THE ATHENS INSTITUTE FOR EDUCATION AND RESEARCH

Abstract Book

6th Annual International Conference on

Physics

23-26 July 2018, Athens, Greece

Edited by

Gregory T. Papanikos

2018

Abstracts

6th Annual International Conference on Physics

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(In Alphabetical Order by Author's Family name)

Preface

This book includes the abstracts of all the papers presented at the *6th Annual International Conference on Physics (23-26 July 2018)*, organized by the Athens Institute for Education and Research (ATINER).

In total 29 papers were submitted by 31 presenters, coming from 17 different countries (Austria, Bulgaria, Egypt, Estonia, Finland, France, Italy, Jordan, Mexico, Romania, Saudi Arabia, Singapore, South Korea, Turkey, UK, Ukraine, and USA). The conference was organized into 8 sessions that included a variety of topic areas such as Energy Production, Analysis, Materials and Characterizations, Physics of Gravity, Plasma, and Oscillators, Science Teaching, and more. A full conference program can be found before the relevant abstracts. In accordance with ATINER's Publication Policy, the papers presented during this conference will be considered for inclusion in one of ATINER's many publications.

The purpose of this abstract book is to provide members of ATINER and other academics around the world with a resource through which to discover colleagues and additional research relevant to their own work. This purpose is in congruence with the overall mission of the association. ATINER was established in 1995 as an independent academic organization with the mission to become a forum where academics and researchers from all over the world could meet to exchange ideas on their research and consider the future developments of their fields of study.

It is our hope that through ATINER's conferences and publications, Athens will become a place where academics and researchers from all over the world regularly meet to discuss the developments of their discipline and present their work. Since 1995, ATINER has organized more than 400 international conferences and has published nearly 200 books. Academically, the institute is organized into seven research divisions and 37 research units. Each research unit organizes at least one annual conference and undertakes various small and large research projects.

For each of these events, the involvement of multiple parties is crucial. I would like to thank all the participants, the members of the organizing and academic committees, and most importantly the administration staff of ATINER for putting this conference and its subsequent publications together. Specific individuals are listed on the following page.

Gregory T. Papanikos
President

6th Annual International Conference on Physics
23-26 July 2018, Athens, Greece
Organizing and Academic Committee

ATINER's conferences are small events which serve the mission of the association under the guidance of its Academic Committee which sets the policies. In addition, each conference has its own academic committee. Members of the committee include all those who have evaluated the abstract-paper submissions and have chaired the sessions of the conference. The members of the **academic committee** of the 6th Annual International Conference on Physics were the following:

1. Gregory T. Papanikos, President, ATINER.
2. Ethel Petrou, Academic Member, ATINER & Professor and Chair, Department of Physics, Erie Community College-South, State University of New York, USA.
3. Bala Maheswaran, Head, Electrical Engineering Unit, ATINER & Professor, Northeastern University, USA.
4. Haiduke Sarafian, Professor, The Pennsylvania State University, USA.
5. Ionel Tifrea, Professor, California State University, Fullerton, USA.
6. Daniel Schertzer, Academic Member, ATINER & Professor & Chair "Hydrology for Resilient Cities", Ecole des Ponts ParisTech (ENPC), France.
7. Alexander Mustafaev, Professor of Physics & Head, Department of General and Technical Physics, Head, Plasma Nanotechnology Laboratory, Saint Petersburg Mining University, Russia.
8. Kirill Levine, Associate Professor, Department of General & Technical Physics, St. Petersburg Mining University, Russia.
9. Christine Condaris, Professor, Massachusetts College of Liberal Arts, USA.
10. Alexandre De Bernardinis, Research Scientist, IFSTTAR, France.
11. Lampros Pyrgiotis, Chemical Engineer, Delegate of the Assembly Presidium, Technical Chamber of Greece.
12. Enzo Bonacci, Academic Member, ATINER & Secondary School Teacher, Scientific High School "G.B. Grassi" of Latina, Italy.
13. Athina Meli, Academic Member, ATINER, Visiting Scientist and Research Scholar, University of Gent & University of Liege, Belgium and Ronin Institute Montclair, USA.

The **organizing committee** of the conference included the following:

1. Olga Gkounta, Researcher, ATINER.
2. Konstantinos Manolidis, Administrator, ATINER.
3. Kostas Spyropoulos, Administrator, ATINER.

FINAL CONFERENCE PROGRAM
6th Annual International Conference on Physics
23-26 July 2018, Athens, Greece
PROGRAM

Conference Venue: Titania Hotel, 52 Panepistimiou Street, 10678 Athens, Greece

Monday 23 July 2018

08:00-09:00 Registration and Refreshments

09:00-09:30 Welcome and Opening Address (Room A)

Gregory T. Papanikos, President, ATINER.

09:30-11:30 Session I (Room A): Education: Global Perspective of Teaching and Learning

Chair: Bala Maheswaran, Head, Electrical Engineering Unit, ATINER & Professor, Northeastern University, USA.

1. Marie Bukowski, Director, School of Art, Kent State University, USA & Chester Wilson, Associate Professor, Louisiana Tech University, USA. Visualization of Science and Technology through Art.
2. Christine Condaris, Professor, Massachusetts College of Liberal Arts, USA. Teaching Creativity: The Value of the A in STEAM.
3. Vladimir Tzvetkov, Assistant Professor, Sofia University "St. Kliment Ohridski", Bulgaria. The Great Science Teachers of Tomorrow: A Study on Pre-Service Teacher Training from Skills Perspective.
4. Vesela Todorova, PhD Student, University of Sofia "St. Kliment Ohridski", Bulgaria & Milena Kirova, Associate Professor, University of Sofia "St. Kliment Ohridski", Bulgaria. Adaptation of the Questionnaire that Measures Students' Motivation toward Science Learning (SMTSL) into Bulgarian version of Students' Motivation toward Chemistry Learning Questionnaire (BG SMTCLQ).
5. Enzo Bonacci, Secondary School Teacher, Scientific High School "G.B. Grassi" of Latina, Italy. Proposals for an Effective Teaching of Quantum Physics at Secondary School.
6. Elitsa Peltekova, PhD Student, Sofia University "St. Kliment Ohridski", Bulgaria & Eliza Stefanova, Associate Professor, Sofia University "St. Kliment Ohridski", Bulgaria. Stem Teaching and Learning – A Journey from Virtual to Real World.

