time operation of multiple neuronal networks and their capacity to undergo adaptive changes and plasticity. What are the fundamental units of network computation and the principles that govern their relationship with behavior? By employing state-of-the-art electrophysiological techniques we were able to record from large pools of cells in the non-human primate brain while animals performed a fixation task. We found that spatio-temporal correlations between neurons could act as an active ‘switch’ to control network performance in real time by modulating the communication between neurons. We believe that ‘cracking’ the mysteries of the population code will offer unique insight into a network-based mechanistic explanation of behavior and new therapeutic solutions to cure brain dysfunction.

## 1. Introduction

A fundamental feature of cortical neurons is their ability to rapidly adapt to changes in incoming stimuli. Several lines of evidence indicate that cortical neurons dynamically change their responses and selectivity to match the changes in the statistics of the input stimuli. Whereas our understanding of information processing at the single neuron level has substantially improved over the past three decades, how populations of brain cells encode information remains largely unknown. In particular, understanding how adaptation changes information processing by individual neurons and networks is essential for understanding the relationship between efficient sensory coding and behavior. We have recently performed neurophysiological investigations to examine how rapid adaptation at the time scale of visual fixation impacts information processing in networks of brain cells.

## 2. Background

### 2.1. Rapid adaptation

Adaptation is a ubiquitous phenomenon in sensory processing. The time-scale of adaptation can range from hundreds of milliseconds to several days. In normal visual processing, adaptation occurs along many stimulus dimensions such as luminance, contrast, orientation, spatial frequency, direction of motion, color, and curvature and shape. In the orientation domain, adaptation has been shown to influence the signaling capabilities of neurons in primary visual cortex (V1). For example, adaptation to an oriented grating induces a repulsive shift in the preferred of individual V1 neurons and changes orientation selectivity when the adapting grating is similar to the cell's optimal orientation [1,2].

Examining rapid adaptation in visual cortex is important for understanding how individual neurons and local circuits change their coding properties in real-time.

An important perceptual effect of adaptation is the change in orientation discrimination performance. Both perceptual studies and physiological recordings in V1 have demonstrated that adaptation improves the capacity of neurons to signal small differences between stimuli such that orientation discrimination is improved [1,3,4]. However, it remains unclear whether and how adaptation influences the information encoded in population activity.

## 2.2. Cortical layers

A fundamental issue in our understanding of brain circuits is how networks in different layers of the cerebral cortex encode information. Cortical layers are ubiquitous structures throughout neocortex [5,6] that consist of highly recurrent local networks that communicate among each other to possibly influence the information encoded in population activity. In recent years, significant progress has been made in our understanding of the differences in response properties of neurons across cortical layers [7,8], yet there is still a great deal to learn about whether and how neuronal populations encode information in a layer-specific manner.

## 2.3. Neural synchronization

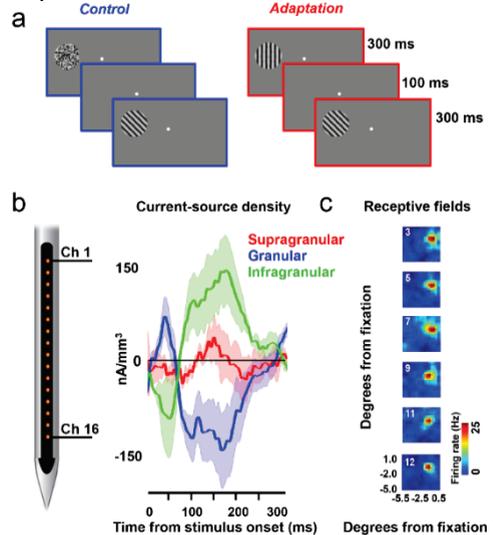
It has been proposed that one way in which networks of cells can efficiently process information about incoming stimuli is through synchronization between the spiking activity of individual neurons and local population activity (measured as local field potentials, LFPs). In visual cortex, it has been found that neuronal groups exhibit strong responses in the gamma-band frequency (30-80 Hz) [9,10,11], and that single neurons synchronize their responses with the local population activity [12].

Synchronization in visual cortex, particularly in the gamma-band, has been found to be critically involved in sensory processing [9,11,13], grouping [9,11], attention [10,14,15], working memory [16], and behavioral reaction times [15].

## 3. Experimental methods

### 3.1. Identification of cortical layers.

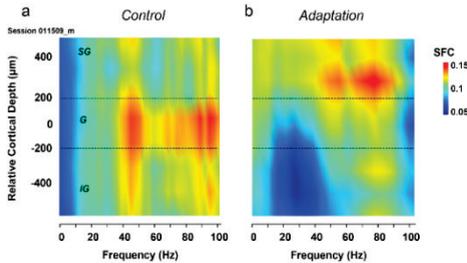
To identify cortical layers, we measured the evoked response potentials (ERPs) of LFPs across equally-spaced contacts (Fig. 1b left, inter-contact distance = 100  $\mu\text{m}$ ) in response to a full-field flashed stimulus.



**Fig. 1.** Rapid adaptation across cortical layers in V1. (a) Schematic description of the orientation adaptation protocol. (b) Multi-contact laminar electrodes were used to record neuronal activity across cortical depth (left). Current-source density analysis (based on the 2nd spatial derivate of the LFP time-series) was used to identify the polarity inversion accompanied by the sink-source configuration at the base of the granular layer. The CSD traces represent the average of those contacts assigned to a given layer. (c) Receptive fields across contacts were mapped using oriented stimuli presented in random patches. Firing rates for each neuron are calculated independently at 5 ms intervals and the maximum firing rates (shown as red) were used to computed the centroid for each time delay.

We then performed current-source density (CSD; Fig. 1b right) analysis of the LFP time-series to identify the polarity inversion accompanied by the sink-source configuration at the base of layer 4 (the sink is inside layer 4, subsequently referred

to as the granular layer [5,6,7,8,17]. We observed that cells recorded on laminar probes had highly overlapping receptive fields (Fig. 1c) and highly similar preferred orientations (PO) (e.g., the difference in PO for over 58% of the pairs of neurons was within 0°–10° range,  $p < 0.01$ , Wilcoxon signed-rank test).



**Fig. 2.** Example of synchronization, measured as spike-field coherence (SFC) as a function of frequency, across cortical layers during control (left) and adaptation (right). During the presentation of the control stimuli there is an increase in gamma activity in the granular (G) layer. Adaptation increases SFC specifically in the supragranular (SG) layer.

**3.2. Measures of synchronization.** We used multi-taper spectral analysis to compute spike-field coherence (SFC), which measures the degree of synchronization between individual neurons and local population activity (LFPs) for each specific frequency band. In general, the coherence between two signals ( $x$  and  $y$ ) recorded at different sites is a complex quantity whose magnitude is a measure of the phase synchrony for frequency  $f$ . Coherence is an absolute value that varies between 0 and 1 (e.g., a value of 1 indicates a perfect phase relationship between the firing of the spikes to the fluctuations of the LFP). Coherence is defined as:

$$C_{xy}(f) = S_{yx}(f) / (S_{xx}(f)S_{yy}(f))^{0.5}$$

where  $S_{xx}(f)$  and  $S_{yy}(f)$  represent the auto-spectra and  $S_{yx}$  the cross-spectrum of the two signals  $x$  and  $y$ .

**3.3. Neuronal correlations.**

Multiple single-unit recordings were performed from V1 of two fixating monkeys (*Macaca mulatta*). Stimuli were presented such as to cover the center of the neurons’ receptive fields. In control trials, movie strips were presented for ~1.86 s (16 orientations x 7 repeats at 60 Hz; random spatial phase). In adaptation trials, movies were preceded by a 400-m grating of fixed orientation. The Pearson correlation coefficient of spike counts,  $R_{sc}$ , of two cells is defined as:

$$R_{sc} = \frac{\sum_{i=1}^N (r_1^i - \bar{r}_1) \cdot (r_2^i - \bar{r}_2)}{\sigma_1 \cdot \sigma_2}$$

where  $N$  is the number of trials,  $r_1^i$  is the firing rate of cell ‘1’ in trial ‘i’,  $\bar{r}$  is the mean firing rate averaged across the trials, and  $\sigma$  is standard deviation of the responses.

**4. Results**

**4.1. Adaptation increases gamma synchronization**

We used multi-contact laminar electrodes (Plextrode® U-Probe, Plexon Inc.) to record neuronal activity at 20 V1 recording sites, each measured at 16 different depths, while two monkeys performed a rapid adaptation fixation task (Fig. 1a). While animals fixated a white dot at the center of a screen, an adapting stimulus was flashed for 300 ms in the center of the neurons’ receptive field. After 100 ms of blank, a test stimulus of random orientation (8 equally spaced orientations spanning 0–180°) was presented for 300 ms.

The adapting stimulus was either a random dot patch (control condition) or a sine-wave grating with spatial characteristics identical to those of the test stimulus, but fixed in orientation (adaptation condition). In control trials, the presentation of the test stimulus led to pronounced synchronous activity across all cortical layers, with the most significant increase in gamma synchronization in the granular layers (Fig.

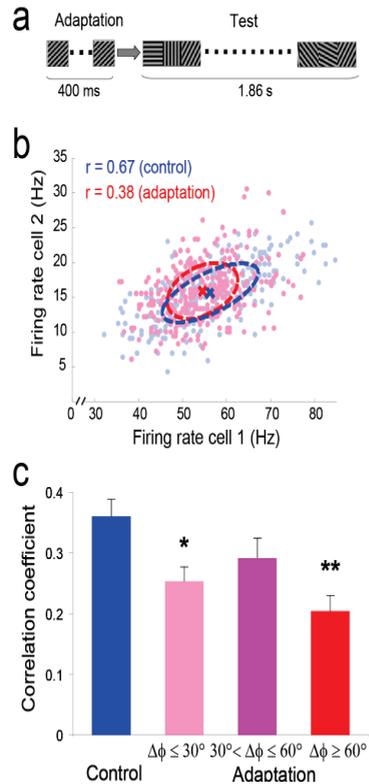
2a). However, after adaptation, there was a significant increase in gamma synchronization specifically in the supragranular layers (Fig. 2b).

#### 4.2. Adaptation reduces neuronal correlations

Responses to dynamic test stimuli in V1 of fixating monkey were recorded before and after brief (400-ms) adaptation to a sine-wave grating of fixed orientation (Fig 3a). We used a movie sequence as test stimulus, in which each frame was a sine-wave grating of pseudorandom orientation flashed at 60 Hz. We measured noise correlations between pairs of nearby neurons ( $n = 423$  pairs).

Fig. 3b shows an example of a pair of cells preferring nearby orientations that exhibit a strong reduction in correlations after adaptation (the pre-adaptation condition is labeled ‘control’). Across the population, we found an overall post-adaptation decrease in the absolute correlation coefficients. Subsequently, we computed network accuracy by estimating Fisher Information (FI) as the upper limit with which any decoding mechanism can extract information about stimulus orientation [18,19]. FI was computed by assuming that adaptation changes (i) only mean correlations, and (ii) both the mean and variability of correlations. Fig. 4a shows that whereas the post-adaptation reduction in mean correlations caused a 25% improvement in the network orientation discriminability threshold, taking into accounts both the changes in the mean and variability of correlations improved the post-adaptation discrimination threshold by 40%.

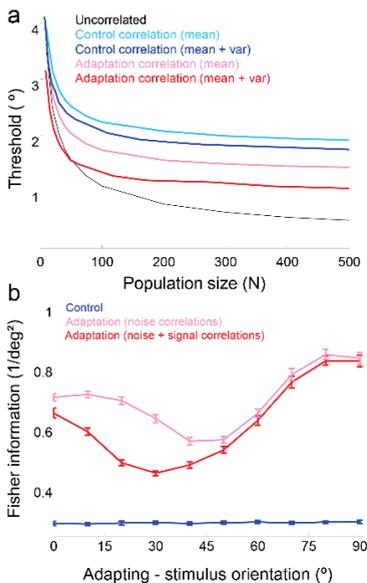
As shown in Fig. 4b, brief adaptation caused an almost four-fold increase in FI when the network discriminated stimuli of similar and largely dissimilar orientation relative to the adapting stimulus, and a three-fold increase in FI for the discrimination of intermediate orientations.



**Fig. 3.** Adaptation-induced response decorrelation in V1. (a) Schematic representation of the stimulus sequence: an adapting stimulus of fixed orientation was presented for 400 ms and was followed by a 60-Hz test stimulus of random orientation presented for 1.86 s. (b) Scatter plot showing the trial-by-trial responses of two cells recorded simultaneously. Each dot represents the firing rates of both cells in a given trial. The dotted ellipses represent the two-dimensional gaussian fits of the firing rate distributions during control and adaptation. (c) The reduction in the mean correlation coefficients after adaptation depends on the adapting orientation. All panels are based on the correlation analysis of  $n = 423$  cell pairs. Error bars represent s.e.m. (\* $P < 0.005$ ; \*\* $P < 0.0005$ ).

### 5. Discussions and future directions

Theoretically, adaptation has been proposed to reduce redundancy in sensory neurons, possibly by decorrelating responses, to improve coding efficiency [20,21]. However, besides the lack of experimental support, theories proposing the decorrelation hypothesis were unable to predict the changes in correlations across the entire network engaged in sensory computations



**Fig. 4.** Rapid adaptation enhances the accuracy of population coding. (a) Light blue/red curves: adaptation changes only the mean correlation coefficients; Dark blue/red curves: adaptation changes both the mean and variability of correlations. (b) The accuracy of population coding (FI) depends on  $\Delta\theta$  and the adapting orientation (fixed at 0°; abscissa represents the test orientation). In control trials, FI is independent on the test orientation. Combining the effects of noise and signal correlations yields a more pronounced U-shape profile of FI.

We provide empirical evidence that adaptation causes both a selective reduction in the strength and variability of correlations and an improvement in

population coding efficiency. These results are consistent with the ‘efficient coding hypothesis’ [22,23], i.e., sensory neurons are adapted to the statistical properties of the stimuli they are exposed to, and with psychophysical changes in human discrimination performance after adaptation. We argue that the visual system employs a metabolically inexpensive solution (selective decorrelation) to adapt neural responses to the statistics of the input stimuli and improve coding efficiency.

For instance, theoretical studies have suggested that temporally decorrelated inputs are transmitted less efficiently than correlated inputs [22]. In addition, our finding that neurons in the supragranular layers exhibit the largest increase in gamma synchronization after adaptation and the highest correlation with the post-adaptation improvement in feature coding has functional implications for models of cortical function. Indeed, neurons in the supragranular layers of V1 provide the only cortical input to downstream visual areas. Intragranular layers also constitute output layers, but they target deep subcortical structures such as the thalamus and superior colliculus. Therefore, neurons in higher-order cortices would benefit most if cells in the supragranular layers would exhibit a large increase in stimulus coding after adaptation.

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# Considerations regarding the necessity of adapting the physical therapy approach to optimize the quality of life of paraplegic persons

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**Abstract:** A pathological manifestation of such a magnitude as the spinal cord injury is undoubtedly one of the most devastating biological disasters for the human being, severity of the disability of paraplegic persons becoming a major goal of rehabilitation services everywhere, this condition requiring significant personal and socio-economic costs. Unfortunately currently there are no medical solutions for restoring damaged spine area, although there are teams of researchers studying the possibility of nerve grafting, stem cells implant or bone marrow electrostimulation devices implant. The conditions are that such therapies will be available in the future. A complex kinetic approach which initially surprises, as detailed and accurate as possible, the whole picture of various morphological, functional and pathological manifestations after spinal cord injury, through an accurate and relevant specific assessment protocol, and which lately acts, using specific methods, towards the restoration of functional balance, can improve the functional development of paraplegic patient, reflected by an increase in the level of physical activity with direct implications for quality of life of these individuals. Let us not forget that the primary goal of rehabilitation is to teach paraplegic persons to help themselves, which means to make those people to fully use their available functionality to compensate for the functions and accept their disability. Paraplegic patient must be aware of the fact that he possesses plenty of helpful resources for him and for those around him and that life can give him enough satisfactions even if his the mode of locomotion is changed.

## Introducere

Starea de bine, sănătatea și completa independență funcțională sunt bunuri de mare preț, pe care, oricât de multă grijă am avea, mai devreme sau mai târziu, mai rapid sau mai lent, treptat sau dintr-o dată, le vom pierde.

O manifestare patologică de o asemenea amploare precum leziunea măduvei spinării constituie, indubitabil, una dintre cele mai devastatoare dezastre biologice pentru ființa umană, severitatea invalidității persoanelor paraplegice devenind astfel un obiectiv major al serviciilor de recuperare de pretutindeni, această afecțiune impunând importante costuri socio-economice și personale.

Fiecare epocă s-a confruntat cu chestiunea morală și politică legată de atitudinea față de persoanele cu dizabilități.

Din păcate istoria a fost chiar tragică pentru aceste persoane, mai ales la începuturile umanității.

Tratarea discriminatorie a persoanelor cu paraplegie are o istorie lungă, începând cu atitudinea manifestată în antichitate în Grecia, Roma sau în societatea evreiască și continuând apoi cu societatea creștină. Secolul XIX a adus importante transformări ale societății, incluzând aici și amploarea înregistrată de conștientizarea socială a problemelor persoanelor cu dizabilități, concretizată prin deschiderea de școli și centre de tratament pentru aceste persoane.

În ultima jumătate de veac a început să fie evidențiată o nouă atitudine din partea societății și implicit a furnizorilor de servicii medicale specializate și anume promovarea independenței funcționale.

Așadar atitudinea față de persoanele cu dizabilități s-a schimbat de-a lungul timpului grație și apariției și dezvoltării unor profesii, printre acestea și a terapiei ocupaționale, care au modificat balanța între atitudinea de ajutorare și cea de represiune și au înlocuit-o acum cu cea de creare de oportunități de dezvoltarea a independenței persoanelor cu dizabilități.

Terapia ocupațională se adresează tuturor persoanelor care din diverse motive medicale prezintă dificultăți de integrare și are ca scop câștigarea potențialului maxim pentru independență și productivitate în viața acestora.

Prin intermediul terapiei ocupaționale persoanele cu dizabilități sunt ajutate să se adapteze mediului în care trăiesc sau să folosească mediul special adaptat pentru nevoile personale, astfel încât aceste persoane să devină capabile să-și desfășoare în continuare viața cu demnitate și autorespect. Obiectivul terapiei ocupaționale, în privința persoanelor cu paraplegie este cel de integrare deplină a acestora, o integrare care vizează toate dimensiunile: fizică, funcțională, socială, personală și socială.

Leziunea măduvei spinării, în funcție de localizarea și intensitatea ei, determină apariția unor tulburări de mișcare și perturbarea funcționalității bolnavului, ambele fiind asociate cu o scădere a calității vieții bolnavului cu paraplegie.

În general, paraplegia are șanse mici de recuperare, cu excepția cazurilor în care întreruperea conducerii nervoase la nivel medular a fost doar funcțională, structurile anatomice rămânând întregre [1].

Din păcate în momentul actual nu există soluții medicale pentru refacerea zonei de măduvă lezate, deși există echipe de cercetători care studiază posibilitatea grefării nervoase, implantul de celule stem

sau implantul de dispozitive electrostimulante la nivelul măduvei. Există premise ca astfel de terapii vor fi posibile în viitor.

În programul de recuperare al pacienților paraplegici reeducarea neuro-motorie reprezintă doar un aspect, problemele medicale ale acestor bolnavi fiind extrem de complexe, aparținând diverselor specialități neuro-chirurgicale, neurologice, urologice, ale terapiei ocupaționale și psihologice.

Acțiunea de recuperare funcțională presupune deci o activitate de echipă în care fiecare specialist trebuie să-și aducă aportul pentru îndeplinirea obiectivelor propuse. [2]

Paraplegicul va primi de obicei suport de la o echipa medicală multidisciplinară ce poate include mai multi medici (neurochirurghi, urologi, chirurghi ortopezi, specialiști în recuperare și pediatrie), un asistent medical specializat în recuperare, specialiști în kinetoterapie și terapie ocupațională și un asistent social. Scopul primordial al reabilitării funcționale în cazul acestor persoane este de a crea un stil de viață pentru pacient și familie astfel ca dizabilitatea să interfereze cât mai puțin cu activitățile zilnice normale

## Discuții

Deși intervențiile de reabilitare funcțională care promovează recuperarea funcțiilor pierdute prin implementarea utilizării tehnicilor compensatorii și a echipamentelor adaptative au fost corelate pozitiv cu îmbunătățirea calității vieții pentru persoanelor paraplegice [3], nivelul calității vieții acestor persoane rămâne cu mult sub nivelul observat la populațiile similare care nu prezintă lezuni la nivelul măduvei spinării [4]. De exemplu, Kannisto și colab. [5], constată în urma unui studiu că persoanele paraplegice au prezentat scoruri ale calității vieții cu aproape 10% mai mici decât cele înregistrate la adulții sănătoși, rezultate similare fiind obținute de asemenea de Post și colab. [6], care au raportat scoruri generale ale calității vieții,

care au fost mai mici decât valorile găsite în populația generală.

Având în vedere aceste constatări, identificarea variabilelor legate de calitatea scăzută a vieții experimentată de către persoanele paraplegice poate fi utilă în modificarea protocoalelor de reabilitare cu scopul de a reduce diferența dintre nivelul calității vieții între persoanele paraplegice și cele fără leziuni medulare.

Deși activitatea fizică crescută îmbunătățește nivelul funcțional după lezionarea măduvei spinării [7], a fost observat un nivel de activitate fizică mai mic la persoanele cu această patologie [8].

Această scădere a activității fizice după lezionarea măduvei spinării poate avea la bază factori psihologici, pierderea funcției motorii, o pregătire fizică deficitară pe parcursul perioadei acute de reabilitare, dar și lipsa unor echipamente de fitness adecvate, a unor săli de de kinetoterapie dotate corespunzător sau lipsa unor programe de exerciții orientate înspre promovarea activității fizice, prin urmare, un stil de viață activ nu poate să apară în mod spontan după lezionarea măduvei spinării, iar pacienții raportează că programele de reabilitare urmate de ei, nu duc întotdeauna la o creștere a activității fizice [9].

În schimb, atunci când o stimulare adecvată este realizată prin activitatea fizică, a fost observată o recuperare mai bună a funcționalității [10,11,12], ceea ce indică faptul că ar putea exista o relație directă între activitatea fizică și calitatea vieții la persoanele cu leziuni medulare [13].

Rezultatele cercetărilor științifice și experiența practică au demonstrat importanța practicării exercițiului fizic, în general, și sportului, în special, pentru persoanele cu dizabilități, ceea ce conduce la ideea că statul și societatea trebuie să acorde o mai mare importanță rolului sportului în politica sa socială și în strategia privitoare la protecția persoanelor cu dizabilități.

## Concluzii

O abordare kinetică complexă care, inițial, să surprindă cât mai amănunțit și exact manifestările variate ale tabloului morfo-pato-funcțional în urma lezionării măduvei spinării prin intermediul unei evaluări specifice, corecte și competente, și care, ulterior, să acționeze cu mijloace specifice în vederea reechilibrării funcționale, poate îmbunătăți evoluția pacientului paraplegic, materializată printr-o creștere a gradului de activitate fizică cu implicații directe asupra nivelului calității vieții acestor persoane.

Absența unui mediu fizic complet accesibilizat și neimplicarea suficientă a societății civile în sprijinirea cauzelor persoanelor cu dizabilități, favorizează eșecul în integrarea socială ceea ce atrage după sine apariția la aceste persoane a sentimentelor de inutilitate, frustrare, neputință, marginalizare.