11:30-13:00 Session II (Room A): Energy Production & Alternative Fuel

Chair: Alexandre De Bernardinis, Research Scientist, IFSTTAR, France.

1. Franz Haas, Professor and Head of Institute of Production Engineering, Graz University of Technology, Austria & Andres Suarez Gonzalez, Research Assistant, Graz University of Technology, Austria. Energy Consumption Factor (ECF) as a New Classification Figure to Compare Machining Processes.
2. Ekin Kipcak, Research Assistant, Yildiz Technical University, Turkey & Mesut Akgun, Professor, Yildiz Technical University, Turkey. Supercritical Water Gasification of Isopropanol and Isobutanol: An Alternative Approach for Energy Production.
3. Ziad Khalifa, Assistant Professor, The British University in Egypt, Egypt. Biofuel Cells based on Glucose Electrooxidation at Conducting Polymer Modified Electrodes with Palladium and Platinum Nanoparticles.
4. Ilker Ors, Teaching Staff, Selcuk University, Turkey, Murat Ciniviz, Teaching Staff, Selcuk University, Turkey, Ali Kahraman, Teaching Staff, Necmettin Erbakan University, Turkey & Bahar Sayin Kul, Lecturer, Selcuk University, Turkey. Using Biofuels in a CI Engine as Alternative Fuel.

13:00-14:00 Lunch

14:00-16:00 Session III (Room A): Analysis, Materials and Characterizations

Chair: Haiduke Sarafian, Professor, The Pennsylvania State University, USA.

1. Alexandre De Bernardinis, Research Scientist, IFSTTAR, France, Wiem Benatia, MSc Student, Toulouse Paul Sabatier University, France & Richard Lallemand, Research Engineer, IFSTTAR, France. Electro-Thermal Analysis for Lithium Carbon (LiC) Hybrid Supercapacitors.
2. Hongyan Zhang, Professor, The University of Toledo, USA & Jacek Senkara, Professor, Warsaw University of Technology, Poland. Joining Aluminum Sheets.
3. Francisco Delgado, Researcher and Professor, Tecnológico de Monterrey, Mexico. Assembling Large Entangled States in the Ingarden-Urbanik Entropy Measure under the SU(2)-Dynamics Decomposition for Systems Built from two-Level Subsystems.
4. Viorel-Laurentiu Cartas, Assistant Professor, The Low Danube State University of Galati, Romania. The Viscoelastic Feature of the Spacetime.
5. Florian Nguyen, PhD Student, University of Lille, France, Jean-Philippe Laval, Researcher, CNRS, France, Bérengère Dubrulle, Research Director, CNRS, France & Pierre Kestener, Researcher, CEA, France. Local and Global Anisotropic Multifractal Analysis of Turbulent Flow.

16:00-17:30 Session IV (Room B): Physics of Gravity, Plasma, and Oscillators

Chair: Ionel Tifrea, Professor, California State University, Fullerton, USA.

1. Haiduke Sarafian, Professor, The Pennsylvania State University, USA. Two-Dimensional Nonlinear Oscillations in an Electrically Charged Rectangular Frame.
2. Liudmyla Kozak, Associate Professor, Taras Shevchenko National University of Kyiv, Ukraine, Bogdan Petrenko, Student, Taras Shevchenko National University of Kyiv, Ukraine, Elena Kronberg, Scientist, Max Planck Institute for Solar System Research, Germany, Andrew Prokhorenkov, PhD Student, Taras Shevchenko National University of Kyiv, Ukraine, Elena Grigorenko, Scientist, Space Research Institute, RAS, Russia & Antony Lui, Principal Professional Staff, Johns Hopkins University Applied Physics Laboratory, USA. Investigation of Turbulent Processes in Magnetosphere Plasma.
3. Piret Kuusk, Head of the Laboratory of Theoretical Physics, University of Tartu, Estonia. Theories of Gravity and Contemporary Observations.
4. Mazen Qaisi, Faculty Member, University of Jordan, Jordan. Power Series Solution to Strongly Nonlinear Oscillators.

17:30-19:30 Session V (Room A): ATINER's 2018 Series of Academic Dialogues *A Symposium on The Future Developments and Prospects of Engineering and Science Education & Research in a Global World*

Chairs: Ethel Petrou, Academic Member, ATINER & Professor and Chair, Department of Physics, Erie Community College-South, State University of New York, USA & Lampros Pyrgiotis, Chemical Engineer, Delegate of the Assembly Presidium, Technical Chamber of Greece.

1. Bala Maheswaran, Head, Electrical Engineering Unit, ATINER & Professor, Northeastern University, USA. Experiential and Interactive Learning on Innovation, Prototyping, and Entrepreneurship.
2. Nikos Mourtos, Head, Mechanical Engineering Unit, ATINER & Professor, San Jose State University, USA. Engineering & Science Education & Research in the 21st Century: Are We Dancing to the Music?
3. Marie Bukowski, Director of the School of Art, Kent State University, USA. Designing for the Future.
4. Dimitris Argyropoulos, Distinguished Professor, North Carolina State University & University of Helsinki, USA & Finland. The Dangers of Making Corporations out of Our Universities & the Apparent Rift between Faculty, Administrators and Funding Agencies.
5. Franz Haas, Professor and Head, Graz University of Technology, Austria. The Role of Additive Design and 3D-Printing for the next Product Generation.
6. Francisco Delgado, Professor, Tecnológico de Monterrey, Mexico. STEM Initiatives in Mexico for 2030: Challenges and Achievements.
7. Haiduke Sarafian, Professor, The Pennsylvania State University, USA. Implicit Challenges Facing Native Local Students to the Influx of Visiting Foreign Students in Engineering and Science.
8. Ellene Tratras Contis, Head, Chemistry Unit, ATINER & Professor of Chemistry, Eastern Michigan University, USA. STEM-it! Increasing Success Rates for Our Students.
9. Peter Yannopoulos, Vice President of Global Communications, ATINER, Co-editor, Athens Journal of Business and Economics & Professor, Brock University, Canada. Marketing a STEAM Program.

21:00-23:00 Greek Night and Dinner

Tuesday 24 July 2018

07:45-11:00 Session VI: An Educational Urban Walk in Modern and Ancient Athens

Chair: Gregory A. Katsas, Vice President of Academic Affairs, ATINER & Associate Professor, The American College of Greece-Deree College, Greece.

Group Discussion on Ancient and Modern Athens.
Visit to the Most Important Historical and Cultural Monuments of the City (be prepared to walk and talk as in the ancient peripatetic school of Aristotle)

11:15-13:00 Session VII (Room A): STEAM: The Current Trend

Chair: Christine Condaris, Professor, Massachusetts College of Liberal Arts, USA.

1. Adrienne Coleman, Director of Equity and Inclusion, Illinois Mathematics and Science Academy, USA. Diversifying the STEM (Science, Technology, Engineering, Mathematics) Education to Career Pipeline.
2. Abe Zeid, Professor, Northeastern University, USA. Engineering-Based Learning: A New Methodology for High School Students STEM Learning.
3. Francis Stonier, Associate Professor, University of West Georgia, USA & Jill Drake, Professor and Department Chair, University of West Georgia, USA. Chinese Pre-Service Teachers STEAM Engagement through Legos.
4. Lorraine Howard, President, Women and Mathematics Education, Wilkes University, USA. Girls' Mathematics Identity: The Gateway to STEAM Success.
5. Gladys Ong, Graduate Student / Senior Education Officer, University College London / Ministry of Education, UK / Singapore. Exploring Authentic Assessment in the Learning of Mathematics.
6. Ronnie Bryan, Teacher, Sequoyah High School, USA. Math Foundations at Sequoyah High School.

13:00-14:00 Lunch

14:00-16:00 Session VIII (Room A): Special Topics

Chair: Ethel Petrou, Academic Member, ATINER & Professor and Chair, Department of Physics, Erie Community College-South, State University of New York, USA.

1. Kyu-Bong Kim, Professor, Dankook University, South Korea, Hyang Yeon Kim, Research Professor, Dankook University, South Korea & Yong Jae Lee, Graduate Student, Dankook University, South Korea. Analytical Method Development of Methylisothiazolinone.
2. Ionel Tifrea, Professor, California State University, Fullerton, USA. Thermoelectric Effects in Gapped Monolayer Graphene.
3. Ayman El-Faham, Professor, King Saud University, Saudi Arabia. Recent Progress in Peptide Coupling Reagents and Greener Solvents in Peptide Synthesis.
4. Mona Arsanious, Professor, National Research Centre, Egypt & Shabaan Darwish, National Research Centre, Egypt. Synthesis and Antimicrobial Evaluation of New 2-Methyl-quinazolin-4 (3H)-one Phosphonodithiotes.

20:00- 21:30 Dinner

Wednesday 25 July 2018
Mycenae and Island of Poros Visit
Educational Island Tour

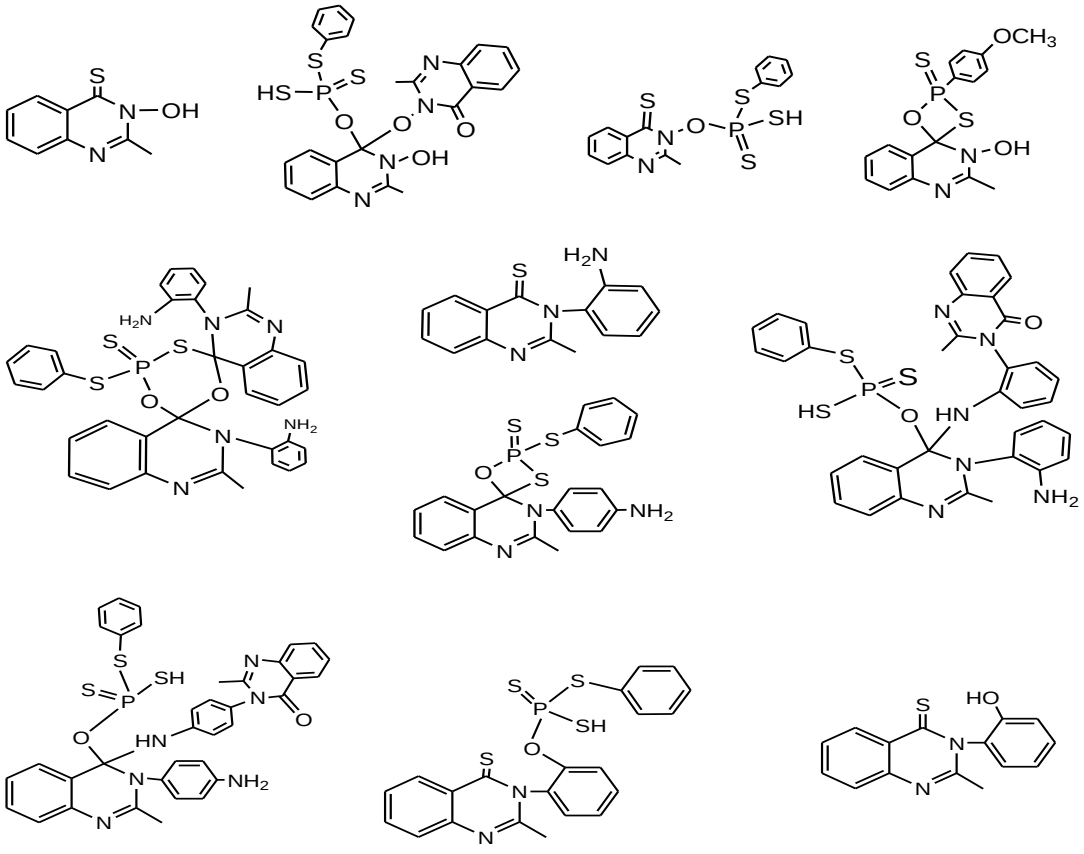
Thursday 26 July 2018
Delphi Visit

Friday 27 July 2018
Ancient Corinth and Cape Sounion

Mona Arsanious
Professor, National Research Centre, Egypt
&
Shabaan Darwish
National Research Centre, Egypt