Să nu uităm că scopul kinetoterapiei și/sau al terapiei ocupaționale este *de a învăța paraplegicul să se ajute singur*, ceea ce înseamnă a-l face să-și utilizeze la maxim restantul funcțional de care dispune pentru a compensa partea paralizată și să-și accepte disabilitatea. Pacientul paraplegic trebuie conștientizat cu privire la faptul că are încă multe resurse de a fi util lui și celor din jur și că viața poate să-i ofere destule satisfacții și în aceste condiții în care modalitatea de deplasare i se modifică.

Cu toate că omenirea a cunoscut un progres enorm până în prezent, conform Organizației Mondiale a Sănătății (OMS), persoanele cu dizabilități sunt printre grupurile cele mai marginalizate din lume, au o stare de sănătate mai precară, realizări mai modeste în domeniul educației, participă mai puțin la viața economică și au o rată a sărăciei mai ridicată decât persoanele fără dizabilități. Dizabilitatea este acum considerată ca fiind o problemă a drepturilor omului, dizabilitatea oamenilor datorându-se și societății, nu doar modificărilor organismului. [14]

Societatea a parcurs un lung drum în ceea ce privește atitudinea față de persoanele cu dizabilități. Studiarea trecutului ne oferă oportunitatea reflectării asupra ceea ce dorim să dezvoltăm în viitor: o atitudine deschisă, constructivă, de acceptare necondiționată față de aceste persoane, o societate în care se oferă fiecărei persoane șansa unei existențe decente.

Aceste bariere pot fi depășite numai printr-o conlucrare organizată a guvernelor, a organizațiilor non-guvernamentale, a profesioniștilor din domeniul reabilitării funcționale și a persoanelor cu dizabilități împreună cu familiile sau aparținătorii acestora.

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# Cardiovascular Mortality: An overview of Premature Death in the Republic of Moldova

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**Abstract:** YPLL health outcome indicator (Years Potential Life Lost) proposed in the Global Burden of Disease 1990 study [1] to estimate the burden of disease in a population, shifts the emphasis from more familiar health measure of occurrence of death to quantify the burden of loss. YPLL allows selectively evaluate the mortality in younger age groups. The purpose of research is to estimate the impact of premature death caused by major contribution cardiovascular diseases in the Republic of Moldova. This research is a population descriptive study. The study estimated that the population of working age (up to 62 years) in Moldova lays 70% of the major contribution cardiovascular diseases YPLL average (y.2008-2012). Systematic evaluation of YPLL health outcome indicator leads to increase priority on community interventions and evidence-based planning of cardiovascular risk management in the Republic of Moldova.

**Keywords:** Cardiovascular disease, premature death, YPLL, cardiovascular risk management planning

## Introduction

Cardiovascular diseases are known worldwide as the „top killer of the 21st century”, having a mortality level higher than all combined cancer diseases. World Health Organizations’ (WHO) data show that cardiovascular diseases is the highest mortality cause in the last decade (31% of total disease cases in 2010 year) [2].

Cardiovascular mortality rate in Republic of Moldova exceeds the global average value by two times for at least a decade by now [3].

WHO prognosis for the upcoming 2020 and 2030 years aren’t so bright, the number of mortality cases will reach up to 20 million cases in year 2020 and 24 million in year 2030. WHO calculated that cardiovascular diseases, hearts attacks and diabetes annually reduce a countries’ GDP by 1-5% [4].

According to WHO strategies, premature mortalities caused by non-communicable chronic diseases can be reduced by 25% until year 2025, by achieving this goal we

will have a simultaneous reduction of premature cardiovascular mortality by correcting behavioral risk factors among the population [5]. While international statistics are using potential health outcome indicators like YPLL and DALY, which were proposed by the WHO for assessment of disease burden, in Republic of Moldova systematic assessment of populations’ health status is calculated, most times, by analyzing crude mortality that are centered on each occurrence, rather than the caused losses.

## Study Design

### The aim of the study

Evaluation of mortality impact caused by cardiovascular diseases in Republic of Moldova. The evaluation is based on the burden of loss caused by premature decease to improve cardiovascular risk management planning.

## Material and Methods

In order to achieve the aim was applied a descriptive method of investigation using

the data provided by the World Health Organization (2010-2014) and National Center of Health Management from the Republic of Moldova (2014) [6].

Research design covered three classic directions of descriptive study investigation: 1 - by time, 2 - by place and 3 - by personal characteristics. Data analysis by time included the period 2008-2012, depending on place - the Republic of Moldova, rural and urban areas and depending on the person - by sex and age.

Years of Potential Life Lost (YPLL) was calculated using the equation (1):

$$YPLL = \sum_{i=1}^{11} (70 - a_i) \times d_i \quad (1)$$

YPLL – years of potential life lost  
*i* – number of groups of quinquennial age;  
 70 – superior limit of age that is considered a premature decease;  
*a<sub>i</sub>* – age class center;  
*d<sub>i</sub>* – number of deceases in each age group.

**Results**

Populations’ statistical indicator of mortality is considered to be among the most important ones that influences life expectancy and is an undesirable outcome of morbidity and disability, also including quality of life.

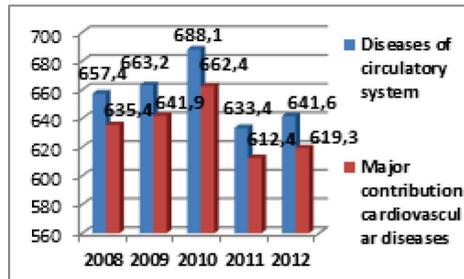
**Major contribution cardiovascular diseases for mortality**

Mortality by circulatory diseases among the adult population of Republic of Moldova in the period 2008-2012 year and by cardiovascular diseases of major contribution for the same period demonstrated a decrease from 657,4 (y. 2008) to 641,6 (y. 2012) per 100,000 population and 635,4 (y. 2008) to 619,3 (y. 2012) per 100,000, respectively.

With this, it is important to mention the unstable character of the decreasing trend represented above. Therefore, for years 2008-2010 took place an increasing of the mortality level of circulatory diseases from 657,4 (y. 2008) to 663,2 (y. 2009) followed by a frequency hop with a level of 688,1 for

each 100,000 population (y. 2010). Subsequently was produced a rapid decrease in year 2011, reaching a level of 633,4 per 100,000, which was again followed by an increase up to 641,6 per 100,000 population.

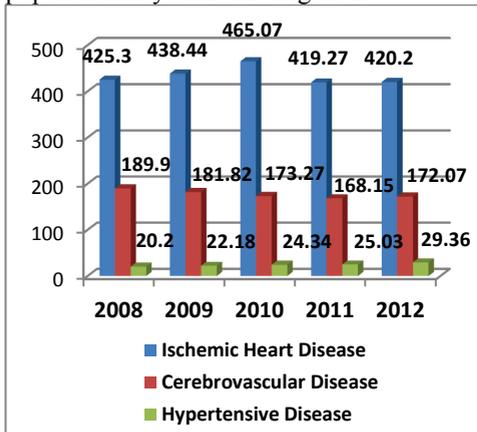
Mortality rate by major contribution cardiovascular diseases for years 2008-2010 demonstrated a value increase from 635,4 (y. 2008) to 641,9 (y. 2009) followed by a frequency hop of 662,4 per 100,000 population for year 2010. Subsequently was produced a decrease in year 2011, down to 612,4 per 100,000 population, which was again followed by an increase up to 619,3 per 100,000. Therefore, major contribution cardiovascular diseases for mortality in sum manifested the same logistic of changes described in the circulatory diseases case.



**Figure 1.** Mortality rates by circulatory system diseases and major contribution cardiovascular diseases, Republic of Moldova, 2008-2012 (per 100,000).

Analysis of major contribution cardiovascular diseases in dependence of clinical form (ischemic heart disease, cerebrovascular disease and hypertensive disease) showed that only ischemic heart disease is maintained the stated tendency. Therefore, for years 2008-2010 was seen an increase of mortality rate by ischemic heart disease from 425,3 (y. 2008) to 438,8 (y. 2009) followed by a frequency hop of 465,07 per 100,000 population for year 2010. Subsequently was produced a remarkable decrease in year 2011, reaching a level of 419,27 per 100,000 population, which was again followed by a small increase up to 420,2 per 100,000 population. In cerebrovascular disease case

for years 2008-2012 was not seen a significant frequency hop, manifesting in this way a much more stable decrease tendency than major contribution cardiovascular diseases and ischemic heart disease. In this context, rate for cerebrovascular disease for years 2008-2011 manifested a stable decrease from 189,9 (y.2008) down to 168,15 (y.2011) per 100,000 population, followed by a modest increase up to 172,07 per 100,000 population in year 2012 “Figure 2”.



**Figure 2.** Mortality rates by major contribution cardiovascular diseases, Republic of Moldova, 2008-2012 (per 100,000).

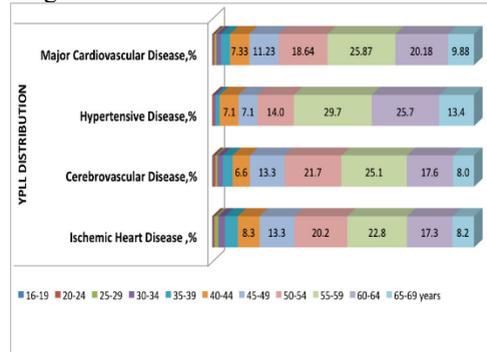
At the same time, for the same research period hypertensive disease manifested a continuous trend of value increase from 20,2 to 29,36 per 100,000 population.

**Aspects of premature death by major cardiovascular diseases**

In the distribution of the phenomenon due to premature deceases, cause by major contribution cardiovascular diseases in dependence of groups of quinquennial age, was determined that the greatest proportion had age group 55-59 years (25,87%), followed by age 60-64 years (20,18%) and 50-54 years (18,64%). It is important to note that all three groups represent period of working age (economically active population). Additionally, in 18,56% of total years of potential life lost because of major cardiovascular diseases are assigned

to the age groups that cover a period of 40-50 years and groups of a younger age (less than 40 years) in 6.87% of cases.

Unlike major cardiovascular diseases and hypertensive disease, premature decease phenomenon distribution, caused by ischemic heart disease and cerebrovascular disease, showed an inclination towards younger aged groups “Figure 3”.



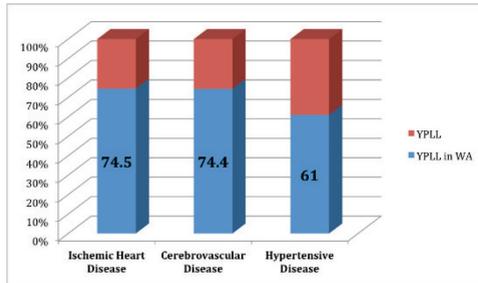
**Figure 3.** Years of Potential Life Lost distribution under the age of 70, Republic of Moldova, 2008-2012 (%).

Therefore, in cerebrovascular diseases’ distribution the highest determined value presented age group of 55-59 years (25,1 %), followed by age 50-54 years (21,7%) and afterwards by age 60-64 years (17,6%). Age group of 40-50 years demonstrated 19,9 % and younger groups (< 40 years) of 7,7 % from the total years of potential life lost due to hypertensive disease.

Ischemic heart disease shows the highest value of premature decease in age groups 55-59 years (22,8%), followed by age group 50-54 years (20,2%) and afterwards by age group 60-64 years (17,3%). Age group of 40-50 years showed a percentage of 21,6 % and younger age groups (< 40 years) of 9,9 % from the total years of potential life lost due to ischemic heart disease „Figure 3”.

In the context, involvement in avoidable decease phenomenon due to major cardiovascular diseases among population of working age, effectuated analysis in the current study has estimated high values for economically active population.

Therefore, estimated percentage of premature decrease among working age population caused by ischemic heart disease is 74,5%, cerebrovascular disease - 74,4% and hypertensive disease - 61% from the total years of potential life lost between the period 2008-2012 “Figure 4”.



**Figure 4.** Proportion of Years of Potential Life Lost in working age (YPLL in WA) by major contribution cardiovascular disease population under the age of 70, Republic of Moldova, 2008-2012 (%).

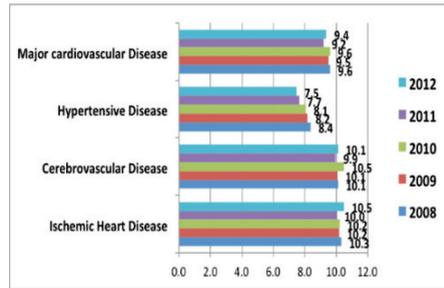
Evaluation of disease burden focused on losses produced by death demonstrated that in the period 2008-2012 was estimated an increase from 10.3 up to 10.5 of YPLL number average for a death caused by ischemic heart disease “Figure 5”.

Therefore, achieving a general tendency of mortality level decrease due to ischemic heart disease among working age adult population was produced predominantly at the expense of advanced age groups.

The analysis of the average YPLL number for each occurred death due to cerebrovascular disease showed that in this case the tendency of decrease mentioned above for the period 2008-2012 was produced predominantly at the expense of advanced age groups, demonstrating an average YPLL of: 10.1; 10.1; 10.5; 9.9; 10.1 for a occurred death “Figure 5”.

Increased level of mortality due to hypertensive disease among working age adult population between the periods of 2008-2012 was predominantly at the expense of age groups higher than 60 years (from 17.5 up to 32.1 per 100,000 population). Decrease of the average YPLL

from 8.4 down to 7.5 for each occurred death due to hypertensive disease in the period of 2008-2012 demonstrates the same situation; tendency of decrease for the period 2008-2012 was produced predominantly at the expense of advanced age groups “Figure 5”.



**Figure 5.** Years of Potential Life Lost distribution for one death under the age of 70, Republic of Moldova, 2008-2012 (%).

### Discusions

The different approaches of YPLL measure (versus crude mortality) incorporating age at death can serve as an index of the social and economic consequence of mortality.

Using YPLL statistics in addition to more familiar crude mortality rates shifts the emphasis from occurrence of deaths to losses caused by premature mortality.

Unlike major cardiovascular diseases and hypertensive disease, the structure of premature decease phenomenon, caused by ischemic heart disease and cerebrovascular disease, estimated an inclination to the younger age groups.

Average proportion of years of potential life lost in working age (YPLL in WA) due to major cardiovascular diseases among the population under 70 years in Republic of Moldova between 2008-2012 was 70 % (respectively, ischemic heart disease – 74.5%, cerebrovascular disease – 74,4%, hypertensive disease – 61%). Mortality causes calculated using YPLL statistics differ from those obtained through other methods: reflects the cause of mortality, which influences economically active

young population and determines the biggest economic losses.

Average number of YPLL for each occurred death due to hypertensive disease demonstrated a stable decrease in the investigation period from 8,4 YPLL in year 2008 down to 7,5 YPLL in year 2012, which indicates a stable inclination towards superior age groups (YPLL influence is less).

While, cerebrovascular disease shown a set YPLL value of 10,1 in the period 2008-2012, which indicates a persistence of premature disease phenomenon among younger population (maintaining the same quality characteristics of age).

Ischemic heart disease shown values that represent an area with low increase tendency from 10,3 YPLL for each produced death in 2008 and 10,5 YPLL for each produced death in 2012. This indicates an inclination towards age groups with a more important YPLL contribution – younger.

Years of Potential Life Lost represents a quantitative indicator of premature mortality, reflects mortalities tendencies of young age groups by not only considering deaths' medical causes but also age groups' (age when death occurred).

Obtained results showed that using statistical data focused on loss (YPLL) and not on occurrence of phenomenon allows to determine disadvantage population groups, intervention priorities for health services, better identification of disadvantaged population groups, determining the most optimal criteria for health resources allocation, determining priorities for health research.

Premature deaths can be avoided if community action and prevention measures would be applied correctly and on time. Generally, a higher importance is shown towards medical care and less to the preventive aspect, forgetting the idea that an efficient prophylaxis can substantially reduce premature mortality and can add a

substantial number to years of life expectancy.

## Conclusions

1. Ensuring a systematic monitoring and evaluation of health status using potential statistical indicators (YPLL) in the Republic of Moldova will contribute in prioritization in age group and individual interventions.

2. By using YPLL for systematic elaboration of complex indicators, which at the same time will take into account phenomenon of premature mortality intensity and non-fatal consequences of causes of illness – disability adjusted life years (DALY), will contribute qualitatively in evaluation of cardiovascular disease burden and risk management efficiency in the Republic of Moldova.

3. Systematic evaluation of potential statistical indicators (YPLL, DALY) will ensure an additional insurance when making decisions based on the evidence of cardiovascular risk management in the Republic of Moldova.

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# ***In Silico* Evaluation of Radiobiological Hypoxia And Its Effect on Tumour Control During Radiotherapy**

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**Abstract:** Modelling in cancer research is a useful tool that can assist in the understanding of tumour growth and treatment response, while also elucidating correlations between various parameters and their interplay that can affect treatment outcome. The aim of the current work was to simulate the growth of a hypoxic head and neck tumour and to treat it with radiotherapy. Tumour hypoxia is one of the main culprits for treatment failure due to the high radioresistance exhibited by the poorly oxygenated cells. The impact of tumour hypoxia on the treatment outcome has been evaluated for the following scenarios: (1) oxygenated versus hypoxic tumour response to radiotherapy; (2) conventional versus hyperfractionated radiotherapy; (3) exponential versus Gaussian distribution of the partial oxygen tension within the hypoxic fraction, and (4) the effect of various hypoxic fractions within the tumour on treatment outcome. The model has shown that hypoxia-related parameters have a strong influence on the tumour's response to irradiation. The results indicate a strong need for pre-treatment quantification of the tumour's hypoxic fraction and its distribution within the tumour in order to assess the effect of hypoxia on treatment outcome and to personalise the treatment for a high therapeutic ratio.

## **Introduction**

Tumour control in radiotherapy is achieved by targeting those cell categories that are able to repopulate the tumour from surviving cells. These cells usually exhibit higher radioresistance due to various factors such as: hypoxia, stem-like properties or intrinsic radioresistance.

Several clinical studies are looking into possible ways to overcome tumour recurrence in aggressive cancers, however with limited success. While clinical trials are important prerequisites in establishing novel treatment techniques and schedules, they also have several shortcomings. Trials are lengthy processes that involve several determining factors for their success, and often the clinical outcome involves unexpected side effects. Perhaps one of the most important downsides is the impossibility to forecast the outcome with certainty.

*In silico* or computational modelling has lately become an important tool in medical sciences that is able to offer predictive assessments of complex processes that dictate radiotherapy outcome. The non-invasive approach and the possibility for quantitative treatment optimisation using *in silico* simulations confer this tool an important position among traditional methods of treatment evaluation.

One of the main factors responsible for treatment failure in radiotherapy is the hypoxic content of the tumour population that leads to radioresistance. Oxygen is regarded as the most effective sensitizer during radiotherapy. When ionizing radiation interacts with the tissue, free radicals are produced as a result of ionization. In the presence of oxygen the hydroxyl radical produced by water radiolysis is oxidized and creates an unrepairable lesion to the DNA strand. On the other hand, during hypoxia the free

radicals are commonly reduced by sulfhydryl compounds thus the DNA damage is either scarce or easily repaired. Clinical hypoxia is quantified via the partial oxygen tension ( $pO_2$ ), which was shown to have very low values for hypoxic tumours (below 10 mmHg).

Due to tumour heterogeneity and wide variations in the hypoxic content among patients, patients enrolled in clinical trials should undergo a thorough selection for the outcome to be clinically significant and reliable. Modelling the variation of hypoxia and the interplay with other kinetic factors related to tumour development offers an easier way to simulate different scenarios and to evaluate the impact of each individual parameter on treatment outcome.

The aim of the present work was to develop a virtual tumour having biologically valid parameters and to assess the tumour's response to radiotherapy as a function of kinetic parameters and radiobiological hypoxia.

## Methods

Given that tumours originating from different tissues present with different kinetics and dynamics, the current model has focused on one tumour group, namely head and neck cancers that originate from the squamous epithelium.

The virtual tumour growth follows the evolution of a biologically realistic head and neck cancer, by encompassing all those kinetic parameters that are responsible for tumour development: cell lineage (cell types), percentages of various cell types, cell cycle length/duration, apoptotic cell death, and volume doubling time [1]. The major cell types that are incorporated in the tumour are:

- Tumour initiating stem cells with unlimited proliferating ability
- Differentiated cells with limited proliferative ability
- Quiescent cells, without the ability to proliferate (unless a stimulus, such as irradiation, triggers them

from the quiescent state into the cell cycle).

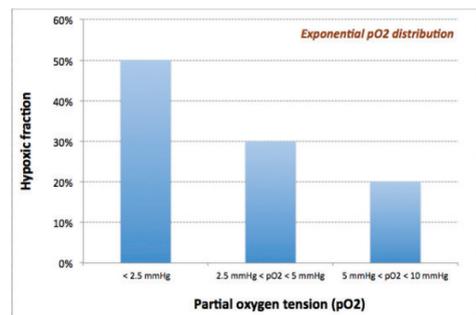
Hypoxia is an important parameter that has been employed by the current model. The hypoxic fraction varies from 10% to 50% of the tumour population and is classified into three categories: mild hypoxia (i.e.  $5 \text{ mmHg} < pO_2 < 10 \text{ mmHg}$ ), moderate hypoxia ( $2.5 \text{ mmHg} < pO_2 < 5 \text{ mmHg}$ ) and severe hypoxia ( $pO_2 < 2.5 \text{ mmHg}$ ). Two distributions of  $pO_2$  values have been modeled (see figures 1 and 2).

The effect of fractionated radiotherapy has been modeled using the Linear Quadratic formalism of cell survival:

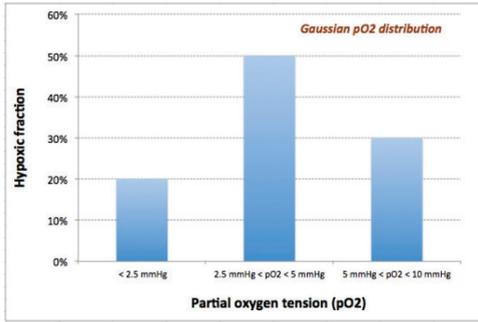
$$S = \exp[-(\alpha D + \beta D^2)] \quad (1)$$

where  $S$  represents the surviving cells,  $D$  is the overall radiation dose and the  $\alpha$  and  $\beta$  parameters are tumour specific parameters that characterize radiosensitivity. Based on the scientific literature for head and neck cancer, a surviving fraction after a radiation dose of 2 Gy ( $SF_2$ ) of 54% has been implemented [3].

Using the linear quadratic relationship of cell survival (1) and considering the value for the  $\alpha/\beta = 8$  [3] surviving fractions for altered fractionation radiotherapy (i.e. less than 2 Gy dose per fraction) have been determined and implemented in the model.



**Figure 1.** Exponential distribution of hypoxic fraction in the virtual tumour.



**Figure 2.** Gaussian distribution of hypoxic fraction in the virtual tumour.

Using the linear quadratic relationship of cell survival (1) and considering the value for the  $\alpha/\beta = 8$  [3] surviving fractions for altered fractionation radiotherapy (i.e. less than 2 Gy dose per fraction) have been determined and implemented in the model.

The impact of tumour hypoxia on the treatment outcome has been evaluated for the following scenarios:

- (1) Oxygenated versus hypoxic tumour response to radiotherapy;
- (2) Conventional versus hyperfractionated radiotherapy;
- (3) Exponential distribution of pO<sub>2</sub> versus Gaussian distribution, and
- (4) The effect of various hypoxic fractions (10%-30%-50%) on tumour control.