Synthesis and Antimicrobial Evaluation of New 2-Methyl-quinazolin-4 (3H)-one Phosphonodithiotes

Lawesson's reagents are considerable thiated reagents as well as instruction of acyclic and cyclic systems containing phosphorus and sulfur. In the present investigation, we aim at synthesizing new 2-methyl-quinozolin-4-one derivatives bearing dithiaphosphetane- 2,4-disulfide group. Spiro[1,3,2-oxathiaphosphetane -3-ol derivatives are derived from the reaction of Lawesson's reagents with 3-hydroxy-2-methylquinazolin-4(3H)-one and 3-(4-aminophenyl)-2- methylquinazolin-4(3H)-one. The phosphorotri-thiate adducts are formed by addition of 2,4-bis(phenylthio)-1,3-dithia,2,4-diphosphetane-2,4-disulphide (JR) to 3-(2-aminophenyl)-2-methylquinazolin -4(3H)-one and 3-(2-hydroxyphenyl)-2-methyl- quinazolin-4(3H)-one. The Compounds exhibited antibacterial properties against Gram-positive, Gram-negative bacteria and antifungal.



Enzo Bonacci
Secondary School Teacher, Scientific High School "G.B. Grassi" of Latina, Italy

Proposals for an Effective Teaching of Quantum Physics at Secondary School

In the Italian education system, secondary students (ages 14-19) face the foundations of quantum physics during the final term of scientific high school (pre-university year). The Italian Ministry of Education, Universities and Research (MIUR) has remarked its importance in the syllabus to address the high school exit examination (30% of the 5th year physics course) but, due to limited learning time and intrinsic difficulty, this branch of physics is neither assimilated nor appreciated as it should.

We wish to illustrate six didactic suggestions focused on learning motivation, emerged during a 16-year long teaching experience, which could help to tackle the main problems found. The key reference is the talk "Why nobody understands quantum mechanics?" given in 2013 at the 2nd Rome workshop «Science Perception» together with a concise and evocative poster outlining the history of quanta.

Other useful resources are the two invited lectures "Relativity vs. Quantum Mechanics" and "Relativity vs. Quantum Physics" held, respectively, in 2010 at the International Year of Astronomy (IYA09) and in 2015 at the closing day of the Academic Year by the Astronomical Pontine Association (APA-lan).

Ronnie Bryan
Teacher, Sequoyah High School, USA

Math Foundations at Sequoyah High School

The mathematics curriculum at Sequoyah High School leads students through an unfolding of abstract concepts that build up their skills while drawing interdisciplinary connections. Beginning with the Natural Numbers and the Properties of Equality, students engage in a series of logical explorations that guides them through an expansion of their definition of "number" throughout Algebra 1, Geometry, and Algebra 2. Practical applications suggest the need for concepts such as Integers, Rational Numbers, Real Numbers, and Complex Numbers. Included among the application projects are those outside the realm of STEM that seek to explain or create visual art, music, and poetry. Student statements, examples of their work, and descriptive statistics of their performance on learning objectives are provided to support the efficacy of the program.

Marie Bukowski
Director, School of Art, Kent State University, USA
&
Chester Wilson
Associate Professor, Louisiana Tech University, USA

Visualization of Science and Technology through Art

Advances in technology and science have made previously unimaginable concepts wholly possible. The intent through collaborative work is to advance the arts and cross-pollinate disparate fields of endeavor.

My collaborations at Louisiana Tech University with scientists and engineers have led to cross-disciplinary projects. My science-based art has led to multi-discipline grants where art can teach science. Scientists have realized that my artwork carried out over the years has engaged contemporary science and technology through projects incorporating disciplines from cell biology to neuroscience to imaging technology through a variety of artistic approaches. This generative process seeds artistic experimentation through collaborative efforts between artists and scientists. Within the broad framework of this interdisciplinary interaction, a locus of activity has emerged, which included work in three interrelated areas:

Art: the connection of humanity with the larger environment,
Biology: the relationship of biological science and cognitive science with the human being, and
Computational Studies: the physics of the relationship of the intelligent machine with the human being.

This activity takes advantage of the extensive technological and artistic capabilities at Louisiana Tech. Combining the ABC's will develop methods for creating interactive social interfaces, incorporating tangible objects, networked devices and collaborative activities. "Context aware components" are designed to facilitate discourse and enhance understanding and contextualization of information and shared awareness. The goal of this interdisciplinary method of learning/creating is to design a set of tools and user interfaces for initiating dialogue and building bridges between people, their intellectual and practical actions, and socio-cultural reality as they encounter each other in public environments. The ultimate goal of my creative work/research is to creative an environment within a university setting that brings disparate fields of endeavor together, where students and faculty become part of "whole brain thinking" in order to become more efficient in today's ever changing world.

Viorel-Laurentiu Cartas
Assistant Professor, The Low Danube State University of Galati, Romania

The Viscoelastic Feature of the Spacetime

The present paper aims to describe the spacetime viscoelastic feature in the light of the LIGO gravitational waves and Gravity B-probe experiments. The elasticity of the spacetime fabric it seems to be more evident if we consider the tensorial similarity between the Einstein's equations and the Cauchy-Voigt-Hook's strain-stress equations. Since, in the frame of the General Relativity the spacetime is a real object, featuring a certain structure and physical properties, the viscosity successfully completes the gravitational description. A very humble and minimalist spacetime model is introduced in order to fit the viscoelastic properties.

Adrienne Coleman
Director of Equity and Inclusion, Illinois Mathematics and Science Academy, USA

Diversifying the STEM (Science, Technology, Engineering, Mathematics) Education to Career Pipeline

According to the National Science Foundation, "the U.S. STEM workforce must be considered in the context of an expanding and vibrant global scientific and technological enterprise" (2014). "The National Academy of Sciences further suggests that, without the participation of individuals of all races and genders, the increasing demand for workers in STEM fields will not be met, potentially compromising the position of the United States as a global leader". The stark reality is that there are a disproportionate number of Blacks and Latinos who lack the access and exposure to become STEM-literate. In order for the U.S. to remain a global STEM leader, an intricate look at STEM inequity on a national scale must occur and diversifying the STEM education to career pathway must be a priority.