**Results**

Based on the parameters described in the Methods section, the following results have been obtained:

**Oxygenation status**

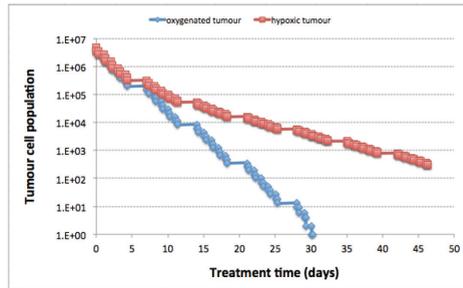
The fact that the best radiosensitising agent is oxygen is illustrated in figure 3, where the same hyperfractionated radiotherapy schedule has been simulated on a hypoxic tumour (10% hypoxic fraction) and on an oxygenated tumour, respectively.

While the oxygenated tumour can be controlled by radiotherapy, hypoxia is shown to dictate radioresistance.

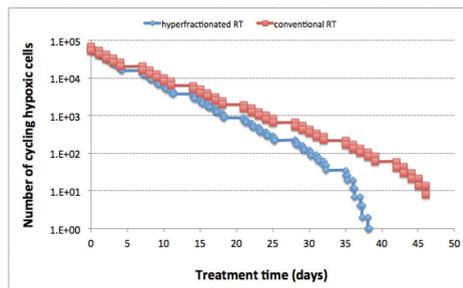
**Radiotherapy schedule**

The virtual tumour has been treated with both conventional radiotherapy (2 Gy a day,

5 days a week over 7 weeks) and hyperfractionated radiotherapy (1.2 Gy twice daily, 5 days a week, over 7 weeks). The cell survival curves represented by the active hypoxic cell population (figure 4) show that the hypoxic tumour cannot be controlled with conventional fractionation, as there is still a significant percent of active hypoxic cells that survived irradiation.



**Figure 3.** Simulation of oxygenated versus hypoxic tumour response to radiotherapy

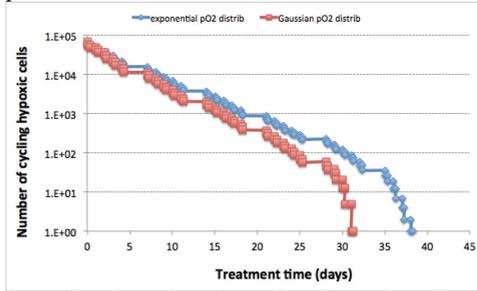


**Figure 4.** Simulation of conventional and hyperfractionated radiotherapy on a virtual head and neck tumour with hypoxic fraction.

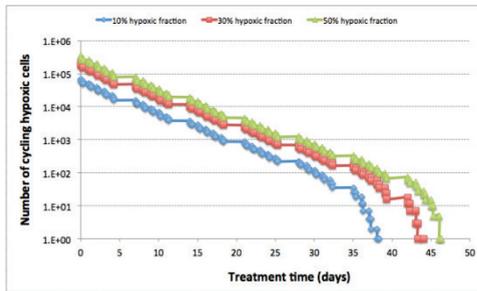
**pO<sub>2</sub> distribution**

Exponential as well as Gaussian distribution of the hypoxic fraction as a function of pO<sub>2</sub> have been simulated during hyperfractionated radiotherapy (figure 5). Since tumours present with various distributions of the partial oxygen tension, patients having similar tumour kinetics but different pO<sub>2</sub> distributions within the tumour will respond differently to the same treatment schedule. Large population of severely hypoxic cells (such as in the

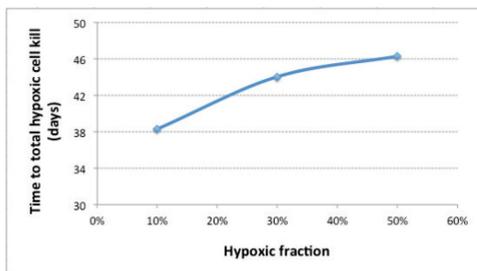
exponential distribution) lead to a more aggressive tumour than other distribution patterns.



**Figure 5.** The effect of exponential versus Gaussian distribution of pO<sub>2</sub> on tumor response to treatment.



**Figure 6.** The effect of the hypoxic fraction on tumour response to treatment.



**Figure 7.** The relationship between the hypoxic fraction and tumour control (expressed as the time to total hypoxic cell kill).

**Hypoxic fraction**

Three hypoxic fractions have been implemented in the virtual tumour growth: 10%, 30% and 50%. Figure 6 illustrated the survival curves of the active hypoxic population in the three situations, when all the other parameters are kept constant. The pO<sub>2</sub> distribution is considered exponential

and the tumour is treated with hyperfractionated radiotherapy. Figure 7 shows a supralinear relationship between the hypoxic fraction and tumour control.

**Conclusions**

A virtual head and neck tumour with radiobiological hypoxia has been developed using Monte Carlo modelling techniques. The *in silico* model has shown that hypoxia-related parameters have a strong influence on the tumour’s response to irradiation. Conventionally fractionated radiotherapy is not effective on hypoxic tumours as the surviving cells can regrow the tumour. Hyperfractionated radiotherapy is recommended for hypoxic head and neck cancers as multiple and smaller doses a day, with an overall larger total dose (84 Gy versus 70 Gy) can overcome tumour resistance to radiation. Nevertheless, it is crucial to undertake a pre-treatment quantification of the tumour’s hypoxic fraction and its distribution within the tumour in order to assess the effect of hypoxia on treatment outcome and to personalise the treatment for a high therapeutic ratio.

**Acknowledgment**

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# Surprise Romanian Presence Abroad

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**Abstract:** This article is about the Romanian presence abroad and the discoveries I made throughout the years in the 40 articles I wrote and published in Romania and in diaspora papers and magazines in Romanian. My self-imposed mission is to make cultural Romanian aspects known. There are three categories in which we are known: the classics (such as Constantin Brancusi - abstract sculpture, and Eugen Ionesco - the theater of the absurd), the world-class sports achievers (such as Nadia Comaneci, Ilie Nastase and, more recently, Irina Halep), and Dracula (this being at the top). Then there are Romanian achievements known only by those in a specific field of activity. Even we, as Romanians, do not know many of the accomplishments of which we should be proud. Unveiling the positive aspects of Romanian culture is necessary and I will continue the hunt for my discoveries.

## Introduction

For many years I have written and published articles on the theme of my self-imposed mission: making known my discoveries about the surprise Romanian presence abroad. Romania has so many beautiful things to tell the world and there is a Romanian presence almost everywhere. Yet even we, those from Romania, don't always know about them.



**Figure 1.** Ileana Costea studying a book in which Brancusi's art is mentioned. Books, the Internet, and field studies are her tools.

Romania being a small country, located in “the armpit of the Soviet Union” – as I used to tell my students who did not know where our beautiful country is on the map, is

seldom officially recognized in the vast world as being the place of origin of successful and famous people.

## Known Romanian people

### The classics, the sports and Dracula

There really are only three categories in which we can say that we are known: the classics, the world-class sports achievers, and Dracula. And yes, Dracula (about whom, with shame I must confess I first heard when I came in the US in 1972!!) is always at the top, followed by Ceausescu's violent killing in 1989, and then probably by Nadia Comaneci, the Olympiad-gymnastic winner, and Ilie Nastase and more recently, Irina Halep, the tennis players. Then follow the exceptional skills of Romania trained computer programmers and analysts, whose hiring in large numbers at Microsoft Headquarters in Seattle, Bill Gates had to justify to the US government: why non-resident Romanians and not Americans?

As for the classic Masters famous world-wide, such as Constantin Brancusi (creator of the abstract sculpture), Eugen Ionesco (father of the theater of the absurd)

and Tristan Tzara (founder of the Dada nihilist art movement), they are believed to be French, because it is in France where they worked most of their lives. Only seldom a more cultured non-Romanian or a foreigner with some Romanian connection (a wife, a colleague, a Fullbright scholarship in Romania) will know that they are originally from Romania.

## 2.2 Known mainly in their field

Some important Romanians are well known mainly by people in their field, such as: Mircea Eliade – whose books are used in most of the American Universities in history of religion courses and most probably, since he was a professor at the University of Chicago, he is believed to be an American scholar; Emil Cioran, who is famous only among philosophers and mostly in France, where he was made a member of the French Academy, an Institution very difficult to penetrate, especially as a non-French, yet quotes by him are found in many cultural events; composer George Enescu, more known in Europe, although played from time to time on radio stations in California and maybe also in other parts of the US. The only person from Romania who is better known among non-Romanian university intellectuals in the States is Andrei Codrescu from Brasov, because of the visibility he obtained through the intelligent and humorous shows he made for years on American National Public Radio.

## 3 Romanian presence everywhere

In short, we must accept that Romanians and their accomplishments are simply not well known. Yet, there is a “hidden Romanian hand, head, and idea” almost everywhere around the world. Few people know that the Eiffel Tower was made following the innovative assembly method of an engineer from Iasi, Pănculescu (legend or reality?!); that the head of the colossal statue of Jesus Christ

at the summit of Mount Corcovado in Rio de Janeiro was created by the Romanian sculptor Gheorghe Leonida; that the leaders of the French Institute of Petroleum near Paris, France claim that they learned how to process oil from the Romanian school. These are only a few of the beautiful hidden Romanian treasures that need to be discovered.

That there are few museums in the world to not have a Brancusi sculpture (be it in Paris, New York, Chicago, Canberra, Australia, or Rio, Brazil), and that there is no book of modern art or history of art which does not mention his name is no surprise. But in my travels I discovered an unexpected Romanian presence almost



**Figure 2.** Ileana Costea next to Florin Hategan's etching on linoleum "Mamma, worker on a conveyor belt", CSUN Art Gallery, Northridge, 2013.

everywhere, in large art events, as well as in smaller less famous ones: paintings by Aida Tomescu in many galleries and museums in Australia; a gilded Maramures gate by the sculptor from Cluj Mircea Catontor in the large event *La force de l'Art* at Grand Palais, Paris, 2009; paintings by Adrian Ghenie at Palazzo Grassi in the exhibition "The World belongs to you," Venice, 2011; two etchings by the printmaking artists Florin Hategan and Raluca Iancu [1] in a small exhibition of the National Society of the Art of Printmaking at CSUN, Northridge, California. The very well known Romanian

play directors Liviu Ciulei and Andrei Serban have not been the only ones active on the US Theater stage. More recently at the University of California Irvine (UCI) one could see impressively beautiful plays staged by Mihai Maniutiu, professor at the UCI Claire Trevor School of the Arts (The Bacchae Trilogy and The Electra Project). In Europe and the US everywhere there are Romanian professors of literature, of mathematics, of engineering, etc. The list is long and it is growing.

#### 4. Did you know that ...?

Although we, Romanians, of course know our classics, we are not necessarily aware of the Romanian past and contemporary presences which were not held in the limelight.

*How many of us know that:*

- *Romania is ranked on the 6th place in the world and the 2nd place in Europe in professional competence and intellectual training?*
- *Romania is at present the outsourcing alternative to India?*
- *Queen Mary of Romania has a museum in the US, the Maryhill Museum of Art in the state of Washington, not very far from Portland, Oregon?*
- *There is a bust of Romanian biospeologist Emil Racovita on the harbor promenade of Palma de Mallorca, Spain?[2]\**
- *The Romanian architect Harlambie (Bubi) Georgescu\* build villas and commercial buildings in Southern California?[3]*
- *Lauren Bacall's mother was from Romania?*
- *The well-known expressionist painting Van Dongen has painted a Romanian singer Modejsko?[4]\**
- *In Culver City – LA there is an Art Gallery held by a Romanian: Mihai Nicodim?*
- *When Frank Coppola won fame and the freedom to make movies he chose to make, in 2007 he selected the novella by*

*Mircea Eliade "Youth Without Youth" for his fantasy drama film with the same name?*

- *A known anatomy term is called "Gerota's fascia" or "Gerota capsule" after a famous Romanian surgeon from Bucharest?*
- *The first sculpture by Brancusi was an ecorché - the anatomical shape of the human body- ordered to Brancusi by Prof. Dr. Gerota?*
- *The well-known English playwright Tom Stoppard wrote a play (Travesties) in which one of the principal characters is Tristan Tzara?*
- *Hammamet, Tunisia became a well-known seaside resort due to a beautiful Mediterranean villa built by a Romanian, George Sebastian? (You ask the local guide about the owner and the answer comes right away: "An American.")*
- *Hollywood stars have their eyebrows shaped by a Romanian cosmetician, Anastasia Soare?*
- *We have successful fashion designers (Aurora Cercel - Eva Culture, in the US) and successful trend setting stylists (Smaranda Schaechtele\* in Germany)?[5]*
- *Dumitru Berea\*, a Romanian painter, has a museum in the city of Berea?[6]*
- *Picasso and other artists, not only Matisse, painted a Romanian blouse ("iie")?*

The list could be rather long...

The main theme of my articles (soon to be published in a volume) is the same as the title of this presentation "Surprise Romanian Presence Abroad."

I wrote about all the people and issues marked with a star (\*) in the list above, and about many others such : Mihai Anghel [7] (a young man who works in high-tech); books written by Romanians (Astăzi "Începe de Mâine" [8], by Dentist Sorin Issvoran - his story about escaping by swimming across the Danube - and "Muntele Iubirii" by Livia Medilanski [9]; Emanuel Tanjala [10] - National

Geographic style photographer; Ben Todica [11] journalist and newperson at the Romanian radio and TV station in Melbourne, Australia; Lidia Lazu [13] and her poetry recitals; Ion Lazu's novel "Veneticii" (about which Ana Blandiana said that it is "the best portrait of a mother" in Romanian literature) and the "Odyssey" of memorial plaques [14] Ion Lazu placed in Bucharest on houses where writers lived; Matei Visniec's play "The Chekhov Machinery" staged in Hollywood by director Florinel Fatulescu [15]; Brancusi and Patriciu Mateescu, since I organized three exhibitions on their sculpture at CSUN; ARA Congresses of the past, and many more...

Each of us, Romanians living abroad, can contribute to make known to the world the beautiful things we have; hence my self-imposed mission which is not accomplished yet. I am still on the hunt for more discoveries of Romanian presence ...

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# Des histoires familiales pour engager les élèves dans l'écrit et valoriser les langues et cultures d'origine à l'école: les « textes identitaires plurilingues »

Par Angela Stoica, enseignante-chercheuse

Chargée de cours en Didactique du français langue seconde  
à l'Université de Montréal

**Résumé:** Cet article présente un projet de recherche-action intitulé Écriture et histoires familiales de migration, une recherche action pour promouvoir les compétences à écrire des élèves allophones immigrants et réfugiés dans les écoles primaires et secondaires du Québec (FQRSC, Vatz-Laaroussi, Armand, et al. 2010-2013). Le projet avait pour but de développer les compétences à l'écrit en français des jeunes élèves allophones immigrants durant leurs premières années de scolarisation en pays d'accueil. Pour ce faire, nous avons croisé l'histoire familiale et les compétences en écriture, en invitant les familles à participer au projet, accompagnées par des organismes communautaires. Ce projet visait la production d'un livre de leur histoire familiale de migration. Ce livre, personnel à chaque jeune, conçu et réalisé en classe, est écrit en français, avec des apports de membres de leur famille et éventuellement de leur langue d'origine.

## 1 - Problématique

Le Québec accueille chaque année près de 50 000 immigrants indépendants et réfugiés. De plus en plus, ces nouveaux arrivants proviennent de toutes les régions du monde et une grande majorité d'entre eux est allophone. Diverses recherches concernant les élèves immigrants et réfugiés allophones et leur performance scolaire démontrent que l'apprentissage de la langue française représente pour eux un premier facteur de retard dans la trajectoire scolaire. (Armand, 2005; Steinbach, 2008). C'est au cours des deux premières années de scolarisation au Québec que cet obstacle est le plus manifeste, soit au primaire ou au secondaire, essentiellement dans les classes d'accueil (Allen, 2006), mais les effets du manque de maîtrise de langage scolaire continuent durant les études post-secondaires (Roessingh & Kover, 2003). Plusieurs de ces élèves, en particulier les réfugiés, ont aussi eu une trajectoire scolaire perturbée et certains présentent un

grand retard scolaire voire ne sont jamais allés à l'école.

Selon le milieu social dont on provient, la culture dans laquelle on vit, la trajectoire qu'on a suivie, la langue dans laquelle on écrit, l'écriture prend des sens différents. Il y a un lien entre littératie et culture (Painchaud et al., 1994) et les stratégies d'enseignement de l'écrit doivent être différenciées selon le type d'apprenants et leur culture. Les enfants allophones nouvellement arrivés, lorsqu'ils rentrent à l'école québécoise, apportent aussi tout un bagage à la fois cognitif, culturel et affectif qui est lié à leur parcours migratoire. Leurs expériences de scolarité avant le départ du pays d'origine et aussi des repères culturels, des événements familiaux, parfois des traumatismes dus à l'exil viennent donner à la langue, à l'école, au français et à l'écrit des sens nouveaux (Rousseau, 2005). Les élèves immigrants allophones ont le double défi de développer des compétences à l'écrit dans une langue seconde, parfois sans la littératie dans leur langue maternelle

(Armand, 2007). Dès lors les enfants sous ou non scolarisés dans leur pays d'origine ou au cours de leur trajectoire migratoire comme les réfugiés et en particulier ceux qui ont vécu dans des camps durant plusieurs années, rencontreront des difficultés supplémentaires dans l'apprentissage du français écrit.

## 2- Hypothèse et questions de recherche

Nous avons posé l'hypothèse que l'écriture de l'histoire familiale de migration représente un contexte significatif qui peut aider le jeune élève immigrant allophone à développer des apprentissages en écriture et en français dans un processus gratifiant, ludique et authentique.

Notre projet de recherche action a permis de répondre aux questions suivantes: 1) Comment favoriser l'écriture de l'histoire familiale en milieu scolaire pour développer la motivation à l'apprentissage de l'écrit et du français tout en reconnaissant la valeur symbolique et affective de la langue d'origine et des savoirs familiaux ? 2) Comment faire participer la famille à cette écriture? 3) Quels outils pédagogiques et didactiques utiliser pour que cette écriture de l'histoire familiale devienne une motivation pour l'apprentissage du Français et de l'écriture? 4) Quels outils construire pour que dans cette expérimentation les élèves développent leurs compétences à écrire en français ?

3- Les objectifs de la recherche action : ils sont de 5 ordres.

1) Objectifs de connaissance : Apporter de nouvelles connaissances sur les motivations à l'écriture, sur les collaborations famille-école et sur les questions linguistiques pour des jeunes immigrants et réfugiés allophones à l'école primaire et secondaire québécoise durant leurs deux premières années au Québec.

2) Objectifs d'action: Construire, expérimenter et évaluer l'implantation d'un projet portant sur l'écriture d'histoires familiales de migration en milieu scolaire

primaire et secondaire par les jeunes et leur famille.

3) Objectifs de formation et de transfert: Former des enseignants par l'expérimentation, transférer ces nouveaux savoirs et ce projet pilote à d'autres milieux scolaires et communautaires.

4) Objectifs de transformation: Transformer les pratiques enseignantes, les collaborations famille-école et les représentations mutuelles.

5) Objectifs de développement éthique: Développer une réflexion éthique sur les rôles de l'école, des familles et des organismes communautaires pour les apprentissages en écriture et en français des jeunes.

## Partie B: Pistes de solution

### 1- Des résultats utiles pour divers publics

Notre projet de recherche action repose sur l'hypothèse que l'écriture de l'histoire familiale en milieu scolaire, en français avec des « clins d'œil » à la langue d'origine, avec des apports de la famille et l'aide du milieu communautaire, représente un processus de motivation à l'apprentissage du français écrit pour les jeunes immigrants. C'est aussi un processus qui permet la construction identitaire du jeune et son adaptation à son nouveau milieu. Finalement il s'agit au travers de cette action d'écriture de l'histoire familiale en milieu scolaire de favoriser une représentation positive à la fois de la langue française et de l'écriture. Aussi les résultats et retombées de notre projet visent comme indiqué dans les objectifs, plusieurs publics représentés dans nos partenaires.

Le milieu académique et de la recherche bénéficie des résultats de la recherche action à trois niveaux : 1) L'identification des dimensions d'un contexte significatif favorisant la motivation des jeunes élèves allophones pour apprendre à écrire en français comme l'histoire familiale, la trajectoire de migration, les souvenirs, les réseaux, la langue maternelle et les talents

déjà développés. 2) Une analyse des représentations des acteurs scolaires et immigrants quant aux langues (française et d'origine), quant à l'écriture et quant à l'histoire familiale. 3) L'enrichissement des connaissances sur les pratiques pédagogiques pertinentes et novatrices visant l'écriture authentique en contexte significatif pour ces jeunes (en particulier, les stratégies de différenciation et de personnalisation des apprentissages ressortent ici comme des conditions de réussite. Évidemment ces résultats ont des impacts directs pour les milieux de pratique. Les commissions scolaires, les milieux scolaires et les enseignantes bénéficient de l'expérimentation et des stratégies pédagogiques innovantes qui y sont développées ainsi que de la réflexion pédagogique et éthique qui y est menée. On envisage un enrichissement des pratiques pédagogiques en situation d'accueil et d'apprentissage du français langue seconde. Les familles et les jeunes bénéficient directement de l'expérimentation pour les enfants qui y ont participé. Les parents vont ainsi se rapprocher de l'école, mieux connaître le système dans lequel s'inscrit leur enfant et comment ils peuvent l'accompagner. Dans le même temps le personnel scolaire connaît mieux ses élèves, leur trajectoire et leurs proches, développant ainsi de nouvelles collaborations familles-écoles. La participation des organismes communautaires au projet permet ce rapprochement entre les familles et l'école et ouvre sur de nouveaux partenariats entre l'école et le milieu de vie, favorisant ainsi une école inclusive. Finalement les décideurs et gestionnaires peuvent bénéficier de ces résultats pour améliorer la formation des enseignants en classes d'accueil et pour mieux gérer les publics de ces classes. De manière générale, ce projet représente un prototype des actions qui peuvent être menées en classe en collaboration avec les familles et les milieux, pour développer les apprentissages

en écriture en français et renforcer la motivation à apprendre et à écrire des jeunes.

3- Grands principes issus du projet et retombées

La recherche action fait ressortir 4 grands principes qui sont illustrés dans les outils issus de la recherche action et qui peuvent servir de fondements à de nouveaux projets: 1) Motiver grâce à des situations signifiantes. 2) Valoriser le dialogue entre les langues. 3) Faire de la place au dialogue entre les familles et l'école. 4) Oser des pratiques innovantes. Ainsi un guide d'accompagnement des enseignantes et milieux communautaires souhaitant mettre en œuvre de tels projets, a été produit ainsi que deux DVD qui enrichissent les données pédagogiques et didactiques issues de la recherche action. Des formations et ateliers peuvent être donnés dans les commissions scolaires et auprès des conseillers pédagogiques. Des fiches pédagogiques pour les ateliers en classe sont aussi disponibles pour les enseignantes ainsi qu'une boîte à outils identifiant des articles, sites WEB, vidéos pertinents à la mise en œuvre de projets d'écriture signifiantes ainsi que des outils utilisables directement en classe.

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#### Sitographie

Site d'activités Éveil au langage et ouverture à la diversité linguistique

ÉLODIL: [www.elodil.com](http://www.elodil.com)

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# Romanian flavor of an American painter

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**Abstract:** This article presents, in the context of his life work as a heterogeneous artist, some art pieces with Romanian inspiration created by the American artist Jerry W. McDaniel. Sketches, animations, posters, and paintings on subjects like: the Maramures wooden gates, Lucian Blaga's and Ana Blandiana's poems, Ion Tuculescu, and the tennis player Ilie Nastase. From expressive ink sketches, watercolors and acrylic paintings, to beautiful poster designs, Mr. McDaniel's "Romanian flavor" work is part of a very rich artistic life of this New York – Los Angeles painter for over half a century. Mr. McDaniel gives to the Romanian subjects the same expressiveness of his skilled flowing line, in the drawings, and the same appeal, brightness, and liveliness of all his other colorful paintings.

## 1. Introduction

Sometimes elements of an ethnical culture are made known to the world by persons who are not from that country. One of these cases is the Japanese photographer Kosei Miya who fell in love with Maramures, and was the first to introduce this region to the Western world in the exhibition "La Roumanie des quatre saisons" at the "Muse de l'Home" in Paris, 1997 [1]. The Roumanian Blouse (iie) was made famous in France by Matisse, by his painting with the same name "La Blouse Roumaine" which he did in 1940, followed by a series of representations of women wearing Romanian blouses. Matisse discovered the beauty of the "iie" from the gifts given to him by Theodor Pallady, the Romanian painter whom he befriended since the time they were studying together at the Ecole des Beaux Arts in Paris (1891-1900) [2].

## 2. McDaniel's Romanian Subjects

### 2.1. Before exposure to Romanian Culture

Like in Matisse's case, a strike of fate exposed Jerry W. McDaniel [3,4,5,6], a New York and Los Angeles artist, 100%

non-Romanian, to Romanian culture, and like the French Master, McDaniel started creating several pieces of art on Romanian topics.



**Figure 1.** Tennis poster

It is interesting that McDaniel had a Romanian subject in the 50's, when, while doing the entire advertisement campaign in South America for Philip Morris/Marlboro, he created a sports poster in which the name of Nastase appeared, way before the latter became a world-class tennis player. The poster was shown for the first time at the Fashion Institute of Technology FIT/SUNY in New York, where Mr. McDaniel was a professor and the Chair of the Advertising Design department, in an exhibition of a series of 14 posters. The exhibition travelled across the country and

ended up at the Columbus College of Art and Design where the artist studied. The whole series was donated to the CCAD where it was used for years as an educational device for students.

## 2.2. After exposure to Romanian Culture

### 2.2.1 Blaga-inspired Paintings

In 2008, McDaniel was commissioned to create stage background images for a poetry recital tour in California of Lidia Lazu, an artist from Bucharest. He created an entire series of small acrylic paintings on paper after poems by Lucian Blaga which were enlarged and used in projections [7]. One of these paintings, “I want to dance” after Blaga’s poem with the same name, evolved into a series of six acrylic paintings on canvas. McDaniel was invited to present the series at “The Dialogue of the Arts” event organized by the Atheneum Foundation in Dusseldorf, Germany, 2-3 December, 2011 [8]. The paintings were presented again in a solo exhibition at the Klein Art Academy in Beverly Hills, Ca in September 2012 [9].



Figure 2. Jerry W. McDaniel and Ileana Costea next to the “I want to dance” series of paintings, Dusseldorf, December 2011.

### 2.2.2. Salon ARTIS and European nightscapes

In 2010 Mr. McDaniel was invited as Guest of Honor at the Salon ARTIS held in Bucharest. Mr. McDaniel created the art for the cover of the catalog [10] and the poster of that exhibition and presented two of his

six European nightscape paintings, “Amsterdam at 4am” and “Eiffel Tower Everywhere” [11]. The nightscapes were created by Jerry W. McDaniel in his studio in Montparnasse, They were based on sketches he made during various trips to Europe, 2010-2011. Jerry’s European nightscapes painting integrated very well in that show since the theme was architecture and art. “The special trait of Jerry’s nightscapes is their impressionistic character. He goes beyond the realistic elements of his subject and reaches a more general meaning. The nightscapes are very courageous paintings.” (Ion & Lidia Lazu)

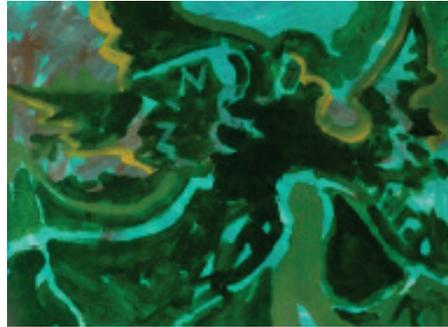


Figure 3. “I want to dance - green”, ©JWM



Figure 4.

Jerry W. McDaniel in his studio creating the design for Salon ARTIS 2010.



Figure 5. The European nightscapes series, 20109-2011, ©JW McDaniel

**2.2.3. Maramures Gates and art based on research**



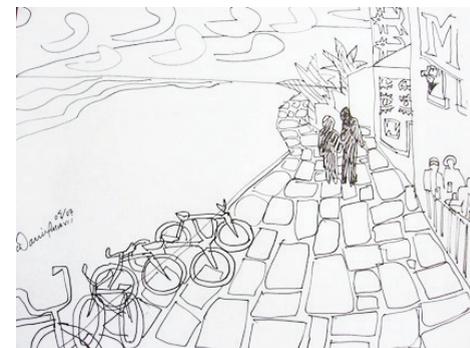
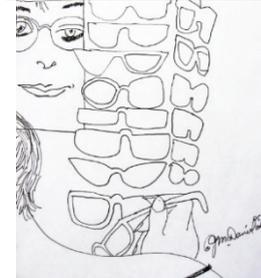
**Figure 6.** “Bird of Paradise and Maramures gate”, ©JWMcDaniel’2009, Topala private collection, Paris, France

The “Romanian inspiration journey” of Mr. McDaniel continued. The golden structure in the size of a real Maramures wooden gate by Romanian Sculptor Mircea Cantor [12] he saw at a large show of contemporary art in the Grand Palais, Paris, gave McDaniel the idea of a painting he was doing for a Romanian Couple whose daughter studied in Los Angeles. McDaniel wanted to combine Romanian elements with Southern Californian ones. This was how the painting “Bird of Paradise and Maramures gate” was born. This painting is an example of the numerous art pieces that McDaniel created based on research. With many years of experience as an illustrator, graphic designer, and advertising personality McDaniel seems to have an uncanny ability to create art based on research in a contemporary surrealism style, be it portraiture, landscapes, abstracts, hence the heterogeneous artist [13].

**2.2.4. Color and repetitive elements Tuculescu and McDaniel**

Browsing through an album of Tuculescu’s art [14], Jerry W. McDaniel discovered with pleasure the two things the Romanian Master and he have in common: the bold use of strong, bright colors, and

the expressivity of repetitive geometric elements. He immediately made some drawings in pen, but with Southern California subjects, the madness of freeways and the famous Venice Beach: “Yin-Yang California Freeways”, “Looking at you”, and “Bicycles at Venice Beach”. They are sketches in black and white. “One day in the near future I plan to go back to these sketches and make them into colorful paintings.” (Jerry W. McDaniel)



“These three drawings in pen by Jerry W. McDaniel can be considered as a comment on how Tuculescu sees the world. In his sketches the American painter caught the repetitive character of the elements in the Tuculescu’s art. The well-known paintings of Tuculescu’s

“eyes of the field” series and

**Figures 8, 9, 10** Sketches inspired from Tuculescu’s paintings ©JWM 2009

seem to have inspired Jerry’s drawing “Looking at you”, where the woman’s eye is reflected in the mirror next to the multitude of sunglasses. The drawing

“Bicycles at Venice Beach” strengthens the idea of repetition, showing the stones, the clouds and the waves as compositions of line, shapes, and texture in mysterious communication with each other. Then, what is literally organic in nature, the sphericity and bilateral symmetry appearing so often in Tuculescu’s paintings, which must have been what the Master saw in the laboratory under microscope (Did you know he was a microbiologist?) are suggested by Jerry McDaniel’s “Yin-Yang California Freeways’ drawing.” (Lidia and Ionu Lazu)

### 3. Sickle and hammer



**Figure 11.** Broken symbol of Communism  
©JW McDaniel 1970

Yet one more interesting discovery, in McDaniel’s work: one can even find some “behind the iron curtain” unconscious inspiration. In the 60’s Jerry has made a series of 15 large circle paintings, some of which he presented in a solo exhibition at the Valley Performance Arts Center (VPAC) in October 2013, at California State University, Northridge (CSUN) [15]. At the Opening Reception a Romanian architect friend living in Los Angeles, Dino Tudor, baptized one of Jerry’s large circles “Broken Communism Symbol”. “I just returned from a trip to the former Soviet Union, Dino told Jerry. To me, Maestro, it is clear what you wanted to represent in this painting: the inverted “sickle and

hammer” symbol; that communism has been broken” [16].

### 4. Recent Romanian subjects

#### Ana Blandiana’s poems

The most recent Romanian-influenced artistic activity of McDaniel’s sketches and paintings to illustrate Ana Blandiana’s beautiful poems. He found them in English translation and was thrilled by their visual expressiveness. These paintings will be shown at the private reception organized by Ileana Costea at IC ART House-Gallery in Encino (opening of this new gallery too), on the occasion of the visit to Los Angeles of the well-known Romanian writers Ana Blandiana and Romulus Rusan on June 14, 2015.

They trundle by on roller skates  
With earphones droning in their ears  
And their eyes glued to monitors,  
Unaware that the leaves are falling now  
And the birds are flying away.

...  
*While God Comes down  
And learns to roller skate  
In order to save them.*

Fragment from the poem “On Roller Skates” by Ana Blandiana Translated from Romanian by Paul Scott Derrick and Viorica Patea From volume: *My Native Land A4*



As a Master of Illustration and Painting, from stylized realism to very abstract, with Van Gogh-like colors and shapes, orderly Mondrian compositions, and Stewart Davis’s modern style, Mr. McDaniel does

it with talent and a twist on American, European, and now Romanian subjects.

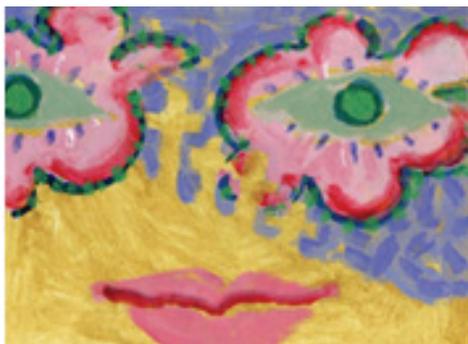
*Note: Many thanks to Ion and Lidia Lazu [17] which contributed to this article with ideas discussed on Skype.*

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Paintings - acrylic on paper  
by Jerry W. McDaniel -  
inspired by Blaga's poems

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## Arghezi's epic poetic text in the volume

### "Una sută una poeme"

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**Abstract:** In volume *Una sută una poeme* Tudor Arghezi appears as an upgraded folklorist follower of constructive negativity, refusing to be represented by standard forms. Volume whose poetry is deeply plastic, where the poet's humble attitude is reflected in folk themes with strong social character, offers a hybridization of language, so it became epic. In Arghezi's case, his lived experiences stretch in his poetry so they can legitimate in themselves, without depriving the poetic text with his polemically-objective character and deeply personal notes of originality. Lyric plasticization is so deep that each word, each letter, hides a story, each one is explained by itself. A hidden epic, where the lyrical ego can mirror or hide. The author has no language but the language describes itself becoming a descriptive art of speech and language, where text seeks to hide in the cracks of the significant.

Chiar dacă volumul *Una sută una poeme* se diferențiază de lirica obișnuită argheziană, fiind apreciat de Ovid S. Crohmălniceanu ca „un eveniment literar al vremii”, publicarea acestuia nu va avea o traiectorie obișnuită. Receptarea volumului la apariție este una deosebit de marcantă pentru un volum pus în fața atâtor opreliști. Tipărit într-un tiraj mic, de 3000 de exemplare, volumul de poezii suferă o mutație la nivelul conținutului. Poezia intitulată *Aci, la noi* „cade victima proaspăt reactivatei cenzuri” [1] astfel apare o neconcordanță între titlul volumului care promite 101 poeme și sumarul care înregistrează doar o sută.

Din dorința de a se arăta intențiile serioase ale noului regim, „pentru a-și regla conturile cu întreaga mișcare literar-artistică postbelică, impunându-i programul și restricțiile jdanoviste” [2] și pentru a oferi un exemplu și un precedent celor care ar fi îndrăznit să treacă peste normele impuse de puterea în curs de consolidare, „dându-i-se <o riposta drastică> lui Tudor Arghezi, erau avertizați, altfel spus, toți cei tentați să-și mai manifeste, prin scris, ostilitatea”.

Astfel, o mare parte din tirajul volumului de poezii ajunge stocat sau interzise, în cazul exemplarelor „dosite de librari, care probabil au mai putut alimenta, câțva timp, piața neagră a cărții” [3].

Titlul volumului coincide cu titlul volumului arab *Una sută și una de nopți*. Asemănarea volumului de poezii cu manuscrisul oriental nu apare doar la nivelul titlului. Atât multitudinea temelor folosite în volumul arab, cât și caracterul profund descriptiv se regăsesc și în volumul arghezian. În volumul *Una sută una poeme* poezia lui Tudor Arghezi capătă o nouă formă, o formă care transcede liricul. Lirica argeziană este prin definiție matură, poetul având 47 de ani la publicarea primului volum, dar în viziunea lui Ion Pop, în volumul „Una sută una poeme” apare o atitudine mai înțeleaptă față de maturitatea specific argheziană „oferind chei mai lesnicioase de acces în universul artistic” [4] și o nouă formă de expresivitate. Această expresivitate este evidențiată de teme abordate (familia, religia, jocul, societatea), și tot aceste teme oferă poeziei o notă epicizată. Poezie profund plastică,

descriptivă, în care atitudinea umilă a poetului se regăsește în teme cu un caracter puternic folcloric și/sau social, oferă o hibridizare a limbajului astfel acesta devenind epicizat. Această epicizare a textului liric se mulează după formele estetice moderne, deoarece poezia modernă nu poate fi limitată de granițele genurilor literare. Depășire a granițelor vine odata cu ideea de nou. Granițele textului poetic se modifică, se înnoiesc astfel că poetul trebuie să se muleze după acestea. Un nou limbaj pentru un nou cititor, care trăiește într-o nouă societate, într-un nou regim. Normal ca și influențele asupra liricii vor fi altfel.

Un text literar care se dorește a fi mai expresiv decât obișnuita expresivitate (și așa marcantă) arghezană, va avea nevoie de un alt fel de scriitură. Astfel, devine absolut acută necesitatea unui limbaj care transcede. Un text fereastră care leagă realitatea de ficțiune, textul liric de subtext, interiorul de exterior, o punte a antitezelor specifice structurii argheziene.

Plasticizarea liricului este atât de profundă încât fiecare cuvânt, fiecare literă ascunde o poveste, fiecare se explică pe sine. O liricizare ascunsă în care eul liric se poate oglindi sau ascunde. Un *Una sută și una de nopți* cu sunete specifice și înțelese doar în spațiul nostru, în care eul liric, ca o Șeherezadă, prezintă „comuniunea auto-impusă cu sacrul [...] „moșia” strabună, napadită de „furi” și expusă tuturor relelor veacului [...] dialogul incertitudinii mistuitoare” [5], transcendența și biograficul. „Ogor pustiu și neumblat. /S-a tot risipit, s-a tot adunat./Luna-i într-un coș de vatră veche /Și soarele-animat de o ureche, /Cofa de lut, atima de-o prajină, /Mînjit cu zmalțuri ce-ar fi fost lumină./Uscate stele, pe coceni și ostrete, încep de slăvi și cer să se dezvețe./Buruieni de scamă și otreapă. /Muntele-i strîmb. /Țarina crapă. /Cenușe, funingini și zgură. /Mucegai și malură./Un sobor de vladici, la matca-nclăita,/S-a făcut buturugi de rachită./A trecut, undeva, și oaste:/Ies din țarina suliți, coifuri și coaste./Valuri de

cîrpă/Se răstoarnă cimpul. cu scîrbă./O harfă și o vioară. /Cu strunele de sfoară. /Zac în sînge și noroi./O singură jivină, gogoloi, /Ca un arici, ca un pește, /Pitulată, se rostogolește./Și un coșciug spînzură-n văzduh:/Al Tatalui, al Fiului și-al Sfîntului Duh.” [6]

Un folclorist modernizat, adept al negativismul constructiv, reprezentat de refuzul formelor standard, care dă naștere altor forme. O negație care „purcede, în noi și în afara noastră, de la o activitate constructivă. Ea pretinde că spiritul care lucrează este un factor de evoluție. A gândi bine realul înseamnă a profita de ambiguitățile lui pentru a alerta gândirea”[7] Ironia autocritică induce un spirit efectiv creator. Trebuie să te desprinzi de rigiditatea familiarului provocat de empiric pentru a nu deveni steril în atitudini și limbaj. În cazul lui Arghezi resorturile experiențelor sale trăite se întind în poezie, se legitimează în ele, fără a priva textul poetic de caracterul polemic-obiectiv, de note profund personale sau de originalitate „Nu ai adus-o tu în țară/ Otrava palidă și acrisoară,/ Voinic întors de pe hotar acasă,/ O lifta mai ascunsă îl apasă,/ Mai molcomă și mai gingașe./ O simte ca-n opinca și-n cămașe./ Tiptilul corci de matragună/ Cu griul crește dimpreună./ El s-a ivit, s-a strecurat/ Pe arături, la semănat./ Și-a prins atîta radacină/ Că țarina, -mparate, este plină./ Unde-și da brazda rodul cel mai cald/ Acolo-i sare vîrfurile mai înalt.”(*Buruiana asta*) [8]. Această constrângere a experienței dă naștere spiritului idoneist - să cunoști și să fi constrâns de cunoștințele tale, să faci față exigențelor situației și să nu rămâi limitat; o filosofie a deschiderilor. Dorința de a transcede este văzută ca un act de cunoaștere aproape obsesivă, o căutare de a depăși neputința ființei, a imaginarului, a incertitudinilor care generează interogările.

Necesitatea comunicării întrepătrunde claritatea obiectivității și a rațiunii, oferind un eveniment al limbajului în detrimentul faptului, o contemplare a formelor, o artă

descriptivă a limbajului și a vorbirii. Autorul nu prezintă limbajul, ci limbajul se descrie pe sine „pare să urmărească o fantomă a cuvintelor, un neauzit, o esență ascunsă a lor”[9]. Elementele de finețe oferă profunzime, nu mutațiile masive sau „convenabilitatea” care oferă subiecte ușoare. Unui om căruia i se impune o anumită conduită a scrisului, ori se va supune, ori va găsi o fisură a textului în care să ascundă semnificantul, ori va suporta consecințele. Ideea de supunere nu se potrivește pamfletarului Arghezi, așa că lirica limbajului lui va transcende în epic, dispersând granițele limbajului, mesajului sau stilului specific liric, folosindu-se de sugestie și de dedesubturile cuvintelor pentru a explica atitudinile poetice. „Spuză fierbinte, drumul fierbinte. /Cîmpie de oseminte./Mi-e ca o coajă de pîine arsă gura. /Și balele-s ca saramura./Limba mi-i ca piatra de ascuțit coasa./S-au lăsat pe mine păreții, bimele, și toată casa/Se strînge cosciug./Mă frînge un zăvor, ma rupe un belciug./Am în gitlej lacate sparte/Un lanș m-a-ncolăcit cu zale moarte./Ai vazut luna./Nebuna?/A intrat pe furiș/În trestie și papuriș./Secera de-a valma rogoz, șerpi și broaște./Pe la ferestre trece chivotul stelelor cu sfințele moaște./Vine otrava cu sînge, pe moară /Nu bea mocirla murdară !”(*Spuză fierbinte*) [10]

Spiritul polemic, dârz, care refuză orice fel de limitare se resimte atât în neafilierea lui față de un curent literar, cât și în caracterul lui antisocial. O anumită neseriozitate a autorului asupra concepțiilor în sine sau asupra formelor canonice. Din aceasta dorință de destandardizare apare dedublarea și dualitatea. O lirică a cuvântului și una a sensului fără a îngreuna textul poetic. Un dublu atât al incertitudinii condiției umane, cât și al antitezelor acestuia.

O analiză a stărilor sufletești pentru o descifrare lăuntrică a eului liric pierdut/scufundat/copleșit de imprevizibil. O revărsare a fluxului sufletesc în pasajele biografice, oferind o relație stransă între

autor, eu liric și text, un text aparținând vocației de poet. O nemulțumire refulată „Țara le era moșia./ Cugetul, ticăloșia./.../Birul, biciul, bunul-plac./ Altă lege-n țară nu-i:/ Fiștecare legea lui.”[11] dar și ascunsă „Cine ești tu, acel de care gândul/ Se-apropie necunoscîndu-l?” [12], specifică unui spirit în scindare. Antagonicul între nemulțumire și acceptanță oferind o panoramă a curiozităților, nemulțumirilor, fascinației sau incertitudinii unde textul apare ca o oglindire a eului creator, o refulare a sinelui, a propriilor trăiri care necesită o conștiință autorială, pentru a strabate lumile interioare ale autorului.

Se poate nota o dorință de a atinge libertatea (cuvântului, formei). O proză spontană în care actul creator se produce involuntar poate fi considerată naivă, dar Arghezi oferă o artă a instinctului, fara a fi considerat infantil sau predispus amatorismului. Scriitorul nu se implică în crearea operei, devine obiectiv ”artistul trebuie să fie în opera sa ca și divinitatea în creație, invizibil și atotputernic; să fie pretutindeni simțit, însă nicăieri văzut”[13]. O artă liberă, fără constrângeri în care este prezentată sensibilitatea realității. „Păianjenul visării parc-ar sui cu frică/Și ar călca, pe firul nădejdirilor întiins, /Are-și destramă varful, pe cat i se ridică/Un căpătâi în haos, de-o stea de unde-i prins./Singurătatea-n zale mi-a străjuit cavoul/Ales pentru odihnă rănitului oștean/Și i-a cules auzul catifelat ecoul/Cu șase foi, al frunzei căzute din castan./De mult păzește cripta și treapta ce scoboară, /Dar vremea, nentruptă de morți și crăci uscate, /Prin mâinile tăcerii, de ceară, s strecoară/Ca un fuor de pulberi și brume deslîinate/Întercalate-n ritmul unicului viu vrs/Ar mai simți cadența, de-a pururi ascultată/De valuri și de zodii, agale-n pasul mers, /Cand s-ar opri secunda și inima să bată?” (*Când s-ar opri secunda*) [14].

Volumul prezintă o lume captivantă, când foarte bine conturată, aparținând registrului realității raționale, când difuză,

aproape onirică, în care simbolul și fantasticul oferă sensuri noi circumstanțelor precedente „Cine șoptește are dor de ducă./ Și cine pleacă vrea să stea:/ Lipsește fitecui câte ceva.” [15]

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## 39<sup>th</sup> ARA Congress Visual Literacy in the Digital Age

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**Abstract:** Visual literacy is a major component in today's expanding digital world of mobile technologies and media saturated environment, especially in the growing domain of online learning. Visual literacy consists of three components - visual thinking, visual learning and visual communication. This paper proposes to discuss various practices used in humanities and art history courses to aid learners in developing higher acuity of visual literacy and thus enable them to become more discerning and informed thinkers and citizens.