The Illinois Mathematics and Science Academy sought to gain a better understanding of how to diversify this STEM education to career pathway. Thus, a study was conducted on the motivation of Black and Latino students to engage in STEM as well as two Diversifying STEM Think Tanks held to understand and address the racial STEM divide. The racial inequities in STEM were examined, strategies to address these inequities were discussed, and factors that motivate Black and Latino STEM engagement were identified.

From the perspectives of 415 STEM Stakeholders (students, parents, professionals, and educators), the D-STEM Equity Model to diversify the STEM Education to Career Pathway with national implications and global scalability, was developed. This model suggests "diversifying STEM policies" need to be developed that mandate funding for racially-based collaborative STEM initiatives to be implemented, that work towards achieving equity by addressing the identified problems collectively and integrating factors of Black and Latino student STEM motivation into STEM programming as well as encourage culturally responsive training for state/national teacher certification and current STEM educators.

Christine Condaris
Professor, Massachusetts College of Liberal Arts, USA

Teaching Creativity: The Value of the A in STEAM

As professional educators, we understand the importance of instructing our students using a great variety of teaching strategies. We combine lectures with demonstrations, lead discussions, encourage feedback, utilize online programs and facilitate hands-on participation. However, as arts educators, when we are presented with students who have little or no previous experience in the arts, we immediately eliminate all of these methods in favor of lecture style teaching. Typically, we ask non-artists, some of whom might be majoring in a STEM field, to sit quietly, often in uncomfortable chairs and behind desks, for the duration of the semester while we talk at them. By not allowing all students to physically interact with art, regardless of previous experience, we miss the opportunity to teach a skill valued by most disciplines and most especially by those in STEM fields: creativity.

Instead of the traditional lecture-style music appreciation course for non-musicians, I offer an entirely hands-on experience where all students, regardless of major, are generating and manipulating sound themselves. Throughout the semester they are required to describe, document, analyze, discuss, evaluate and debate their sound creation. By the end of the course, students are more willing to engage within a foreign context, can self-reflect and debate purposefully, and have the capacity to listen more deeply. These students have gained self-confidence and overcome their fear of working in an unfamiliar environment. They are able to defend and stretch their original insights. The ultimate learning outcome is that they have become comfortable working "outside the box."

Alexandre De Bernardinis
Research Scientist, IFSTTAR, France
Wiem Benatia
MSc Student, Toulouse Paul Sabatier University, France
&
Richard Lallemand
Research Engineer, IFSTTAR, France

Electro-Thermal Analysis for Lithium Carbon (LiC) Hybrid Supercapacitors

The research work within the framework of the IFSTTAR ELECTROCAP project, has concerned the analysis of electro thermal characterizations performed on a storage component named Lithium-carbon Supercapacitor (LiC) of highest capacity. LiC is a hybrid supercapacitor. By employing the technique of frequential electrochemical impedance spectroscopy (EIS) in potentiostatic mode which consists in controlling the cell voltage, several series of tests have been performed on 3300F cell. The experimental EIS set-up is shown in Fig. 1. Static tests with several voltage amplitude points, then thermal tests by placing the Supercapacitor in a programmable and regulated climatic chamber. The performed measures were then reported on frequency Nyquist diagrams, as shown in Fig. 2. The obtained results demonstrate, on the one hand, that for low frequencies the physical behavior of the LiC Supercapacitor approaches that one of a lithium battery (or electrochemical accumulator) characterized by a certain slower dynamics of the internal electrochemical reactions. On the other hand, for high frequencies the behavior is the one of a classic Supercapacitor with a faster dynamics of the charge transfer. A similar tendency was able to be observed for the temperature characterizations. Indeed, at low temperature (0°C) the behavior of battery is dominating while for high temperatures (above 40°C) the evolution of the impedance frequency spectra show a behavior of high faradic supercapacitance. For the voltage characterization, at the absolute potential of 3V, an inflexion of the voltage curve is observed which corresponds to the (Li+/Li) Redox potential E^0(V)=-3,04V, and which may explain the change of behavior for the LiC between battery and supercapacitor. Additional characterizations in temperature will be further planned to consolidate the first experimental results and bring new elements of analysis and explanation to the physicochemical phenomena that were observed.

Interface d'acquisition Thales

Impédancemètre IM6+PP240

Supercondensateur LiC 3300F

Fig.1. Experimental set-up for EIS analysis for 3300F LiC cell Supercapacitor.

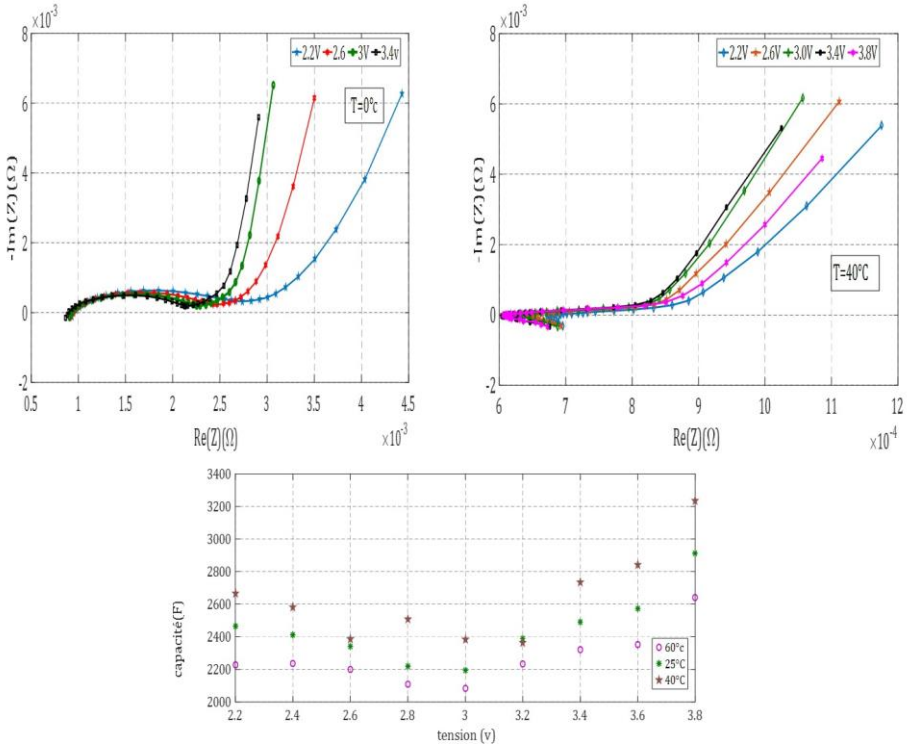


Fig.2. Impedance spectra for 3300F LiC cell under voltage and temperature constraints.

Francisco Delgado
Researcher and Professor, Tecnológico de Monterrey, Mexico

Assembling Large Entangled States in the Ingarden-Urbanik Entropy Measure under the SU(2)-Dynamics Decomposition for Systems Built from two-Level Subsystems

Entanglement is not only a special feature of quantum mechanics, instead it is a processing resource in quantum information. In the nature, quantum entanglement can be achieved only through entangling bipartite interactions, which combined could give extended entangled states involving a large number of single elementary quantum systems. Recently, an architecture to hold quantum information has been proposed in the form of weak chains of two-level subsystems involving local and bipartite non-local (entangling) interactions:

$$\tilde{H} = \sum_{\{i_k\}} h_{\{i_k\}} \bigotimes_{k=1}^{n} \sigma_{i_k}$$

in such sufficient general systems, the Hamiltonian can be decomposed as a direct sum of two-dimensional subspaces in the global Hilbert space, which is directly inherited to the evolution matrix of the system:

$$H = \bigotimes_{i=1}^{2^{n-1}} \mathbb{S}_{Hi} = \left(\begin{array}{c|c|c|c} \mathbb{S}_{H1} & 0 & \dots & 0 \\ \hline 0 & \mathbb{S}_{H2} & \dots & 0 \\ \hline \vdots & \vdots & \ddots & \vdots \\ \hline 0 & 0 & \dots & \mathbb{S}_{H2^{n-1}} \end{array}\right) \rightarrow$$

$$U = \bigotimes_{i=1}^{2^{n-1}} \mathbb{S}_{Ui} = \left(\begin{array}{c|c|c|c} \mathbb{S}_{U1} & 0 & \dots & 0 \\ \hline 0 & \mathbb{S}_{U2} & \dots & 0 \\ \hline \vdots & \vdots & \ddots & \vdots \\ \hline 0 & 0 & \dots & \mathbb{S}_{U2^{n-1}} \end{array}\right)$$

despite there are multiple basis to reach this decomposition in the quantum information of the system, generalized Bell states (GBS) is a universal basis for this decomposition if Hamiltonian is time-independent.

In anyway, the blocks of Hamiltonian:

$$\begin{aligned} \mathbb{S}_{H\mathcal{I},\mathcal{I}'} &= \begin{pmatrix} h_{11} & h_{12} \\ h_{12}^* & h_{22} \end{pmatrix} \\ &= \frac{h_{11}+h_{22}}{2}\mathbb{I}_{\mathcal{I},\mathcal{I}'} + \mathrm{Re}(h_{12})\mathbb{X}_{\mathcal{I},\mathcal{I}'} - \mathrm{Im}(h_{12})\mathbb{Y}_{\mathcal{I},\mathcal{I}'} + \frac{h_{11}-h_{22}}{2}\mathbb{Z}_{\mathcal{I},\mathcal{I}'} \end{aligned}$$

generate as well a dynamics which can be expressed as a semi-direct product of evolution matrices in the form of exponentials of the last, a structure well known on SU(2). This structure lets to set generalized standard information operations as: logical, loop, exchange, Hadamard, and controlled gates. Due to the universality of the bipartite quantum

processing on qubits, this procedure gives a general structure for quantum processing on these systems. In particular, the processing to obtain maximal entangled states as W or Greenberger–Horne–Zeilinger ones are easily obtained as recursive procedures. In this work, under last scheme, the construction of more arbitrary large entangled states is presented using the Ingarden-Urbanik entropy measure.

Ayman El-Faham
Professor, King Saud University, Saudi Arabia

Recent Progress in Peptide Coupling Reagents and Greener Solvents in Peptide Synthesis

After the identification of the potential explosively of HOBt and HOAt, which are used as additive in carbodiimide for coupling methodology, there has been a large development of new additives. Recently, we reported the OxymaPure as a superior peptide coupling additive. OxymaPure has been showed always superior to HOBt and even in some cases superior to HOAt. More recently, We developed a new series of peptide addtives and coupling reagent such as uronium salts based on isonitroso Meldrum's acid (HONM) was reported as stand-alone coupling reagents. Later we reported a new additive, its potassium salt and its uronium salts. This new additive, Oxyma-B, and it thio-deriavtives OxymaTB. They are oxime derived from 1,3-dimethylbarbituric acid, showing a similar cyclic structure as HONM with a special orientation of the carbonyl moiety, which can play an assisted basic catalytic role by enhancing the reaction of the amino function during coupling. In addition, Oxyma-B and Oxyma-TB does not show any ester moiety in its structure and, therefore, there is no risk of any side-reaction. These new additive have been used with greener solvents such as 2-Methyltetrahydrofuran (2-MeTHF), cyclopentylmethyl ether (CPME),) tetrahydrofuran (THF), acetonitrile (ACN), and δ-Valerolactone as greener alternative solvents for *N,N*-dimethylformamide (DMF) in peptide synthesis.

Here we reported the ability of these solvents to dissolve amino acid derivatives and a range of coupling reagents were evaluated as well as the swelling of polystyrene and polyethylene glycol resins. In addition, racemization and coupling efficiencies were evaluated with a model of peptide (stepwise and segment coupling). such as Aib-enkephaline pentapeptide and Aib-ACP decapeptide, in combination with the totally polyethylene glycol ChemMatrixresin, gave a better coupling efficiency than DMF.