### Introduction

From the earliest times with the advent of language and imagery, human beings have attempted to interpret, understand and imagine their relationship to the natural world and each other using various forms of communication. The world of sensory perception and experience was recorded in a variety of representations, such as paintings and sculptures revealing the process of extrapolation and abstraction of the evolving human brain. The two dimensional imagery often simplified the real object and led to the development of signs and symbols, which by the 4<sup>th</sup> millennium BCE gave birth to writing. The oral traditions of prehistoric humans were eventually transcribed with the invention of writing and through the advent of written documents information and ideas were preserved and spread. As historian David Christian explains in his TED Talk on Big History, "What makes humans different is human language. We are blessed with a language, a system of communication, so powerful and so precise that we can share what we've learned with such precision that it can accumulate in the collective memory" [1]. The methods of communication proliferated as communities grew into cities with complex hierarchical and social interactions, along with trade and technological advances, leading to an ever-growing expansion of inquiry, discovery

and invention. The power and immediacy of visual imagery led to the proliferation of artistic creations and conventions visible in the monumental architecture and sculpture of the ancient world, which proclaimed the power of the gods, kings and priests. The language of visual messages was encoded and its repetition resulted in widespread visual literacy. In the 15<sup>th</sup> century, the printing press revolutionized the means for dissemination of information ever widening the growth of ideas. As the modern times arose, beginning with increased exploration and continuing towards the industrialization of the 18<sup>th</sup> and 19<sup>th</sup> centuries, a faster pace developed in the lives of ordinary human beings. The rapid development of technological advances diminished opportunities, access and time and yet led to various social movements of democratization, individualism and nationalism. These movements reveal the search for freedom dignity and democracy, which is increasing to our modern day. Throughout history, the visual image has retained its prominence for its instantaneous communication and even propaganda. The evolution of technology and predominantly of the electronic, digital world, which enabled the expansion of visuals and especially multimedia has resulted in the necessity for increased attention to visual literacy in the learning process.

## 2 Visual Literacy

Today's proliferation of digital and mobile technologies enables any individual to participate in the consumption and creation of digital and visual media. "The new digital media provide new ways of engaging with each other, with information, and with the world" [2]. Digital literacy is the ability to develop, read, present and share meaning in different modes and formats; to create, collaborate and communicate effectively; and to understand how and when digital technologies can best be used to support these processes. Digital literacy involves critically engaging with technology and developing a social awareness of how various factors, including commercial agendas and cultural understandings, can shape the ways in which technology is used to convey information and meaning [3]. Contemporary culture is wrought with a cacophony of visual and multimedia bombardment, dramatically impacting the required literacies of the 21<sup>st</sup> century. Visual literacy pertains to the essential skills of examination and critical thinking about visual media, thereby empowering individuals to participate successfully in the increasing visual culture of today's world. The Association of Colleges and Research Libraries, a division of the American Library Association defines visual literacy: "Visual literacy is a set of abilities that enables an individual to effectively find, interpret, evaluate, use, and create images and visual media. Visual literacy skills equip a learner to understand and analyze the contextual, cultural, ethical, aesthetic, intellectual, and technical components involved in the production and use of visual materials. A visually literate individual is both a critical consumer of visual media and a competent contributor to a body of shared knowledge and culture." [4]. Visual literacy facilitates individuals to decipher the messages, symbols, propaganda or advertising that the different means of digital communication

have produced. In order to acquire visual literacy, one needs to be able to deconstruct images into their component elements and, at the same time, to decipher the deeper meanings within the compositions. Visual expressions from the past reveal different modalities of seeing the world and oneself in relation to the environment. From devotional images to portraits and abstract works, colors, lines and shapes have been used to portray or evoke emotion. Past masterpieces inspire us and even challenge us to enter in a dialogue with them, thus furthering the connection with the past.

All learning begins with wonder and basic curiosity, which leads to questions and the thirst for further inquiry, which in turn promotes life-long learning. Visual literacy is perhaps more important today than in the past, due to the increasing visualization, video, and multimedia that are used on the Internet and in various types of advertising. But it is the power of vision – looking and seeing – that is paramount as Leonardo explained in his discussion of vision "The eye, which is said to be the window to the soul, is the primary way in which the receptacle of the brain may more fully and magnificently contemplate the infinite works of nature, and the ear is the second, gaining nobility through the recounting of things which the eye has seen... (from the Ashburnham II manuscript, 19r around 1492)"[5]. While the human eye can apprehend images spontaneously, it needs training to decipher, understand and manipulate them.

Visual literacy incorporates three main components: Visual thinking, Visual communication and Visual learning. In its broadest term, Visual literacy is defined as the ability to read and create visual information, to think and solve problems visually, and to interpret and evaluate those visual messages that bombard us each day. Visual thinking incorporates graphs and visualizations along with a variety of means of interpreting data in order to discover correlations in different

informational materials or statistics. Visual thinking includes the manipulation of objects and their organization, as well as the creative use of data. Visual communication pertains to the effective use of images to convey ideas, to persuade people and even to produce propaganda. YouTube and Facebook have become the most commonly used vehicles for the dissemination of visual media throughout the globe. Visual learning incorporates the analysis of images, their deconstruction in terms of messages and meanings, their cultural information and social impact.

Visual literacy begins with visual phenomena which include signs and symbols, icons, representations, recreations and illusions, which are based on a variety of gestalt principles such as symmetry, figure-ground relationships, proximity diversity and similarity. The successful combination of these elements and principles of art underscore the idea that the whole is much greater than its individual parts, or to use a well-known cliché –a picture is worth a thousand words. The meaning of the term ‘icon’ has grown from its original spiritual and religious connotation, to encompass, as Martin Kemp explains: “[the] Definition of a visual icon - an iconic image is one that has achieved wholly exceptional levels of widespread recognizability and has come to carry a rich series of varied associations for very large numbers of people across time and cultures, such that it has to a greater or lesser degree transgressed to the parameters of its initial making, function, context, and meaning” [6]. Today icons are used to signify various merchandize brands, convey political or social ideas and even draw the spotlight on popular celebrities.

The very basics of a visual image pertain to line and shape, value, color, texture, movement, balance and unity, scale and proportion. It is the manipulation of these elements that indicates the function of the image, the message and meaning of a visual representation and thus a complete

description of a visual image provides the starting point for analysis. Visual literacy encompasses a number of different areas of study. First, one needs to begin with a close observation of the elements used in the image to fully describe the image, followed by research to identify the artist, if known, the style and time period. The materials and techniques used to create the work are closely connected to the purpose and function of the piece and the impact the image had when first revealed as well as subsequent interpretations of the work. Visual literacy also impacts morality and ethics in terms of copyright and intellectual property or the opposite, censorship and privacy. The extensive use of Facebook and other social media requires careful and critical decision making for the types of images one ought to share with the world. The creation of visual media is also an important aspect of visual literacy, allowing for experimentation and graphic representation of data. The overwhelming amount of accumulated data on the Internet can be visualized in various ways from graphs to infographics allowing for the discovery of patterns and connections [7]. The interpretation and analysis of images includes investigation of contexts and meanings as well as functions and purposes for the work. The intended audience as well as the individual viewer, completes the work via personal responses, emotions and reactions to the piece, thus making a visual work a continuous artistic dialogue, which combines the past and the present while suggesting the future.

### **3. Digital learning**

Learning is one of the most important and fundamental activities of human beings. Education provides a central aspect in any society today both formal and informal. While the purpose and function of education has dramatically changed over the last century, as the need for education grew and expertise was increasingly sought, the pursuit of education has also

entered the business world based on the new digital possibilities and appropriating business practices. A variety of programs, including online courses, have been created to provide opportunities and flexibility for the general population to benefit from educational offerings. With the advent of the electronic age and digital technology, increased opportunities for learning have arisen in the online world. Online education is mitigated through technological interfaces, such as a computer, tablet or smart phone. Basic computer skills as well as a reliable connection to the Internet are necessary for online learning. Despite the fact that online learning lacks face-to-face encounters, this new delivery method has the capability to provide comparable quality instruction to the more traditional educational delivery methods. A variety of software is available to connect participants in an online course and provide opportunities for asynchronous discussion, synchronous chat and the creation of a variety of materials both textual and multimedia.

Today's technology enables fast interaction, research and inquiry through the use of the Internet and hyper link software. The ability to have a vast array of information and data practically at ones fingertips, through an internet connection, increases the potential for deeper learning through discovery and connections of relevance to today's world. Learning and education provide the foundation for the necessary skills to examine the data and draw interpretations and relevance to the present world. To this end critical thinking skills of analysis and synthesis are paramount and necessary across the curriculum. Learning is a necessary activity that is both desired and lifelong. In this context, visual literacy lends itself easily to the online environment. Emerging digital pedagogy emphasizes the central position of the student and the increasing flexibility of the media. Mobile technologies today literally provide for the anywhere, anytime

participation of the learners within their environment. The enormous databases accessible through the Internet and the evolution of sophisticated technologies for both visualization and imagery compound the possibility of amplifying the connections between different areas of research. To promote lifelong learning, the innate curiosity of the student must be developed and this can be accomplished by revealing the connections and the relevance of the subject under study to everyday life. The Internet allows for easy to accomplish links between different areas and subjects that can provide further insight into a given image. From the chemical analysis of the materials used in a work, to the stylistic analysis of the work and available historical data, additional information can be gathered about objects from the past, which may reveal their functional or aesthetic purpose. The celebration of diversity of the current world emphasizes a variety of experience and multiculturalism. But as symbols, colors and images have different meanings across the globe, the skills of visual literacy are necessary for both sensitivity and tolerance. The interactive elements of an online course prompt individuals to connect given imagery to their contexts, the artist or historical periods, to the myths or icons being presented, and thereby to discover deeper meanings within the works. Such an inquiry of necessity would bridge a variety of subjects and cultures incorporating diverse experiences as well as personal interpretations.

#### **4. Components Online course**

The design process for an online course is very similar to that of a traditional class with the exception of the means of communication and interaction. One begins the process with clearly outlined learning objectives which indicate the purpose and function of the course. The quality of the course depends not only on the interaction between participants, but also on the

material studied and structure of the class. The learning objectives are followed by a variety of instructional materials, which promote and enhance the learning process, leading to a deeper study of the material. The students demonstrate their level of understanding of the material through a variety of projects, portfolios, exams or discussions. Successful learning depends of the active interaction of the participants engaged with both the content and each other in the common search for meaning and understanding. Carefully crafted discussion questions can lead the student on their own paths of discovery and further their inquiry into the subject. Critical thinking skills can be developed for the analysis of various media and materials for the course. For example, in a humanities course a variety of the visual and performing arts would be connected with literature, religion, history, economics and political or social movements. In business and science courses, simulations, experiments and data visualization form a key component of learning. But the ultimate goal of all learning is gaining a deeper understanding of oneself and of the modern world by becoming a critical independent thinker able to connect information, make successful decision and solve various problems.

### 5. Conclusion

The digital media of today's world is transforming the way human beings gather, process and evaluate ideas and information. Traditional reading is increasingly being supplemented by browsing, listening or viewing material on the Internet. Visual literacy teaches us about the different relationships between human beings, the interconnectedness of various ideas and subjects, the ubiquity of the visual means

of communication ultimately enabling each of us to participate fully in the modern world and thus it requires careful, vigilant and critical scrutiny in its use.

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## 39th ARA Congress Lucian Grigorescu

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**Abstract:** This presentation continues the series dedicated to the Modern Romanian Art Masters of the late 19<sup>th</sup> and 20<sup>th</sup> centuries and their important contribution to the evolution of Romanian Art. This paper examines the work of Lucian Grigorescu (1894-1965), an important and original Romanian Post-Impressionist, who skillfully fused the perceptual vision of the impressionists with the structural analysis of the post-impressionists and unique Romanian motifs. Lucian Grigorescu created a balance between tradition and modernity infused with a personal sensibility and delight in nature rendered through a vigorous construction of form bathed in color and light. This paper proposes to unveil the unified continuity of a spiritual and material universe rendered through a vivacious symphony of color and the virtuosity of brush strokes in the oeuvre of the great colorist - Lucian Grigorescu through an analysis of some of his important works. Introduction.

### 1. Introduction

The evolution of Modern Romanian Art includes significant influences from the various styles that arose throughout Europe during the late 19<sup>th</sup> and 20<sup>th</sup> centuries, but is infused with strong indigenous characteristics based on the unique Romanian landscape and way of life. Among the great Romanian artists of the early 20<sup>th</sup> century Lucian Grigorescu stands out as one of the most important colourists whose paintings exhibit a chromatic vivacity of colour revealing the subtle variations of the landscape motifs, especially those of Cassis and Dobrogea that permeate his oeuvre. Lucian Grigorescu is considered a postimpressionist but his importance lies in his contribution to the art of the 20<sup>th</sup> century through the unique combination he achieved especially in landscape painting through which, following the example and influence of Andre Derain and Paul Cezanne, he opened new horizons in the expression of nature filtered by his own unique sensibilities. Although Lucian Grigorescu's oeuvre primarily focuses on landscape, human nature and portraiture also interested him, which he rendered with great sensitivity and observant compassion in vibrating brush

strokes and juxtaposition of pulsating colours.

### 2. Biographical notes.

Lucian Grigorescu was born on February 1, 1894 in Medgidia [1], a city in Dobrogea, almost equidistant from both the Black sea and the Danube River situated at 24 km. from the famous site of Cernavoda whose history extends thousands of years back to the Neolithic period [2]. His love of nature was revealed during his early high school studies at Constanta and Braila, where he often took long walks through the marshes. He continued his studies at the Academy of Belle Artes in Bucharest, respectfully remembering his teacher Gabriel Popescu as a 'highly modest man' [3]. Unfortunately these years were interrupted by military training and fighting on the front during WWI in 1916, an experience which left him wounded, returning in 'crutches and overwhelmed' [4]. After earning his diploma in Bucharest in 1920, he opened a personal exhibit which was followed by three years in Rome, of which he later confessed that 'the blue intensity of the sky devoid of transparency exhausted him' and thus he went to Paris, where he enrolled in the private Academy La Grande Chaumiere and Academy Ranson to study with Bissiere and Lapicque [5], but endured misery and

hunger supporting himself with odd jobs. Finally, with money earned from costume designs for various theater productions, he managed to travel to Cassis-sur-Mer, where he established himself for the next 12 years, having discovered the fascination with the sunlit landscape of the south of France similar to Matisse, Picasso and Derain [6]. During this time however, Lucian Grigorescu continued to remain active in the artistic life of Romania by participating in Official Exhibitions and group exhibits such as the Artistic Youth, Our Group (which later became the New Group in 1939), and the Arts [7]. He also exhibited in Europe at the Hague, Venice, Bratislava, Prague, Helsinki, Dresden and in 1937 he became an Associate member of the "Artistic Youth" [8].

From the travels through Rome and France, Lucian Grigorescu discovered the atmospheric vibrations through which light dematerializes volumes, and while he adopted the ephemeral look of Impressionism, and continued the sensibility of his famous predecessor whom he admired, Nicolae Grigorescu, he infused his works with the new international approach to the depiction of form [9]. At first he felt spiritually attached to Ion Andreescu whose works indicate a lyrical sensitivity to tonalities which suggest forms and their spatial relationships. During his sojourn in the South of France, Lucian Grigorescu discovered the 'joy of painting' through the opulent effect stemming from the application of paint in thin layers of refined and harmonious colors [10]. Although his painting remains dedicated to 'plain-air', his work is Post-Impressionist echoing the geometrical order of the construction of forms of Paul Cezanne which transformed the visible reality of landscape through the strong sensibility of the painter. The years in Cassis were punctuated often by difficult misery, but in 1940 Lucian Grigorescu organized a personal exhibit at the Athenaeum in Bucharest [11]. Upon his return to

Romania, the painter continued the pictorial lyricism and joy of color aiming toward an ideal synthesis of color, light and form, representing reality filtered through an intensely subjective experience and gaining the label of 'the most painterly painter' [12]. Lucian Grigorescu returned to Romania at the outbreak of WWII working mainly in Dobrogea, whose light he considered "pearly and miraculous" [13] and in Bucharest where he was one of the few painters to render vedute of the city during the war years in oil, gouache and watercolor. He died on October 28, 1965 in Bucharest.

### 3. Artistic philosophy and style.

Lucian Grigorescu was a highly original painter whose oeuvre harmoniously fuses impressionistic techniques with an abstract expressionism, based on the deliberate and rationally articulated construction of forms and chromatic virtuosity. He strongly believed that artistic creation requires conscientious and considerable effort and energy, founded on complex personal discoveries and sensible experiences [14]. While Lucian Grigorescu appropriated the rational and geometric lessons of Cezanne and the colorism of the fauves, his lyrical and ardent temperament led him to an emphasis on chromatic verve and atmospheric luminosity [15]. It is important to note that while various influences can be detected in the work of this great colorist, he never copied any particular style, claiming that 'influences are necessary without blindly and slavishly following them' [16] as they must be felt in order to be authentic and the essential element remains continuous and diligent work. His palette reveals an affinity for the emerald greens, cadmium reds, ocher and intense blues applied in a symphony of vibrant color that assured the architectural composition of the work [17]. The infusion of light dematerializes volumes accentuating the spontaneity of the paint application and thereby reinforcing the

sheer joy of nature and of the act of creation [18].

#### 4. The oeuvre.

Early in his career, Lucian Grigorescu's works revealed affinities to the impressionist style, but in the 1920's his works began to show the influence of Derain and Cezanne while his discovery of Cassis led to a brighter and richer palette as his painting "became characterized by a robust spontaneous sensuality and an unbridled vitality in its evocation of nature" [19]. Working backwards from the constructivist abstraction the artist arrives at a personal combination of fidelity for the concrete reality, expressed analytically through a synthesis of forms spontaneously rendered in a chromatic play of loosely applied paint [20].

"Landscape with a Red Church" (Figure 1) exemplifies the planar construction of shapes juxtaposed in layers of vivid red balanced by a cold green and a clear blue with ochre-brown tones. The high horizon line situates the viewer in an elevated almost birds eye view of the church whose brightness focuses the attention but whose sketchy rendering with bold and rapid brushstrokes, characteristic in the art of Grigorescu, implies a spontaneity and immediacy of vision, hiding the deliberate construction of the picture plane. This work was originally part of the collection of Gabaret Avachian and was sold at the Spring Auction of Artmark in 2011 for 10000 euros [21].



**Figure 1.** Landscape with Red Church

The synthetic constructivism of Cezanne is apparent in "Dobrogean Street" (Figure 2.), a work that indicates the starting point in the work of Lucian Grigorescu toward a personal impressionistic vision framed within a generalized postimpressionism. The restricted palette of earth tones renders a concrete verism to the scene according to classical even architectural principles while the quickly sketched figures focus the perspective and provide a counterpoint to the modular construction of the planes [22, 23]. The uniform application of paint reinforces the linear rhythm of the architectonic construction, but the diagonally placed parallel brush strokes give the impression of hastiness in their rendering, contradicting the carefully constructed composition. The diagonal line of the road centers the attention of the viewer on the middle ground and the distant figure placed almost in the center of the composition balancing the geometrical shapes of the houses. This painting was sold at the Oriental auction at Artmark in 2010 for 30000 euros and included a label of participation in the exhibit 'Artistic Values' from Bucharest collections, MNAR, Muzeul Colectiilor de Artă, București, 2002 [24].



**Figure 2.** Dobrogean street

Among the relatively few portraits Lucian Grigorescu painted, the "Harlequin" (Figure 3.) should be noted for the stark contrast between the nostalgic sadness of the figure and the bright colors of her clothing. The classical three quarter turn of the figure is

thrust into the foreground by the intense amorphous shape of the chair, crowned by the anchoring curtain cleverly placed behind the figure, to balance the cerulean emptiness bringing the viewer back to the dreamy sadness of the lady. The golden hue of the costume highlights the bright blue which tonally complements the background further evidencing the figure. Yet the carefully constructed composition and the vivacious tonality leaves the viewer baffled about the inexplicable sadness or melancholy of the figure. The evanescent, dematerialized face suggests a Venetian setting of arabesques, carnival and lyricism [25]. This work can be seen in the collection of the K.H. Zambaccian Museum in Bucharest [26].



**Figure 3.** Harlequin

The twelve years Lucian Grigorescu resided in the south of France infused his works with the brilliant sunlit color that fascinated him as much as it did in previous decades numerous illustrious artists, and inspired him to create a series of paintings of Cassis. These early works of the 1920's reveal the gradual evolution of Grigorescu's unique style from the formal analysis and construction of shapes to the later exclusive reliance on color and paint, to frame the motif visible in the cycle of works depicting Balcic, another preferred location of the artist. These picturesque land and seascapes are often characterized by high horizon lines and sweeping panoramic vistas peppered with colorful highlights of

cadmium roofs and contrasting details evoking an aura of serenity and peace. In Figure 4 the 'View of Cassis' presents a dreamy composition in which the dabs of color appear like a mosaic, clearly separating the composition into two distinct registers. The distant ultramarine horizon of the sea imperceptibly merges into the hazy sky grounded with the centralized placement of the three flagpoles whose flags appear to be gently fluttering in the breeze. The sunlit façade of the foreground house vibrates in the sun further accentuating the misty view of the empty street suggesting a lazy afternoon siesta. This work was sold at the Artmark Impressionism and Postimpressionism auction in 2011 for 19,000 euros [27].



**Figure 4.** View of Cassis

During the 1940's Lucian Grigorescu is one of the few artists to paint numerous views of Old Bucharest thus preserving the views of the capital during the difficult years of WWII. The majority of these works in oil, gouache or watercolor present the same characteristic high horizon line, most likely having been painting from the studio, and a mosaic of rooftops quickly sketched in assertive and spontaneous strokes of rich complementary colors. In later decades, the painter focused his attention on still life carefully arranging various bowls of fruit, or flowers in his studio. These works are infused with the afternoon light creating a warm and inviting atmosphere dominated by red or orange tonalities, which are often contrasted and fragmented by complementary vermillion.

## 5. Conclusion.

In conclusion, this brief survey of the work of Lucian Grigorescu, examined the unique modernist vision of the important Romanian postimpressionist painter who, while continuing the sensibility of his illustrious predecessor, the great painter Nicolae Grigorescu, discovered a distinctive balance between tradition and modernity. By incorporating expressionistic elements in the construction of forms bathed in light and rendered in a dense chromatic symphony, Lucian Grigorescu became an important Romanian colorist, characterized through his vivacity and chromatic combination of colors.

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# Paradise or Annihilation ~ Paradis sau neant

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**Abstract:** This paper is a continuation of the ideas initiated at the ARA 32nd Congress in Boston, USA [1], many of these poems have been written when the main topic of eschatology was initiated, being faithfully illustrated later within my papers published by the next ARA Congresses. Preserving the initial format of those papers, new poems from my book “Amorfe si Cristaline” [2] were added, as reflected at the ARA 35th Congress in Timisoara, where for the first time here the topic of TRANSDISCIPLINARITY [3] has been approached. This last subject was enthusiastically adopted by the attendees of the ARA 36th Congress in Bari, Italy, within a Round-Table. In the summer of the 2014, in Pasadena, CA the crown of this matter has been brought by the Acad. Prof. Dr. Basarab Nicolescu, with his outstanding keynote speech. The last chapter of [2] has Romanian lyrics for some international hits I wrote, or English lyrics well suited for unforgettable Romanian evergreens. In addition, in this paper is also continued the topic of LIMERICKS, where I tried to sketch in Romanian some more unpaved routes to nowhere. But as always, beyond any shadow of doubt, most of these poems express my gratitude to God, to whom alone should be given all praise and glory for our accomplishments in this life.

## 1. Introduction

Given the importance of the main topic in the Christian poetry that I bring now to your attention, I would love to present it with boldness and humility alike. Some of these poems are not published. The most recent reference to [2] can be found posted by the American-Romanian writer Petru Popescu in Jurnalul National [4]. In the next paragraphs of this essay, fix-form poems, philosophical poems and lyrics poems will follow. Finally, in Romanian, a new kind of fix-form poetry, the limerick - is written.