Franz Haas
Professor and Head of Institute of Production Engineering, Graz University of Technology, Austria
&
Andres Suarez Gonzalez
Professor, Graz University of Technology, Austria

Energy Consumption Factor (ECF) as a New Classification Figure to Compare Machining Processes

Energy efficiency is a more and more relevant topic for the industrial sector due to the demand of low production costs. This topic is also important for governments that impulse the saving of energy for a more sustainable and environmental friendly manufacturing. Within the framework of the Industry 4.0, it is stated that digital technologies have the capacity to transform manufacturing up to a more efficient level. Nowadays machines include a myriad of sensors and actuators that increase the amount of available process data. Consequently, operators and production managers need powerful classification figures to support decisions that will thus positively influence the performance of the whole business. The paper is dealing with a unique method for the evaluation and comparison of energy efficiency. The experiments have been done in the field of milling but the general idea can be extended to all subtractive, formative and additive processes. Besides the theory, test results are presented to demonstrate how this evaluation method can be implemented to become useful for both at the engineering and operational level. There is also an open window for the evaluation of new technologies (e.g. ultrasonic and laser assisted machining, 3D-printing).

Lorraine Howard
President, Women and Mathematics Education, Wilkes University, USA

Girls' Mathematics Identity: The Gateway to STEAM Success

Description of Presentation:

This paper presentation workshop will focus on girls' math identity – the belief that you can do math and the belief that you belong – as a gateway to participation in STEAM education and careers. Mathematics identity refers to a person's beliefs, attitudes, emotions, and dispositions about mathematics and their resulting motivation and approach to learning and using mathematics knowledge. It involves the way students think about themselves in relation to mathematics and the extent to which they have developed a commitment to, are engaged in, and see value in mathematics. Thus, this presentation will look at systematic barriers to impeding participation of girls and women in STEAM, and possible solutions – effective approaches, practices and strategies.

Participant Learning:

According to recent research, the concept of "mathematics identity" is a critical component of framing the knowledge, skills, habits, attitudes, beliefs, and relationships that students need to develop as successful mathematics learners. Thus, participants will learn about how to support a positive math identity in girls using research-based strategies. The presentation will feature a large-group presentation about current research; small-group discussions on addressing barriers as well as specific strategies that foster a positive math identity in girls; and a hands-on, minds-on activity that demonstrates these strategies using math found in everyday experiences. During the activity, participants will explore higher order math in order to improve students' math skills, increase engagement and comprehension, and support the development of a positive identity.

Focus on Math:

The central mathematics content is about the importance of a positive math identity to girls' future success in STEAM.

Interactive Workshop:

Participants will form small discussion groups to problem-solve strategies for developing a positive math identity in girls. They also will participate in a hands-on activity to demonstrate and experience specific identity strategies and will be using math manipulatives that reinforce equity -- easily found, accessible and culturally familiar materials.

Ziad Khalifa
Assistant Professor, The British University in Egypt, Egypt

Biofuel Cells based on Glucose Electrooxidation at Conducting Polymer Modified Electrodes with Palladium and Platinum Nanoparticles

Glucose fuel cells are considered a promising power supply with a competent long-term stability and power density. In this respect, new modified electrodes were fabricated for biofuel cell based on electrochemical polymerization of organic monomer on glassy carbon electrodes. An investigation was carried out on the catalytic electro-oxidation of glucose in basic solution utilizing conducting polymer electrodes modified by incorporation of palladium-nanoparticles (PdNPs) and/or platinum-nanoparticles (PtNPs) dispersed in the poly(1,8-aminonaphthalene) (p1,8-DAN) film. The prepared Pd/p1,8-DAN/GC, Pt/p1,8-DAN/GC, Pd/Pt/p1,8-DAN/GC and Pt/Pd/p1,8-DAN/GC catalysts showed excellent electro-analytical performance with excellent operation/storage stability. Higher activity and stability of Pt/Pd/p1,8-DAN/GC catalyst were observed. These versatile kind of modified electrodes render the potential candidates for developing a new generation of glucose biofuel cells.

Kyu-Bong Kim
Professor, Dankook University, South Korea
Hyang Yeon Kim
Research Professor, Dankook University, South Korea
&
Yong Jae Lee
Graduate Student, Dankook University, South Korea

Analytical Method Development of Methylisothiazolinone

Ekin Kipcak
Research Assistant, Yildiz Technical University, Turkey
&
Mesut Akgun
Professor, Yildiz Technical University, Turkey

Supercritical Water Gasification of Isopropanol and Isobutanol: An Alternative Approach for Energy Production

The development of sustainable, efficient and environmentally benign alternative methods for energy production is currently being the focus of many scientific investigations. One of these promising methods is supercritical water gasification, which takes place at conditions exceeding the critical point of water (T>374°C, P>22.1 MPa). Behaving both as a reaction medium and a reaction participant, supercritical water enables chemical reactions to occur in a single homogenous phase and without interfacial transport limitations. High gasification efficiency and combustible gaseous effluent production are among the other advantages of the process. In this study, the supercritical water gasification of isopropanol and isobutanol was investigated. The experiments were performed at three reaction temperatures (500, 550 and 600°C), and four reaction times (15, 20, 25 and 30 s), at a constant pressure of 25 MPa. The results unveiled that the gaseous products were comprised mainly of hydrogen, methane, ethane, propane and propylene. Gaseous product yields up to 4.2 L/L feed and 8.4 L/L feed were obtained for isopropanol and isobutanol, respectively. For isobutanol, the greatest amount of combustible gaseous effluent was obtained at 550°C and for a reaction time of 25 s. At these conditions, the gaseous product contained 47.6% methane, 5.3% hydrogen, 4.1% ethane, 10.4% propane, 14.5% propylene and 10.1% carbon monoxide. On the other hand, for the case of isopropanol, 99.3% of the produced gas contained combustible components at the same experimental conditions. This produced gas involved 12.1% methane, 19.4% hydrogen, 3.8% ethane, 15.6% propane, 47.5% propylene and 0.1% carbon monoxide.