## 2. Christian Poetry

According to the Word of God, the Bible, the most important thing for each one of us is to not disregard the awesome warning about the inherent End of Time, when it will be too late to seek God's redemption...

## RĂTĂCITOR

Eu sunt Calea, Adevărul și Viața,  
Nimeni nu vine la Tatăl decât prin Mine  
(Ioan 14:6)

Rătăcitor și păcătos din fire  
Alergi și-abia de vezi cu chiu, cu vai  
Că-i doar o CALE strămtă către Rai  
Și multe alte largi, către pieire...

Dovezi ? Sunt la tot pasul, ori se-ascund  
Precum adesea Biblia ne-nvață -  
Că-i doar un singur ADEVĂR profund  
Și multe alte mii de suprafață...

Neprihănirea o primim cadou -  
Doar Tatăl știe anul, ziua, ora!  
Că-i doar o VIAȚĂ să te naști din nou  
Și nu le e sortită tuturor...

Cum cartea vieții ne e scrisă sus,  
În toate cele, am doar o povață:  
Să-L cauți cu nădejde pe Iisus,  
Doar El e CALE, ADEVAR și VIAȚĂ !

27 Mai 2005 - Hayward, California

**WAIT FOR THE LORD!**

The world is very close to Judgment Day -  
Therefore, the Word for you will be  
unsealed,  
When many churches have been gone  
astray  
The last of Daniel's prophesies, fulfilled!

What shell you do? Just seek the narrow  
way  
To be Christ's child in this last harvest field  
-  
The world is very close to Judgment Day -  
Therefore, the Word for you will be  
unsealed.

Wait for the Lord! Obey, and trust, and  
yield!  
And be prepared for that expected May,  
When you'll be ruptured for Eternal Build.  
The world is very close to Judgment Day!  
8 February 2008, Hayward-CA

**3. Fix-Form Poetry**

Within the fix-form poetry, there are many  
more usual species such as the sonnets, and  
the rondels, other ones less usual such as  
the pantums, the gazels, the tertines, etc.  
Because of the space constraints, I selected  
here only a sonnet dedicated to my wife,  
and a rondel written when I was teenager.  
The last, but not the least is a distih I wrote  
thinking with gratitude about the General  
Manager of our last year ARA Congress,  
who was instrumental in the real success  
we all enjoyed in Pasadena/Los Angeles.

**SONET ANIVERSAR**

"Așa cum te țineam pe după umeri  
Scrutând cu tine zările albastre  
Spre ani frumoși cât n-o să poți să-i numeri  
Ne cheamă plinul fericirii noastre".

Așa ți-am scris pe spate la o poză  
Acum cincizeci de ani și jumătate,  
Când ți-ai mai pus la vârstă înc-o roză  
Și ți-am urat mulți ani cu sănătate!

La Domnul să-nălțăm un gând fierbinte,

Ne poarte grija și de-acî nainte  
Oricât de lungă ne-o mai fi zăbava.  
Și cât ne-o fi să mai trăim sub soare  
Ne fie viața ca o sărbătoare  
Și-a Domnului să fie toată slava!  
9 Ianuarie 2015, Kirkwood, CA

**RONDELUL AMURGULUI**

Cântecul amurgului se țesea în zarea de jar  
Și patimile cântului sângerău pe bolta  
sinilie.  
Eu hoinăream pe străzi. Știam că alung în  
zadar  
Șoaptele și sângele de pe cer, din inima  
mea pustie.

Eu hoinăream pe străzi. Sub razele lunii de  
var  
Șoaptele și sângele de pe cer păreau că mor  
și re-nvie  
Cântecul amurgului se țesea în zarea de jar  
Și patimile cântului sângerău pe bolta  
sinilie...

Eu așteptam. Uitam de-al clipelor moarte  
habar.  
Stelele cu țintele lor de-argint pe bolta  
fumurie  
Se aprindeau în zări, țesând pânza nopții  
bizar...  
Au șters sângele de pe cer. Dar în inima  
mea pustie  
Cântecul amurgului se țesea în zarea de jar...  
20 Septembrie 1958, Ploiești

**DISTIHI**

For Dr. Ing. Adrian STOICA, from NASA-  
JPL [www-robotics.jpl.nasa.gov](http://www-robotics.jpl.nasa.gov)  
General Manager  
of ARA-38 Congress- July 2014

Cum ne mișcăm așa, târâș- grăpiș  
Nu știm ce perle ne-o mai naște scoica

La San Francisco nu e Păltiniș  
Nici noi nu suntem filozofi, ca Noica.

În schimb, la Pasadena, pe afiș  
Congresul ARA s-a postat prin..Stoica!

16 Iulie, Pasadena, CA

#### 4. Philosophical Poetry

Now, after more than twenty four years from those so-called “first free democratic elections” in Romania, where in fact the second-line communists took over the power, I can still remember vividly how we sang full of hopes for the first time that night of December the 21st 1989 in the University Plaza of Bucharest the refrain which will soon become the Romanian National Anthem “Wake Up, Romanian!”

...

Later, one of those days of spring before the election, I climbed to the Balcony of Geography Faculty among others, and I recited to the crowd my next poem, entitled “Justice”.

#### DREPTATE

Aici la noi sunt toate cum au fost  
Doar gaura din steag și-o baricadă  
Au scris sub gloanțe un refren anost :  
Dreptate, ochii plânși vor să te vadă!

Aici la noi e primăvară iar,  
Dar alte geruri stau curând să cadă  
Peste acel ce strigă temerar :  
Dreptate, ochi plânși vor să te vadă!

Aici la noi nimic nu s-a-ntâmplat  
Doar niște cruci au apărut pe stradă  
Și lemnul lor îngână un oftat :  
Dreptate, ochii plânși vor să te vadă!

Tu, biet Român, aprinde lumânări  
Și stai la pâine la aceeași coadă  
Strigându-ți soarta-n cele patru zări :  
Dreptate, ochii plânși vor să te vadă !

Destul ai tot răbdat până acum  
În beznă, foame, frig și mascaradă,  
Cu noi speranțe, la-nceput de drum  
Dreptate, ochii plânși vor să te vadă !

6 Mai 1990, București

Fifteen years later, as an immigrant from my native country, Romania, I wrote the English version of this poem:

#### JUSTICE

Right now, at home the life is all the same  
Just holes in flags and barricades so clever!  
Was playing under bullets a must-win game:  
O, Justice, weeping eyes call you forever!

Right now, at home the spring will come again  
And heavy winter has to fall however  
Upon all those who're singing this refrain:  
O, Justice, weeping eyes call you forever!

Right now, at home is almost nothing new  
Just crosses on the streets greet one another  
And from their wood a lamentation grew:  
O, Justice, weeping eyes call you, our brother!

You, poor Romanian, candlesticks light there  
And stay in line for bread right now as ever  
Shouting your fate here, there and everywhere  
O, Justice, weeping eyes call you forever!

You bear enough in darkness still to stay!  
You must break your red chains right now or never  
Renewing hopes are shining now your way  
O, Justice, weeping eyes call you forever!  
January 2005, Berkeley, CA

TRANSDISCIPLINARITY is a new way of thinking. According to Alfonso Montuori [5], it can be summarized as requiring a focus on inquiry-driven ideas rather than discipline-driven thoughts.

Transdisciplinarity is founded upon three axioms : 1. The ontological axiom: There are different levels of Reality; 2. The logical axiom: The passage from one level of Reality to another is ensured by the logic of the included middle; 3. The epistemological axiom: The structure of the totality of levels of Reality appears, in our knowledge of nature, of society, and of ourselves, as a complex structure: every

level is what it is because all the levels exist at the same time [12].

But its framework has the origin in the philosophy of Stefan Lupasco [6], and that has been consistently developed through a school of thought within CIRET [7] by Acad. Prof. Dr. Basarab Nicolescu in Paris and all over the world.

The Project aims to create connections in all areas of study, including religious studies, education, science, culture, and arts. Comprehensive works in books and articles about the transdisciplinarity evolution of the university can be downloaded among other sources from the site [8], where the topic of education is based on Jaques Delors' Report [9].

It will be an injustice to dissociate the name of Basarab Nicolescu from his major outstanding work in Physics and Philosophy alike such as *Nous, La Particule et le Monde*. This book has been rewarded with a prize by the French Academy and translated in many languages. Not to mention some other books he wrote, such as *Theoremes Poétiques*, or *De la Isarlık la Valea Uimirii*, translated in several languages of the World, too.

It is hard to touch in the space of this little paragraph the huge amount of studies performed internationally about this hot subject for more than forty years. I will only mention the *Manifesto of Transdisciplinarity* [10], written by Basarab Nicolescu. With his kind permission, this was the subject of the Round Table [11], presented at the 36th ARA Congress in Italy three years ago.

## 5. LYRICS POETRY

When direct access to the western music was a rare privilege in my native country, I found a way to sing beautiful songs whose lyrics I did not know, by writing my own Romanian texts for them. I continued to write these kinds of lyrics for many years to come. The book [2] has an entire chapter, which brings together these lyrics.

Among them, an emotional connotation is tied to the original English version *The Old Rugged Cross* (1913, George Bennard). Finally, my own English translation for the song *Păsărică, mută-ți cuibul*

### PE STRĂVECHEA CRUCE

On a hill far away stood an old rugged cross

The emblem of suffering and shame  
And I loved that old cross where the dearest and best

For a world of lost sinners was slain.

Pe un deal departat

E o cruce de fag

Simbol de durere si blam.

Pentru tot ce mi-a dat

O privesc cu mult drag-

Eu prin ea mântuirea o am!

R: Domnul nostru Iisus s-a jertfit

Pe Calvar pe o cruce la fel

Pentru mine Iisus a murit

Ca să capăt viață prin El.

Acel deal am să-l sui

Oricât mi-ar fi de greu

Pe acest carismatic meleag...

Urma cuielor lui

Am s-o aflu și eu

Săpată în crucea de fag.

R: Domnul nostru Iisus m-a iertat

De povara păcatului greu

Pentru mine Iisus a-nviat

Ca să calc peste moarte și eu.

10 Octombrie 2004, Hayward, CA

### LITTLE BIRD

(Păsărică mută-ți cuibul! - Romanță)

La fereastra casei mele e un plop uscat

O păsărică cuibu-n el și-a așezat

Și tot cântă, cântă-n el necontenit

Fericit e cel ce-n viață n-a iubit....

In the backyard of my house

Three poplars grow -

Little birds between their branches  
 Come and go...  
 Singing songs about the sorrow  
 In my heart,  
 That my love which came one day  
 Now fell apart.

Little bird, move now your nest  
 And fly away!  
 At the window of my lover  
 Go and pray!  
 Sing a song about the sorrow  
 In my curve,  
 That I loved somebody who  
 Did not deserve.  
 19 March 2001, Corte Madera, CA

#### 6. LIMERICKS POETRY

Limericks are fun to create. They are humorous, often bawdy, full of folk wisdom, and delightfully entertaining. They are also easy to write. The subject matter is basic and often self-deprecating. With only three metrical feet on three lines, and two feet on the other two lines, carrying a beat is straightforward, fueling an uncomplicated rhyme scheme: aabba. Best of all, for spoken-word performers, limericks are as simple to think up and memorize as they are to write:  
 The limerick packs laughs anatomical  
 In a space that is quite economical,  
 But the good ones I've seen  
 So seldom are clean,  
 And the clean ones so seldom are comical.

#### CÂȘTIG

Acesta-i talentul pigmeilor  
 Să cumpere grația zeilor

Cerșind din Olimp  
 Moneda de schimb  
 Ce-aduce câștig ...fariseilor !  
 23 Decembrie 2012, Hayward, CA

#### POLITICHIE

Orișicât ni-s de multe angoasele  
 Că trăim într-o lume de-a-ndoasele,

Fără griji și nevoi  
 Se gădesc printre noi  
 Cin' să tragă la urmă...foloasele!  
 20 Ianuarie 2013, Hayward, CA

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- 5) Alfonso Montuori *Cybernetics and Human Knowing*, 2005
- 6) Stephen Lupasco a great Romanian philosopher who developed the Non-Aristotelian logic of Included Third.
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- 8) <http://basarab.nicolescu.perso.sfr.fr/ciret/bulletin/b12/b12c8.htm>
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## The Romanian Goddess *Ileana Simziana* the Sun's sister

Ana R. Chelariu

The large number of statuettes from late Neolithic found in the area called the Old Europe, including the present day Romanian territory and its surroundings, are archaeological evidences of civilizations awaiting for an in depth investigation. The main character of all these archaeological findings is the Great Goddess, the source of life, feeder of men and animals. She is figured as a snake, bird or fish goddess, covering all aspects of life as protectress of all creatures living in the air, the waters or underground. She is the dominant character of the pre-historic mythology, mistress of the entire nature, creator and protector of animal and vegetal life, goddess of fertility and rejuvenation, of the mystery of birth and death, holding powers over life and death. The mother of all gods, she has power over them, as she can generate life without a male, as the only ruler over the earth and sky. This powerful mythical figure survived in the Indo-European pantheon, with characteristics surfacing in almost all the feminine divinities of the classical mythologies.

In the Romanian folklore one can recognize this pre-historic goddess in the character of Ileana Simziana, Iana Sânziana or Ileana Cosânzeana, the most adorned fairy of the land. She is the heroine of numerous songs, carols, and fairy tales; she is the most beautiful of all fairies, their queen, so beautiful that 'one could look at the sun but not at her'.

This Romanian fairy queen is best represented in one of the most popular song, *The Sun and the Moon*, interpreted by special bards at community fests, telling the story of the sun who wants to get married; because he could not find

anywhere a girl as beautiful as his own sister, Ileana, he asks her hand in marriage. To avoid such sin she starts asking him impossible tasks, such as to build first a copper bridge over the sky, then a silver one, and then a gold one, all easily fulfilled by the astral divinity. At last, to escape the unwanted wedding she throws herself into the sea, turning into a fish. God takes pity on her and raises her into the sky, as the moon. (Alexandri 1866)

The mythical motif of the wedding or erotic relationship between the sun and the moon is to be found in many Indo-European traditions, although, the many different characteristics attributed to these divinities generate sometimes confusions between the divine pair sun-moon and divinities associated with the sun and the moon that are also brother and sister. The motif of their marriage is found in a fable by Phaedrus, where the frogs are worried that the sun wants to marry and have children, which could mean more suns and heat; they start a big noise that rises to Jupiter's ears. (Phaedrus *Ranae ad solem* I-6) This version is popular south of the Danube, together with the one in which the sun falls in love with a mortal girl, more common to Serbia, Bulgaria, and could be found also in the Romanian song "Chicory". (Vrabie 1966)

To establish the goddess position on the gods' pantheon in association with the luminous divinity of the sun, we could examine the many examples of brother and sister that are also the sun and the moon from classic mythology, among whom the most important is the divine pairs Zeus-Hera. Brother/husband and sister/wife they are often associated with the moon and the bull, as in the description: Hera, with her

cow eyes, and Zeus, her bull consort. The divine pair Artemis-Apollo although associated with the sun and the moon does not seem to be involved in an erotic relationship. But Selene, the moon goddess, appears sometimes as Helios' sister, and sometimes as his wife. In her myth, every night Selene goes down to Mount Latmos in Karia, where in the darkness of the cave she kisses Endymion, her sleepy lover. Although in some stories Endymion is a mortal, his name is one of the many callings of the sun. According to Max Müller, in some Greek dialect *enduo* was used in the sense of the sun sinking by night in his mother's purifying water, and from this was formed *endumion* to express the sunset. In time, people would say "Selene loves and watches Endymion", meaning 'it is getting late', or, "Selene embraces Endymion" for 'the sun is setting and the moon is rising', and the original meaning of his name would be forgotten. (Müller 1872: 52-141)

The motif of a girl refusing to marry and throwing herself into the sea is also found in a Minoan legend about the goddess Britomartis, a nymph in service of Artemis, who runs away from the attentions of Minos, and jumps over a cliff into the sea; she is caught and saved by some fishermen, and brought to the island of Aigina, where she becomes a deity. (Callimachus *Hymn to Artemis*)

In the Vedic hymns, Yama, the god of death and the sun god in the same time, together with his sister Yami, are the divine twins creators of humanity. The goddess Yami, as the Romanian one, refuses to marry her brother, arguing the immorality of such an act, but her Persian counterpart will submit to it (Puhvel 1987).

In the Baltic *dainas* the moon is a male deity and the sun a female and their marriage results in many children, the stars. (Dundzila 1991) In the Nordic sagas the sun is also female, as in the Baltic songs, and her companion, the moon is a male; they are children of Mundilfari, thus

brother and sister. (Snorri *The Prose of Edda* 2005: 19) In Scandinavian mythology we find that Njördhr, the oldest among Vanir, married his sister and had as children the divine pair: Freyr, associated with the sun, the sky and the rain, and his sister Freyja, the most beautiful and fair among the goddesses. (Puhvel 1987: 208)

*Ileana Sânziana / Cosânzeana / Simziana*, the queen fairy in the Romanian folklore, the sun's sister, is a brilliant goddess with golden hair associated with the waving fields of wheat. Her epithets are 'the beautiful', the moon fairy, 'lady of the flowers', protectress of the wild animals and the forests. In some Romanian Christmas carols she appears carried in a silk hammock hooked sometimes between a stag's horns, sometimes between a bull's horns. This archaic divinity, as the goddess from Chatai-Huyul holding the lunar horn, the new moon, indicating the cyclical death and resurrection, has the function of *Terra Mater*, a divinity considered to pre-date the arrival of the Indo-Europeans. Her paradoxical character is illustrated by her duplicity, virginity-maternity, contradictions that indicate the archaic mystery of the divine persisting in many European myth and legends. Perhaps the splendor of this archaic divinity is illustrated best in the Greek character of Hera *bo-opis* 'cow-eyed', the Queen of Evening Sky, of full moon, together with Demeter, the distressed mother, whereas the virgins Artemis, Persephone and Helen are goddesses of the new moon, the growing moon.

The name of the Romanian deity, Ileana, sends us to the Greek goddess Helen, both related to an archaic goddess mentioned in Mallory-Adams's *Encyclopedia: \*il(i)eh<sub>a</sub>* – 'goddess name', Lat. *Ilia* 'Numitor's daughter', Skt. *Ilā-Idā* 'Manu's daughter'. Note that *Ilia* was the daughter of the progenitor of Romulus and Remus, the Divine Twins, and the OInd *Ilā* was the granddaughter of Vivasvat, father of the twins Yama and Yami, as Helen was the

twin sister of the Dioscuri. (Mallory-Adams 1997:232) Other researchers consider Helen a pre-Doric version of the 'tree-goddess' having roots in the substratum, "...her name does suggest the Vedic Sūryā (*Helēnē* perhaps from *Swelenā*, cognate with *Helios*< \**Sāweliyos* 'Sun' and with Avestan *xvarənah* < \**swelnos* 'solarity')" Puhvel (1987: 143). It seems therefore, possible that this archaic deity, this goddess Iliā, the Helen of Greek tradition, and the Romanian Ileana, the sun's sister, are all related.

Helen is portrayed on monuments between her two brothers, Kastor and Polydeukes, holding the lunar horn, the growing moon, while the brothers have stars on their hats and tunics. The relationship between the lunar horn and Helen is also reflected in an old Greek tongue twist: *ελενη σεληνη*, meaning that the egg holding Helen fell from the moon (Chapouthier 1935). She was believed to be the most beautiful woman in the world, as the Romanian Ileana, and displays similar connection to flowers as it is found in a tradition in Sparta where young girls would hang flower wreathes from a certain tree consecrated to her. This may be based on the story in which she was hanged by the orders of a jealous queen, thus her other name Helen Dendritis (Chapouthier 1935). Likewise, there was the Romanian custom held in late spring on the day of Sânzienē, flower fairies and forest spirits, Ileana's companions, when Romanian girls would make flower wreathes and throw them on the house chimney, hoping to get married that year. (Ghinoiu 2003)

Ileana's other appellative, *Simziana/Sânziana/Cosenzeana/Cosân-zeana* was the subject of various controversial explanations. In the Explicative Romanian Dictionary (*Dictionarul explicativ al limbii române*, DEX online) the etymology offered for this appellative is the Latin group *sanctus dies Johannis* (an opinion shared by many prominent Romanian

linguists), based on the fact that Sânzienē day is celebrated on June 24<sup>th</sup> Saint John Day. This day was established as the Nativity of St John the Baptist, as listed by the Council of Agde, France, in 506 AD, a the Christian church attempt to associate a feast to the summer solstice folk ceremonies celebrated all over Europe, even though there was no religious connection between the two. The Romanian Simzienē/Sânzienē, are fairies feared by all, associated with the nocturne rites to collect powerful medicinal plants, and have little if any relation to the Christian Saint who baptized Jesus. It is supposed that the phonological innovation *sanctus dies Johannis*>sim(pt)-dzi-*iuane*>sânzianē (Candrea 1927) incorporated this major Christian Saint in popular customs associating His birth day with the goddess of the land Ileana, while remaining in common and religious usage with His original name as Sântioan<Sanctus Ioannis<Greek Ιωάννης, also known in the northern part of the country as Sânt'ion, Sâmc'iuonu, Suntuonu (Bolocan 2012). Yet, it is difficult to accept that the appellative denominating Saint John's fest became a qualifier for the most beloved fairy of the land **Ileana Simziana/Sânziana** and her entourage of fairies.

Mircea Eliade used the concept of Diana Sancta, Sancta Diana>Sanziana, assuming that the Rom. *-ziana* is a development from the Roman goddess Diāna. Based on the adjective *dius*< \**diwios* the form Diana < \**Diviānā*, is a feminine of the sky god *Dius*, as in *Dea Dia*, related to Jupiter and meaning just 'divine' (Puhvel 1987: 151). The relation between this Latin deity and the Romanian Ileana, *zāna florilor, sora soarelui*, 'the flowers fairy, the sun's sister,' may be difficult to establish, since Diana is not known to have the luminous aster as her brother. Perhaps a better approach to understand this archaic divinity would be to consider her appellatives Simziana in

connection with her attributes of the Queen of the flowers and the forests, the Earth Goddess, found in the Thracian mythology as *Σεμελη* ‘Mother of Earth’, and Semele, *διωσ ξεμελω*, mother of Dyonisos, subject of a cult among the Phrigians as well as the Scythes. This Semele, believed to be Cadmus’ daughter, whose name means ‘earth’ has correspondences in Indo-European languages: in Thracian and Phirgian: *ξεμελω*, OSlv.: *zemlja* ‘earth’, Lithuanian *Zemyna* ‘Earth Goddess,’ cognate with Lat. *Humus*, Gr. *Ξαμ-αι*, *Ξαμ-ωνη*, Demeter’s name, and possibly with the Cretan *δηαι*, Ionic *ζηαι* meaning “barley”, so that she is the Corn-Mother and the giver of food. The Lithuanian goddess *Zemyna*, *Zemyne*, *Zemynele*, and the Latvian *Zemes*, “the Baltic Earth Goddess is both grain and mother-nourisher, out of whom humans arise and to whom they return” (Dundzila 1991). The Proto-Indo-European root for ‘earth’ as listed by Mallory-Adams (2006) is *\*dhéǵhōm-*, Skt *kṣam*, Av *za*, *zam*, *zme*, Grk *kthōn*, Lat *humus*, Lith *žėmė*, OCS *zemlja*, Alb *dhe*, Hit *tēkan*, Toch A *tkam*; it survived as ‘human being, earthly’ and as I mentioned above as ‘goddess’ in Phirgian *ξεμελω*, Thracian *Σεμελη* ‘Mother of Earth’. We can recognize how for thousands of years the essential characteristics of the Earth Goddess remained the same, as in Demeter, Semele, *Zemyne*, and even at a later date as a male deity, the Dacian *Zamolxes*, the god who disappeared underground for a number of years. Among the few known Dacian words, preserved by Dioscorides, there is *διεσεμια* ‘luminărică’, a small plant which makes a bright yellow flower, formed of the I.E. root *\*dei-*, *di-*, *dia-*, ‘bright, sun ray’ and *σεμια* ‘Earth’, thus ‘light coming from the ground’, attesting the presence of the word on the Dacian territory. This the PIE *\*dhéǵhōm-* ‘earth’ may help explain the appellative *Ileana Sim-ziana*, meaning the fairy of the Earth, of flowers, of the forests, and her companions the *simziene/sinziene*,

the Romanian word for fairies of the land. Parallel with the form *Simziana*, that of *Sânziana*, may be a result of the Latin influence, a contamination with *sanctus*, *-a*, as it is reflected in toponyms like *Sân Petru*, *Sân Giorzan*, etc. Another possible explanation for the form *Sim-ziana* could be the P.I.E. *\*sem*, *som*, *sm* expressing the concept of ‘oneness in conjunction with others’, a very productive root in I.E. languages. Some examples include Lat. *semper*, *singulus*, *simplex*, *simul*, Toch. *sam-*, ‘equal, the same’, Skt. *samitarām* ‘together’, *sambhārana-* ‘bring together’, *sam-*, ‘complete, perfect’, *samvasa* ‘living together’, Av. *hangam*, ‘to get together’, etc., (Caruba 2000). If we apply this root to our Romanian fairy *Sim-ziana* it could mean that she is a deity belonging to the group of fairies, Rom. *zîne* ‘fairies’, the *simziene*, ‘one-together with, but unique’ among the other fairies, their mistress.

The form with diphton *-zeana*, *ziana* from *Sim-zeana*, *Cosân-zeana* seems to be the result of assimilation with *Ileana*, and *zâna* > *zeana*. One may have to take into consideration the tabuistic aspect of these developments, as pronouncing these words was regarded as potentially dangerous.

In the Romanian folklore the fairies, *zâne*, are beautiful and kind, as opposed to *iele* ‘they’, fairies that could turn very aggressive towards mankind. Their number is unknown as there are fairies of flowers, of fields and birds, fairies of springs and lakes, and the most important one, ‘the fairy of fairies’, ‘*zâna zânelor*,’ the most beautiful of all, *Ileana Simziana*. In the spring time the tradition was for children and unmarried youngsters to start a fire, made only of specific woods and the core of ear corns. Around the fire they will put a jug with water, bread and three chairs, in the belief that the fairies will come to wash, eat, warm up by the fire, and bring good luck to the house. (Olinescu 1944: 418) As fairies of flowers the Romanian *zâne* are spirits of the earth, helpers of the Great Goddess, *Ileana Simziana*.

The word ζήνα is listed by Dioscorides as a Thraco-Dacian word (Russu 1967) with the meaning 'hemlock'. Looking further into this word etymology we find Skt. jyanay-, Av. zyanay-, zyana-, 'to overcome, conquer, weaken', with a reconstructed form \*ĝiena<\*ĝeie-'subjugate, overpower, oppress'. (Detschew 1976) Thus the argument can be made that the Dacian word 'zena' meaning 'hemlock', presents another etymology for the Romanian *zîna*, plural *zîne*, feared powerful fairies, that could 'subjugate' 'oppress' people, do damage to their health, cripple them, if not revered. They were companions of Ileana Sim-ziana, the 'simziane, sânzienne', are flowers fairies, with their own festival on the summer solstice, the day of collecting medicine herbs, feared and revered by women in many rituals and songs.

One note on the moral aspect of the story, the incest, as in certain areas this was rejected and in others it was accepted. In the Baltic and South Slavic cases the marriage between the two stars was considered normal whereas in the Romanian data is immoral, as in the Indian tradition. These two different attitudes may indicate that the myth was readapted in a newer context when the immorality of incest prevailed, even if it involved two divinities, as the mythical connotations were lost. In the other cases perhaps the emphases was on the astral, non-human, aspect of the characters, thus the incest was not regarded as a moral issue. Both aspects could tell us something about the myth and its development in those regions

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# Filozofia ca încercare de întemeiere și gasire a unui sens pentru modernitate

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Rezumat : Ceea ce intenținam să arătăm prin parcurgerea succintă a cinci mari gânditori (Descartes, Kant, Hegel, Husserl și Heidegger) este că filozofia autentică trebuie să rămână totdeauna o formă de inserție în concret, astfel încât principiul libertății, atât de pretios modernității, să se realizeze pe sine în mod responsabil. Eforturile contemporane pentru întemeierea unei lumi mai bune pot fi duse la bun sfârșit dacă vom pune în practică ceea ce filozofia a încercat prin reprezentanții ei cei mai de seamă : să fundamenteze cu luciditate și responsabilitate direcția de construire a unei lumi conștiente de implicațiile ei multiple. Scopul unei asemenea prezentări este de a face cu putință dialogul, deliberarea și punerea în acțiune a unor acte care să genereze o dezvoltare durabilă și cu cât mai puține riscuri. Apelul la un tip de transcendență pe care să o percepem nu ca pe o substanță exterioară ci ca pe o sacralitate existentă în noi, ar putea servi de asemenea scopurilor menționate mai sus.

Ma bucur să putem discuta astăzi însemnătatea și rolul pe care le-ar putea avea filozofia în raport cu problemele ridicate de era globalizării, a multipelilor transformări și inovații, heteromobilității accelerate, internetului, tehnologiei nucleare, agriculturii intensive, bioeticii, clonajului, economiei galopante, dezradacinarilor maselor, dezvoltării durabile, eugenismului, ireversibilității temporale, terorismului, responsabilității, rațiunii, libertății, demnității umane.

Întrebarea care se naște nemijlocit din întâlnirea cu toate aceste "creații-probleme" enumerate, este următoarea : poate filozofia în forma sa actuală în care nu mai este reprezentată de nici un sistem speculativ încheiat care să conducă la cunoaștere, estetică și moralitate absolute, să indice sensul unei noi orientări fundamentate pe normele pure ale rațiunii și demnității umane? Poate ea construi o critică constructivă, izvorată din redescoperirea propriilor ei fundamente: adevărul, binele, frumosul, astfel încât să redăm vieții și umanismului, sensul

spiritual care le sunt proprii? Dar mai ales potrivit idealului sau de iubire de înțelepciune poate filozofia să coboare în modernitatea actuală ca știința atotcuprinzătoare capabilă să unifice diversitatea descoperirilor naturale, arătând clar că sensul lor legitim este conservarea umanismului și a demnității ca scopuri în sine. Poate ea să reîntemeieze idealurile Reformei, ale Renasterii, Iluminismului, înțelese ca fundamente pentru aventura modernității?

Știu cu toții cât de circumspecti sunt astăzi însuși filozofii modernității în privința fundamentului și a unei filozofii întemeiate pe radicalitatea Cogito-ului cartezian, pe Dumnezeu creator, sau pe Ființa parmenidiană. Filozofii de astăzi sunt dispersați în spațiul vid al lipsei de fundament al unei lumi accelerate și urgente. Ei se află în situația, împreună cu toate celelalte discipline, de a nu mai putea indica forma tipică după care fiecare disciplină să se fundamenteze și cu atât mai puțin adevărul după care toate aceste discipline trebuie să fie legate împreună astfel

încât descoperirile lor să fie dirijate spre binefacerile omului.

Și totuși, oricât de dispersate și diversificate ar fi opiniile filozofilor în incapacitatea lor de a indica o întemeiere, există negresit o definiție a termenilor cu ajutorul cărora ne exprimăm și o gramatică prin care ne facem mai clare și mai consolidate mesajele lingvistice și astfel ne facem înțeleși. Aceasta ne face să înțelegem ca există, contrar aparențelor, o sursă, în esența gândirii întemeietoare, care să facă posibilă conexiunea notiunilor în așa fel încât atât cel care se exprima cât și cel care receptează să înțeleagă sensul obiectiv valabil al unui mesaj. Să fie acest fundament de comunicare o treaptă către găsirea unui sens al unei noi întemeieri?

Desigur, în viața curentă și în dezbaterile accelerate ale modernității, ne întâlnim cu o serie de teorii aparute sub presiunea evenimentelor care ne depășesc prin viteza lor și astfel aceste teorii nu-și pot extrage esența din forma pură a adevărului sau înțelepciunii, așa cum ar fi de dorit pentru o filozofie fundamentată. Dar tocmai această capacitate de constientizare a situației limită în care suntem puși când decidem precipitat sub presiunea eficienței și a realizării de sine sau a progresului nedefinit, ne luminează asupra problemei dezvoltării durabile, ca ființe demne și responsabile față de provocările lumii actuale.

Imaginea unor transcendente care ne depășesc, zeii, vin de pe filonul culturii grecești, aceea a unei unice transcendente prin cultura iudaică, iar aceea unui Dumnezeu care se exprimă pe sine în cele trei ipostaze ale Sale, Sfânta Treime, prin cultura creștină. Pentru Europa creștină și pentru civilizațiile occidentale de astăzi care au atins un anumit grad de prosperitate, democrație și libertate, acest fapt este incontestabil și determinant. Numai într-o cultură în care Dumnezeu ne-a creat liberi prin acordarea alegerii între

bine și rău putea să se nască și sensul mai adânc al libertății responsabile.

Încercând să explice sensul procesualității istorice, Hegel arată că formele succesive ale libertății se depășesc unele pe altele pentru a ajunge la forma ideală realizată, împlinită. Cu toate acestea, nu trebuie decât să luăm cunoștința și să fim sensibili la formele precare, la esecuri, la ratări și la ampla suferință a atâtor oameni, chiar și în societățile avansate social, economic și politic pentru a avea o poziție critică față de acesta viziune finalistă. E posibil ca istoria să nu-l fi înțeles bine pe Hegel, însă nazismul și comunismul, care au urmat în timp viziunii hegeliene, infirmă edificarea statului modern, așa cum îl concepușe filozoful idealismului absolut.

Lumea modernă prinde contur în mod explicit prin filozofia lui Descartes (1596-1650). El acordă filozofiei un rol precumpanitor, considerând-o ca fiind unitate a tuturor științelor. Însă ca ea să-și realizeze rolul sau fundamental, este necesară o reconstrucție a ei, orientată către subiect. Unica sursă din care poate lua naștere orice cunoaștere autentică și orice veritabilă filozofie este eu-l cogitațiilor pure. Eu mă îndoiesc, deci cuget, cuget deci există, este singura certitudine a mea, deoarece este posibil ca ceva despre care cuget să nu existe, dar nu este posibil ca îndoiala mea să nu existe ca cugetare, deoarece ar fi absurd. Chiar dacă as afirma că eu cel care mă îndoiesc sunt inexistent, cel care afirmă acest lucru sunt eu însumi, deci eu există. Unicul teren ferm și care nu poate fi eliminat sunt eu cel care judec și astfel filozofia și-a dobândit cu adevărat libertatea sa, care rezidă numai în propria sa gândire, orice altă autoritate sau prejudecată fiind excluse. Aceasta este imensa contribuție pe care a adus-o Descartes la întemeierea subiectivității, libertății și independenței rațiunii, surse primordiale pentru constituirea modernității. Criteriul adevărului se află, începând din acest moment, doar în rațiunea însăși ca expresie

a claritatii si distinctiei care trebuie sa o caracterizeze pentru a o conduce la cunoasterea evidenta. Indoiala metodica care conduce la certitudine, respectiv certitudinea existentei mele ca subiect ganditor liber si ideile clare si distincte sunt cele doua mari principii metodologice descoperite de catre Descartes.

Pe langa aceste doua principii, Descartes mai descopera si patru reguli care conduc bine ratiunea în demersul sau de cunoastere. Aceste reguli pot fi prezentate ca un proces de descompunere a lucrurilor în elementele lor simple care apoi se recompun prin deductie, aceasta mergând, potrivit exprimarii lui Descartes, din evidenta în evidenta si se ridica prin inductie la adevaruri generale. Astfel, Descartes a adus o contributie deosebita procesului complex de matematizare a cunoasterii prin folosirea deductiei si a inductiei, care se completeaza strâns împreuna. Nu se poate imagina matematica de astazi cu aplicatiile ei multiple fara fundamentul ei modern care porneste de la Descartes. Putem spune chiar ca Descartes este primul care încearca sa justifice ipotezele nu doar prin experienta ci si prin calculul matematic.

Putem vedea de asemenea în tratatul despre suflet, "Les passions de l'âme" al lui Descartes începuturile psihologiei moderne. Descartes va clasa si defini pasiunile începând cu cele fundamentale (dragoste, ura, tristete, bucurie) pâna la cele morale, articulate pe principiul libertatii: prudenta, stiinta, generozitate. Contributia acestui ganditor la valoarea subiectului epistemic prin demnitatea ratiunii si cercetarea metodologica au avut o semnificatie fundamentala pentru constructia modernitatii.

Descartes a avut, catre sfârșitul evului mediu, un precursor care poate fi considerat primul filozof al Renasterii în persoana lui Nicolaus Cusanus (1441-1464). Acesta se opune cu determinare logicii scolastice, al carei criteriu de adevar era non contradictia, explicând în mod

speculativ accesul cunoasterii intelectuale la un adevar mai adânc, care integreaza aparentele opozitii prin conceptul de coincidentia opozitorium. Astfel, în Dumnezeu, care este infinit, contradictiile finite dispar, el fiind maximum si minimum, niciunde si peste tot. Cusanus anticipeaza astfel dialectica speculativa a unitatii contrariilor din marele sistem speculativ hegelian.

Modernitatea se naste desigur si cu aparitia noului spirit stiintific capabil sa rastoarne pozitia noastra în univers. Geocentrismul Sfintelor Scrieri este înlocuit de catre Nicolas Copernic (1473-1543) cu heliocentrismul, în care acum Pamântul se invarteste în jurul Soarelui. Dar noua orientare epistemologica vine odata cu publicarea lucrarii lui Galileo Galilei: "Mesajul celest" (1610), în care el arata ca marea carte a naturii este scrisa prin caractere matematice. "S'opère alors pour la première fois dans l'humanité, la jonction de la science de la nature et de l'intelligibilité mathématique, qui sera le fondement de la science expérimentale." . Universul naturii este deci începând de acum un întreg deschis de legi caruia matematica si teoria ei îi poate explica fenomenalitatea. Nu exista pentru Galilei o ruptura între lumea fenomenala si cea noumenala, ceva care ar exista în sine si la care experienta bine condusa de catre inteligenta umana nu ar avea acces. În plus, pâna în acea epoca, teoria vitalista a lui Aristotel atribuia regnului viu o forta vitala imposibil de sesizat pe cale experimentală. Galilei sustine ca si ceea ce este de natura vie poate fi explicat prin legile fizicii, deoarece si aceste tipuri de fenomene au o cauza si un efect care sunt susceptibile de a fi cunoscute potrivit acestor legitati, cauza-efect. Importanta lui Galilei este deosebita pentru începuturile modernitatii si pentru faptul ca "el aplica efectiv matematica în cercetarile experimentale, conjugand astfel rationamentul deductiv cu cel inductiv".

Odata cu Critica ratiunii pure a lui Kant (1724-1804), limitele cunoasterii sunt din

nou reduse la fenomenalitatea lumii. Lucrul în sine, desi exista potrivit lui Kant, ramâne un deziderat incognoscibil pentru ratiunea umana. Kant ridica problema cunoasterii lucrului în sine, adica a noumen—ului care se ascunde în fenomen—si deci implicit posibilitatea fundamentarii metafizice— prin metoda judecatilor sintetice a priori, dar a carei caracteristica nu conduce nici ea la cunoasterea acestui tip de enigma, numit lucru în sine. Aceasta datorita faptului ca si asemenea judecati intuitive sunt condamnate sa ramâna în cadrul spatio-temporal al carui univers nu apartine lucrului în sine. Daca am fi capabili sa transgresam spatiul si timpul ca forme pure ale intuitiei sensible prin intermediul unei intuitii suprasensibile, dar de care în fapt noi nu dispunem, numai atunci am avea acces la o realitate absoluta care însa, în fapt, ne depaseste continuu.

Sa precizam totusi ca prin contributia lui Kant, modernitatea si-a sumat maniera critica de a sonda antinomiile ratiunii cât si problemele care decurg de aici. Metoda critica pe care modernitatea si-a asumat-o astazi în privinta întregii problematici care decurge din însasi radicalitatea schimbarilor pe care le suferim, acesta metoda de abordare, își are fundamentul în criticismul kantian. Ca acest aspect nu se produce întotdeauna astazi de o maniera constructiva este o provocare careia trebuie sa-i facem înca fata.

Am vazut ca progresul în spatiul epistemologic de cunoatere este relativizat de catre Kant datorita imposibilitatii de aprehendere a lucrului în sine. Însa, în spatiul ratiunii practice, potrivit lui Kant, nu avem nici o limita, deoarece avem legea morala proprie, întemeiata în mod categoric pe vointa noastra autonoma, capabila sa atinga perfectiunea morala. Posibilitatea perfectiunii este data tocmai de existenta imperativului categoric cu valabilitate universala: sa actionam astfel încat maxima vointei noastre sa poata oricând valora în acelasi timp ca principiu al unei legislatii

universale. Desi suntem cu totii si fiinte sensible si tocmai prin acesta putem gresi fata de legea morala, valabilitatea ei ramâne neatinsa, deoarece forma în care a fost enuntata este o maxima cu valoare universala. Cum putem pune în practica o asemenea lege? Prin actiuni care sa vizeze omul ca scop în sine si mai mult chiar, ca scop final al naturii. Sa precizam totusi ca scop final al naturii înseamna, în viziunea ecologista de astazi, ca noi suntem responsabili fata de protectia acesteia, deoarece numai noi avem constiinta acestei responsabilitati, ceea ce natura nu are cu necesitate în structura sa. Omul este scop în sine prin faptul ca-si respecta semenul în demnitatea lui absoluta, iar natura, ca sursa a vietii cu care coabiteaza armonios.

Ce însemna în fapt sa te comporti liber, o notiune atât de pretioasa modernilor, societatilor care se pretind avansate? Datorita constiintei morale, orice fiinta umana are acces la producera binelui pe care-l gaseste în maretia indestructibila a libertatii sale împlinite. Astfel, numai o fiinta umana care își apara, își cultiva si își pune în practica esenta demnitatii sale este o fiinta libera. Calea care conduce catre fundamentul lucrurilor nu este ceva care penetreza lumea din afara catre o presupusa esenta a ei, ci cea care pleaca din interiorul nostru pentru o mai buna constientizare. Putem spune chiar ca individul devine persoana exact în momentul în care pune în act potentialul constiintei pe care o posedea în sine.

Odata cu intrarea în arena a filozofiei hegeliene, deosebirea dintre o lume care ar ascunde în ea un oarecare lucru în sine si exerioritatea ei exprimata prin fenomenalitate, nu mai este acceptata. Nu exista nimic în natura sau în spiritul uman care sa se ascunda în sine pentru simplul motiv ca ceea ce urmarim sa cunoastem este purul adevar si nu ceva dedublat cum ar fi lucrul în sine la care spiritul nostru nu ar avea acces. Porivit lui Hegel, nu se poate argumenta existenta a ceva care ar ramâne

în sine, din moment ce cunoasterea nu poate sa spuna nimic despre acel în sine, asa cum nu se poate admite nici existenta lui Dumnezeu daca spiritul uman nu poate spune ceva determinant despre acel Dumnezeu. Problema care se punea si pentru Hegel era de a arata cum e posibil pentru noi ca fiinte subiective, ca eu-uri care gândim sa formulam totusi judecati obiective. Hegel spune ca despasim acest solipsism prin capacitatea de a gândi gândul, obiectualizând astfel propria gândire. Omul modern crestin, asa cum îl percepea Hegel, era acum cel care putea sa sesizeze adevarul unitatii între natura sa divina si umana si tocmai realizarea acestei naturi nascute într-o asemenea credinta îi da certitudinea ca este nascut în libertate. Dumnezeu, prin persoana lui Iisus, nu mai este acea alteritate transcendentă, ci este acum prezenta si actiune vie în spiritul omului. Dumnezeu nu mai este doar un postulat al ratiunii practice cum era la Kant, ci si o manifestare accesibila pentru ratiunea speculativa si teoretica. Punctul culminant al idealismului absolut hegelian este concluzia ca o ratiune finala este în miezul procesualitatii istorice, deasupra tuturor precaritatilor aparente. Hegel vede etapele de constituire a modernitatii printr-o progresiva consti-entizare a libertatii care se împlineste prin forma sa ideal realizata.

La început, despotismul oriental afirma doar ca un singur om este liber: forma singularitatii. Conducerea aristocratiei greco-romane recunostea doar libertatea unora: forma particularitatii. Sosirea crestinismului aduce cu sine libertatea tuturor oamenilor, recunoscând omul ca fiinta umana în sine libera: universalul abstract. Ultima etapa este aceea a edificarii statului modern în care omul devine liber efectiv si concret prin unitatea libertatii sale individuale cu colectivitatea careia îi apartine: universalul concret. Cum am spune noi cei de astazi, fericirea libertatii individuale se realizeza pe sine doar în cadrul propice al unui stat de drept în care

libertatea fiecaruia este garantata prin institutiile sale.

Se formuleaza astfel explicit, pentru prima data în istoria umanitatii, o jonctiune între libertatea individuala si cea colectiva, libertatea fiecarui cetatean având drept de exprimare în cadrul legiferat al unui stat modern, si ale carui institutii garanteaza totodata dreptul la libera exprimare.

Programul modernitatii initiat de Descartes si continuat de catre Kant si Hegel arata ca orice filozofie trebuie sa fie ancorata în libertatea subiectului uman, care prin ratiune si moralitate sa fie exemplu pentru edificarea unei lumi.

Mai tarziu, acest proiect continuat si de catre alti filozofi pe care nu am avut posibilitatea sa-i prezentam aici din lipsa de spatiu- si care ajunge la Kant si Hegel este considerat totusi de catre Husserl un act neîmplinit. În primul rând, potrivit lui Husserl, în pofida sistemului idealist absolut hegelian, ceea ce i se poate reprosa acestuia este lipsa de critica a ratiunii, conditie necesara stiintificitatii oricarei filozofii. Husserl nu a încercat sa valorifice sistemul de gândire hegelian, asa cum face de pilda cu cele ale lui Descartes si I. Kant.

În al doilea rând, conform lui Husserl, proiectul initiat de obiectivitatea stiintifica ajunge sa devina unilateral si sa piarda legatura cu subiectul, cu constiinta, cu ceea ce initiatorul fenomenologiei transcendente post hegeliene numeste lebenswelt. Obiectivismul naiv al stiintei acelor vremi risca sa ramâna în limitele naturii, obiectului si ale cantitatii. Stiinta s-a separat de problemele autentice ale omului care nu pot fi revigorate decât printr-o fundamentala întoarcere la o filozofie a spiritului. O asemenea grandioasa întreprindere însemna fundamentarea unei filozofii radicale pe care Husserl o va preconiza ca o noua metoda fenomenologica în care subiectul constient de sine se va împlini prin raportul cu semenii sai în cadrul comunitatii. Acest scop nu va fi împlinit câta vreme filozoful nu se va oglindi pe sine ca fiinta rationala,

ca trăitor purtător de logos, ca funcționar în slujba umanismului. Pentru aceasta, este nevoie de o nouă conștiință care să pună în valoare structuri stabile și fundamentale, dincolo de interesele particulare ale unei conștiințe limitate. Desigur, orice tip de conștiință este pentru Husserl o conștiință despre ceva. Dar trebuie largit conținutul cogito-ului transcendental astfel încât acesta să poarte în el propriul sau cogitatum, propriul sau obiect al gândirii.

Calea de cunoaștere și de întemeiere autentică a oricărei lumi mai bune pleacă și pentru Husserl de la ego cogito-ul cartezian, se adâncește într-o reflecție de sine universală, împlinindu-se în intersubiectivitatea transcendentală. Tema inițială era întoarcerea de la obiectivismul naiv al științelor și al psihologiei la subiectivismul transcendental al filozofiei responsabile. Această responsabilitate era inițiată de către îndoiala și punerea între paranteze (epoché) a lumii sensibile cât și a judecăților filozofice despre această lume. Tocmai această punere între paranteze a lumii, această eliminare a tuturor detaliilor insignifiante îl face pe Husserl să afirme că în acest fel mă descoper pe mine ca eu mai profund, ca subiect pur sau eu transcendental. Această mare descoperire îi revenea deja lui Descartes ca initiator al fundamentului prim pentru orice fel de cunoaștere; dar potrivit remarcilor lui Husserl, Descartes a greșit ulterior, deoarece ajunge să deducă existența lui Dumnezeu și astfel tot ceea ce există, din principiile înnascute ale eu-lui. De fapt, Descartes ar fi trebuit să deducă existența și determinările acesteia din ceea ce i-ar fi fost dat în mod real și nemijlocit lui ego cogito.

Nu vom mai urmări demonstrațiile deosebit de complexe și profunde ale lui Husserl până la constituirea intersubiectivității transcendente. Vom reține din stradania lui de constituire a intersubiectivității importante a acesteia pentru lumea de azi de a pune în practică

comunicări de conștiințe capabile să fundamenteze coexistența terestră. Vom mai reține din filozofia lui necesitatea imperioasă pentru noi, de constituire transcendentă a unei lumi al cărei sens și origine se impun a fi clare și responsabile. Vom putea sesiza mai bine și clarifica marile probleme ale mondializării, problema ecologică, a foametei, a păcii, a tehnostiinței, a banilor, a informației, a internetului- și așa mai departe- numai după ce vom plasa toate acestea în spațiul pur al unei reflecții de sine universale, care să ne indice sensul și posibilitatea unei vieți umane autentice.

Cel mai de seamă elev al lui Husserl, Martin Heidegger reorientează fundamentarea filozofiei către solul gândirii originare, acolo unde adevărul era înțeles ca aletheia, ca stare de ne-ascundere care s-a refuzat până azi determinării filozofiei moderne. Eroarea s-a produs, crede Heidegger, deoarece toți predecesorii săi au gândit cautarea adevărului din perspectiva corectitudinii, pe când sarcina întemeierii unei lumi mai bune ar trebui fundamentată pe re-gândirea ființei, așa cum se afla ea în puritatea ei presocratică. Acest început presocratic reprezintă în viziunea lui Heidegger un moment privilegiat în care ființa se poate arăta ca Lichtung, ceea ce pentru Heidegger însemna deschidere-luminatoare. Activitățile creatoare ale omului nu-și vor găsi adâncimea ideatică a scopului atâta vreme cât nu se vor orienta către deschiderea luminatoare, care este ființa însăși, temeiul oricărei creații "rationale".

Să mai precizăm că Heidegger vede în notiunea de khora a lui Platon, prefigurarea subiectului cartezian, în sensul că ființarea devine ceea ce este ea însăși prin capacitatea noastră de reprezentare. Această capacitate de reprezentare va deveni marca determinată pentru modernitate. Ea este metoda fundamentală

de cunoastere a diversitatii lumii cât si o maniera generala de a se înțelege pe sine.

Kant vorbise déjà despre reprezentare ca despre ceva ce însoteste actul gândirii. Caci daca ar fi altfel, reprezentarea n-ar putea fi gândita. Acesta reprezentare care apare în gândire se numea intuitie. Ea este un act spontan al gândirii mele care transcende domeniul sensibilitatii. Reprezentarea este pentru lumea moderna un mijloc prin care fiinta si fiintarea se determina reciproc strabatând domeniile culturii, politicii, economiei, tehnicii, istoriei, etc.

Toate aceste domenii îi apar modernului ca un izvor de care poate dispune, potrivit puterii sale cu ajutorul careia si-a propus sa cucereasca lumea. Insa tocmai în acest proiect rezida si riscul umanitatii, deoarece o asemenea demiurgie fara egal în istoria noastra risca sa ne depaseasca prin adâncimea si amploarea lor.

Intrebat deja în 1966, într-un interviu în Der Spiegel, daca poate indica o cale în fata provocarilor fara egal din lumea modernitatii, Heidegger raspunde ca filozofia nu poate pentru moment aduce o schimbare directa asupra starii actuale a lumii. Doar un Dumnezeu prezent, preciza filozoful, ar putea sa ne salveze.

Insa ca El sa fie prezent, precizam noi, e nevoie ca umanitatea ca destin luminum sa fie capabila sa structureze o asemea disponibilitate a întâlnirii. Daca suntem cu adevarat rangul cel mai înalt al creatiei divine, lumea în care traim ar trebui refondata din perspectiva transcendentiei. Aceasta nu doar ar impiedica puterile noastre dezlantuite sa devina o maledictiune, într-o lume supra-echipata cu de toate, cât mai ales ar favoriza constructia a ceva traicnic, potrivit unei logici a constientizarii, precautiei si responsabilitatii.

Toate acestea ar conduce catre o noua ontologie îndreptata catre fiinta, în care omul ar mijloci între un același temei si scop care îl transcende. In acest sens, poate ca Dumnezeu nu este o transcendentia exterioara si inaccesibila, ci relatia intima

din noi, care activeaza moralitatea si sensul lumii.

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# The Evolution of the Integration Process as Effect of the Treaties Signing Between the Republic of Moldova and European Union

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**Abstract:** The aim of this paper is to investigate the evolutive aspect of the political, economic and commercial development of the Republic of Moldova's relations with the European Union and the de jure and de facto adhesion to this European Forum. Thus, it argues and testifies that after 2024 the Republic of Moldova will become a titular member of the European Union, also, it counts those 4 evolutive stages of the development of this process.

In this way, it is specified the 3rd evolutive stage (2014-2020/24), particularly 2014, of the European integration process of the Republic of Moldova in comparison with Romania and Bulgaria in 2001. It is demonstrated that the European integration of the Republic of Moldova represents a perpetual process, which depends on and coincides with the process of the transnistrian conflict solving, and the signing the Republic of Moldova - EU Association Agreement and Deep and Comprehensive Free Trade Agreement represents the effect of advancing to a new evolutive phase. These agreements substantiate on vertical and horizontal dimension of the economic relations with the European Union.

So, it is noticed that the success of this progress represents the new agreements with favorable clauses for the Republic of Moldova in comparison with the previous ones, stipulated in the Partnership and Cooperation Agreement. As a consequence, it appears the passage to new phase of relation development with EU in comparison with the Partnership and Cooperation Agreement signed in 1994.

Consequently, in a different hypothesis, it is put forward the idea of the accelerated advancement of the adhesion process of the Republic of Moldova to the European Union after 2020, provided the resolution of the transnistrian conflict till that period, the gain of new market places of national products, the independent development of an economy based on renewable energy resources, such as eolian and solar energy etc.

The liberalization of viza regime in 2014 represents the sine qua non condition of the intensification of the republic of Moldova relations within new geopolitical circumstances and creates real conditions for the acceleration of this economic integration process.

*Key-words:* European integration process, European treaties, Association Agreement, Partnership and Cooperation Agreement, the Republic of Moldova-European Union, Deep and Comprehensive Free Trade Agreement, new geopolitical circumstances

### **1. European integration - the primary stage of the Republic of Moldova (1989-1994)**

The phrase “European integration” and the development stages of this process represent a relevant significance for the Republic of Moldova, depending on certain events, such as the signing of some treaties in certain geopolitical circumstances, the proximity with the European Union, the abolishment of visas for citizens of the Republic of Moldova etc. Such events can serve as evidence of enlargement of the European integration process, from the Western Europe to Eastern Europe.

A major achievement of the European integration process of the Republic of Moldova was the signing of the Association Agreement with the European Union on 27 June 2014. This treaty serves as a solid legal basis for the creation of a unique policy in all areas of social life of the Member States of EU and the associated members.

Thus, we distinguish four (4) phases of European integration process for the Republic of Moldova, strengthening the European vector, promoted at the concept of internal and foreign policy of the state.

So, the first stage covers the period of 1989-1994 years, externally, it is directly linked to the Agreement between the European Atomic Energy Community and the Union of Soviet Socialist Republics on the trade and commercial-economic cooperation, signed on 18 December 1989. The internal aspect is related to the events concerning the national liberation movement by Statements on the proclamation of sovereignty and independence of the Republic of Moldova, of the Laws on the Latin script, anthem, flag etc., including the adopting of the Constitution of the Republic of Moldova.

The Preamble of the nominated Economic treaty follows that the European Economic Union wanted to “encourage the process of regional cooperation with

neighboring republics to favoring a gradual rapprochement between the former Soviet Socialist Republic and a wider area of cooperation in Europe and neighboring regions, and the gradual integration of the Moldavian Soviet Socialist Republic within the opened international trading system”.

Further, the provision of the 3rd Article of the Agreement provides: “for the future prosperity and stability of the region of the former Soviet Union, it is essential that the new independent states emerged from the dissolution of the USSR, maintain and develop cooperation between them”. The sides said that they would undertake all necessary efforts to encourage this process.

In the opinion of V. Pohnițchi “... by signing of the Agreement it was wanted to create a better climate for economic relations between the sides, emphasizing the priority of the trade and investments, which are essential to economic restructuring and technological upgrading. One of the important provisions of the agreement is the acceptance of the principle of free and unrestricted transit of goods from the customs territory of one of the sides or for the customs territory of the other side. The exported goods should be to be sold at market prices, being prohibited the certain direct or indirect imposition and internal taxes, beyond those applied to the similar autochthone goods. In addition, the exported products by one of the sides to the other side shall be accorded the treatment no less favorable than that accorded to the products of national origin in accordance with local law.” [1]

Typically for the 1st phase of 1989-1994 years, it is that the commercial-economic Agreement from 1989 is based on market economy principles and the principles of international law, while in the ex-Soviet republics dominate the administrative control principles, characteristic of the socialist system. Even the Preamble to the Treaty stipulates the encouraging of regional cooperation process and an

approaching and gradual integration of the former Moldavian SSR (nowadays the Republic of Moldova) in the context of cooperation, and other former Soviet republics bordering the countries of Western Europe and their inclusion in the opened international trading system.

## **2. The Partnership and Cooperation Agreement – an instrument of the relations' development between the Republic of Moldova and the European Union (1994-2011/14)**

A second stage of the evolution of relations between the Republic of Moldova and the European Union (1994-2014) is indispensable for the fact that the Partnership and Cooperation Agreement (PCA) was signed between the two sides. PCA, on 1994-2014 years, represents the most relevant legal framework between the Republic of Moldova and the EU, although the signing of other bilateral and multilateral economic treaties, strengthened this perpetual process.

The RCA was signed on 24th November 1994 and entered into force on 1st July 1998 for a period of 10 years with the possibility of extending its application until the signing of a Deep and Comprehensive Association Agreement, ie until 27th June 2014.

This stage is manifested by the fact that PCA embodies all sectors of social life, including the public institutions with the EU, including the political, commercial, economic, legal, cultural, scientific, transportation, industrial, medical, agricultural etc. This treaty are based on several objectives: the strengthening of democracy, the rule of law, the protection of human rights and fundamental freedoms, including minorities.

The sustainable development of economy and the further deepening of relations and the respect of the principles of the market economy through trade etc.. The relations between the Republic of Moldova and the EU were institutionalized basing on 4

structures to develop the political dialogue and supervision of public authorities at central level: 1) Cooperation Council; 2) Cooperation Committee (of the government level); 3) The Parliamentary Cooperation Committee and 4) Cooperation Subcommittees.

The signing of the EU-the Republic of Moldova Action Plan in 2005, which contains the strategic objectives and actions that will strengthen the of the legal system of Republic of Moldova harmonization process to the Community Acquis standards continue until the achievement of these objectives [2].

During this period, the Republic of Moldova's European integration policy is based on 2 pillars, as the implementation of the EU-the Republic of Moldova Action Plan and realizing of the possibilities of the Republic of Moldova to participate in all regional initiatives.

According to I. Clipii, "a major and long-term objective of the foreign policy of the Republic of Moldova is a gradual integration into the European Union. The first step in this pathway is the signing of the Partnership and Cooperation Agreement" [3].

Therefore, we consider that the PCA is already the second stage or the second relevant step in the process of European integration of the Republic of Moldova, being preceded, on external aspect, by the Economic Agreement signed in 1989, and on domestic plan - by stock of laws on sovereignty and independence, including the state symbols, stipulated in the Fundamental Law and other organic laws.

The scientific aspect of this phase (II) is characterized by the signing of the Memorandum of FP7 (Framework Programme 7) on 27th October 2011 relating to the research and information technology and signed by the President of ASM, Gheorghe Duca, and Commissioner for Research, Innovation and Science, Maire Geoghegan – Quinn, in force and implemented from January 1st, 2012.

Following to signing the Memorandum of Understanding between the European Union and the Republic of Moldova on the association of the Republic of Moldova to the 7th Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013), from October 2011, (CIP) Center of International projects of Academy of Sciences of Moldova was officially nominated by ASM to contribute to the implementation of the status of associated country [4].

Similarly, the Common Aviation Area Agreement the Republic of Moldova – European Union [5], signed on 26th June 2012 at the meeting of the EU – the Republic of Moldova Cooperation Council, entered into force provisionally by diplomatic verbal notes exchange, according to the 29th article of the Treaty and ratified by the Parliament of the Republic of Moldova. A provisional entry into force of the mentioned agreement offered to the airlines companies from the European Union the possibility to work in the Republic of Moldova and to Moldovan companies – on territory of the Member States of the European Union. Therefore, the liberalization of air services in the EU has favored the attraction of other European companies to Moldova, including those of low cost type, that has led to lowering of the ticket prices, the number of routes and destinations, the providing of the adequate services etc.. In this respect, the Moldovan authorities have initiated a series of active measures to modernize and other airports from country, as Mărculești, Bălți and Cahul.

The Government Agenda “European Integration: Freedom, Democracy, Welfare” provides the governing policy framework of the Republic of Moldova for 2011-2014 years and represents an integral part of this stage.

“This program is an expression of continuity in meeting commitments to the

citizens, and our external partners. The strategic vision of the proposed program is to increase welfare, which will focus on two major objectives of Government: the raising of living standards and the European integration. The achievement of these broad objectives will undertake a number of actions for the social protection of citizens, the economic development, the strengthening of the rule of law state, the increase of employment, the development of relationships with external partners, the investment attracting, the abolishment of viza and other acts, which set as an intention the better life for our citizens. [6]” Further, the program refers to “Activity Program of the Government, as a whole, aims to create a high level of welfare of the Moldovan citizens, and achieve other important changes in society that, in their entirety, would accelerate the integration of the Republic of Moldova into European Union”. [7]

We consider that this program has been partially fulfilled, because it was not achieved those strategic objectives for the economic development, the social protection of citizens, the foreign investments etc..

On 4th March 2014, the President of European Parliament, Martin Schulz, and EU Council representative, Deputy Foreign Minister of Greece, Dimitris Kourkoulas, had signed the Amendment of the 539/2001 Regulation to allow the transfer of the Republic of Moldova in the list of third countries whose nationals are exempt from a viza.

The decision of liberalization of the viza regime for Moldovan citizens is stipulated in the Regulation nr.259/2014 of the European Parliament and of the Council of 3rd April 2014 amending the Regulation (EC) nr.539/2001 of the Council that establish the list of third countries whose nationals must be in possession of vizas when crossing the external borders and the list of countries whose nationals are exempt

from that requirement, published in the Official Journal of the European Union L 105, p. 9-11.

The practical experience demonstrates an increased attraction to residents of the left bank of Nistru for the biometric passports and citizenship of the Republic of Moldova. Even some citizens of former Soviet republics, including Russia's eastern districts require a residence in order to obtain citizenship of Moldova and biometric passport to travel later in the EU without a viza.

The liberalization of the viza regime since April 28, 2014 is an attraction of Moldovan citizens to the EU member states, but also a bridge between the two sides of Nistru, by attracting the residents from the eastern districts of the Republic of Moldova to unify the country.

### **3. The Association Agreement - a new dynamic stage of the process of European integration (2014-2020/24). The 3rd stage**

The distinctive point of the 3rd stage is the fact that it starts with the signing of the Association Agreement at Brussel on 27th June, 2014, and continues on 2nd July with the ratification of the Agreement by Parliament, and until November 2014 the Parliaments of 28 Member States of EU should ratify the Treaty. Such procedures for ratification of the Association Agreement allows the Republic of Moldova to implement its terms immediately.

Thus, the 1st Article of the Agreement establishes an association between the European Union and its Member States with the Republic of Moldova having the following purposes:

a) to promote the political association and economic integration between the sides on the basis of shared the common values and close relations, including the increased participation of the Republic of Moldova within the policies, programs and agencies of the European Union;

b) to strengthen the political dialogue in all domains of mutual interest, which will contribute to the development of close political relations between the sides;

c) to contribute to the consolidation of the democracy and political, economic and institutional stability of the Republic of Moldova;

d) to promote, to preserve and to strengthen the peace and stability on the regional and international dimensions, including the joint efforts to eliminate the sources of tension, to increase the border security, to promote the cross-border cooperation and good neighborly relations;

e) to support and to strengthen the cooperation on the domains of justice, freedom and security in order to strengthen the rule of law state and the respect of human rights and fundamental freedoms, as well as in the area of mobility and contacts between people;

f) to support the Republic of Moldova's efforts to develop its economic potential through the international cooperation and harmonizing its legislation with the EU legislation;

g) to create the conditions for the trade and economic relations that will lead to the gradual integration of the Republic of Moldova into EU internal market, as stated in this Agreement, including the establishment of a Deep and Comprehensive Free Trade Area, which will provide an extensive harmonization of the regulatory framework and liberalization of market access, in accordance with the rights and obligations arising from membership of the WTO; and to the transparent application of these rights and obligations;

h) to create the conditions for closer cooperation in other areas of mutual interest. [8]

Currently, we are at the start of this particularly relevant stage, which practically decide the future of the Republic of Moldova with the European Union. This means that the Republic of

Moldova goes to another area of influence, than CIS, on political, economic, social, cultural and scientific aspect. "The European Union exerts a powerful force of attraction especially by "the people's everyday level of lives". The teacher, doctor, chemist, pharmacist, engineer see in the European Union a true "golden city", where the revenues are 3000-7000 dollars per month" [9], the equivalent of 2300-5200 euros in 2005-2006. While in Romania the monthly salary income in 2014 reached the level of 400-2500 euro, in Bulgaria the concerned categories have a monthly gain of 350-2400 euros, while in Croatia the salary of categories of employees arrive at the amount of 450-2800 euros. Concerning the Republic of Moldova at the aspect regarding the average wage of the same category of employees is 120-250 euros per month, excepting the worker, farmer, or retired in some cases, their income is lower.

So, we see that the benefits of these advances is limited to the fact that in recent treaties there are contained clauses more favorable to the Republic of Moldova comparing to the previous ones.

Therefore, Republic of Moldova will execute the clauses according the Associate Membership Agreement, i.e. to follow the path traveled by the Baltic States, Romania, Bulgaria, taking into account the specific geographical situation, the Transnistrean conflict and other circumstances, which influence the EU relations with the Republic of Moldova. [10]

On the 28th April 2014 took place the liberalization of the viza regime for citizens of the Republic of Moldova for the EU and candidate countries. Such event shall be equivalent to the 1st January 2001 for Romania and Bulgaria and from that event to the full membership it passed six years.

The National Action Plan for the implementation of the Deep and Comprehensive Association Agreement the Republic of Moldova - European Union for

2014-2016 [11] represents the basic document for the monitoring of the European integration process in the next 3 years.

Negotiations on the Association Agreement were completed on 25 June 2013, and the Agreement was initialed on 29 November 2013. Before the full Agreement enters into force, measures must be put in place to ensure that the parties are able to enjoy its full benefits; the Agreement's partial provisional application is the first of these measures. The aim of the Association Agenda is to prepare and facilitate the implementation of the Association Agreement, by creating a practical framework through which the overriding objectives of political association and economic integration can be achieved. It replaces the EU-Moldova European Neighbourhood Policy Action Plan. [12]

Therefore, in practical terms, the immediate implementation of the Association Agreement will continue by obtaining of the candidate status, and later – full membership's rights within the European Union.

So, the 4th stage starts with becoming a Member State of the European Union after 2020. European Union seeks to promote peace, its values and the welfare of its peoples. (Article 2, paragraph 1).

The European Union shall offer to its citizens an area of freedom, security and justice, without internal frontiers, where there is ensured the free movement of persons in conjunction with appropriate measures with respect to external border controls, the rights for asylum, immigration and the criminality prevention and combating of this phenomenon (article 2, paragraph 2 of the Treaty of Lisbon [13]).

So, hypothetically, we launch the idea of joining the Republic of Moldova to the European Union after 2020, creating the best performing economic, social and security conditions, at the internal level,

and using the geopolitical conjuncture, including the resolution of conflict from the eastern districts of the Republic of Moldova, the strengthening of the Association relations of Ukraine with the European Union etc

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- 3) Igor Clipăi. Evoluția cadrului politic al problemei integrării europene. In: Moldova și Uniunea Europeană. Chișinău: Editura Prut Internațional, 2001. p. 10.
- 4) See The Memorandum of Understanding between the European Union and the Republic of Moldova on the association of the Republic of Moldova to the Seventh Framework Programme, October 2011, JO L 412, 30.12.2006, p.1.
- 5) All stipulations of the Agreement will be valuable concomitantly with temporary entering in force until the end of the all European Parliament ratifications procedures.
- 6) Programul de activitate al Guvernului „Integrarea Europeană: Libertate, Democrație, Bunăstare” pentru perioada 2011-2014, Chișinău, 2011, p. 4, it was partially achieved.
- 7) Ibidem, Introducere a Programului de activitate al Guvernului 2011-2014, p. 4.
- 8) Association Agreement between the European Union and the European Atomic Energy Community and their Member States, of the one part, and the Republic of Moldova, of the other part. p. 6.
- 9) The incomes of 3000-7000 dollars are reported to 2005- 2006years, but in 2014 the incomes are higher. See: Mazilu D. Integrare Europeană. București: Lumina Lex, 2006. p. 6-7.
- 10) Mămăligă I. Aspects of Impletation of European Law in the Legal System of the Republic of Moldova within European Integration Process In: ACTA UNIVERSITATIS DANUBIUS. ADMINISTRATIO, No 1/2011, p. 56, ISSN:2068-5 .
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- 12) Association Agenda between the European Union and the Republic of Moldova, Brussels, 26 June 2014, p. 1.
- 13) The Amendment of the Treaty on European Union and the Treaty establishing the European Community, called the Lisbon Treaty was adopted in Brussels on 3rd December 2007 and entered into force on 1st December 2009.

## **Proceedings of the 39th ARA Congress**

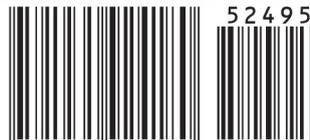
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