Liudmyla Kozak
Associate Professor, Taras Shevchenko National University of Kyiv, Ukraine
Bogdan Petrenko
Student, Taras Shevchenko National University of Kyiv, Ukraine
Elena Kronberg
Scientist, Max Planck Institute for Solar System Research, Germany
Andrew Prokhorenkov
PhD Student, Taras Shevchenko National University of Kyiv, Ukraine
Elena Grigorenko
Scientist, Space Research Institute, RAS, Russia
&
Antony Lui
Principal Professional Staff, Johns Hopkins University Applied Physics Laboratory, USA

Investigation of Turbulent Processes in Magnetosphere Plasma

In this work we used the measurements of four spacecraft of the space mission of the Cluster-2 with time resolution 22,5 Hz in the moments of magnetic field dipolarization for the analysis of turbulent processes in the magnetosphere plasma.

We carry out the following: analysis of tail and evolution on different scale of the probability distribution function of magnetic field fluctuations; determination of kurtosis and analysis of expanded self-similarity ESS-analysis; spectral power density analysis; amplitude analysis and wavelet power spectral of the signal. In the wavelet analysis, we used the Morley wavelet, consisting of a plane wave modulated by a Gaussian.

Among the obtained results we note that for all measurements considered during the dipolarization (DP) of the magnetic field the distribution function of the magnetic field fluctuations is substantially wider than at moments up to DP. Power law tails indicates on non-Gaussian statistics of processes, as well as the kurtosis of energy of large-scale perturbations generated by the source.

In this investigation we carried out a comparison of obtained dependencies with existing at the moment models for description of both uniform and non-uniform turbulent processes.

We can note the significant difference of the spectral index for moments before and during the dipolarization of the magnetic field: the spectral index is close to Kolmogorov's model before; and close to electron-magnetohydrodynamic turbulence during the event.

Wavelet analysis showed the presence of both direct and reverse cascade processes, and presence of Pc4 and Pc5 pulsations.

The work was conducted in the frame of complex program of National Academy of Science of Ukraine on scientific cosmic researches; with support of education program of Ministry of Education and Science of Ukraine No 2201250 "Education, Training of students, PhD students, scientific and pedagogical staff abroad"; the grant Az. 90 312 from the Volkswagen Foundation ("VW- Stiftung") and International Institution of Space Research (ISSI-BJ).

Piret Kuusk
Head of the Laboratory of Theoretical Physics, University of Tartu, Estonia

Theories of Gravity and Contemporary Observations

Florian Nguyen
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Jean-Philippe Laval
Researcher, CNRS, France
Bérengère Dubrulle
Research Director, CNRS, France
&
Pierre Kestener
Researcher, CEA, France

Local and Global Anisotropic Multifractal Analysis of Turbulent Flow

The regularity of the solutions to the Navier--Stokes equations is a major concern for theoretical hydrodynamic, being even one of the Clay prize's problems. The thematic of singularities in turbulence has in particular been studied by Onsager. This subject, that appears to be mainly of theoretical interest, may actually have serious physical applications. Indeed, more recent results state that the presence of singularities could have a non-negligible influence on the flow.

Namely, those singular structures would be able to dissipate energy in a non-viscous way, which may be related to the so called "turbulence zeroth law". Said another way, to compute the energy balance of a turbulent flow, one would have to include the effect of singularities.

To search for singularities, one possibility is to use the concept of multifractal analysis. Indeed, this method computes the fractal dimensions of the subspace of singularity exponents h where this coefficient h corresponds to a measure of the regularity of the flow. In particular, finding a singularity exponent below 2 means that the field is not twice differentiable, and thus not a solution to the Navier--Stokes equations.

The multifractal theory, introduced by Parisi and Frisch is a statistical method to quantify globally the probability of observation of a singularity of scaling exponent h. In the understanding of the regularity properties of a velocity field, it would however be useful to be able to quantify locally the Holder continuity, i.e. to devise a local multifractal analysis.

In this talk, we discuss the extension of the multifractal theory to be able to get local Holder exponents. We then apply both global and local the multifractal analysis to the velocity vector field measured in direct numerical simulation of Navier-Stokes.

Gladys Ong
Graduate Student/Senior Education Officer, University College London/ Ministry of Education, UK/Singapore

Exploring Authentic Assessment in the Learning of Mathematics

Throughout the ages, the development of Mathematics has been fuelled by the need to solve real-world problems, explain phenomena and pursue the intellectual desire to search for the truth. Applications of Mathematics have permeated almost every discipline of human knowledge, including the hard sciences (e.g. physics, engineering, computing), soft sciences (e.g. psychology, economics and finance), life sciences (e.g. biology, chemistry, medicine), humanities (e.g. geography), arts (e.g. music, dance), and linguistics. Nevertheless, obvious distinctions exist between the tasks learned in school Mathematics and those tasks mathematicians or users of Mathematics actually carry out (Lampert, 1990). How we learn inside the classroom is also different from how we learn beyond its walls. (Resnick, 1987).

These disparities between in-school and out-of-school learning have implications for the kinds of instruction and assessment that goes on in educational institutions with a Mathematics curriculum. Singapore recognizes the imperative role of a strong foundation in Mathematics, Science and technology in the economic development of the nation. Schools play an important part in laying this foundation for the Mathematics and Science education and the nation emerged first in Mathematics, Science, Reading and Problem Solving through Teamwork in PISA 2015. To help our students thrive in a fast-changing world, the Ministry of Education identified 21st Century competencies (21CC) within a framework that underpin the holistic education that schools provide to better prepare our students for the future.

This symposium seeks to provide an example of how an authentic assessment task can be used to fulfill student outcomes in the 21CC and Singapore Mathematics Frameworks. Instead of referring to a mark scheme, rubrics are employed to better reflect the nature of the task and the authenticity of assessing problems in real-world contexts. Student voice is also included through the use of group presentation peer checklist and the student self-reflection, in addition to having the students present their opinions, defend their positions and critique the validity of ideas. In constructing the assessment task and the rubrics, Wiggins' (1998) standards for authentic assessments were utilized. Assessment is a critical aspect in the teaching and learning of Mathematics. It requires careful consideration by teachers. However, assessment experiences for many students remain as one based on an approach where discrete facts and skills are tested (Niss, 1993). We cannot stop assessing problems in real world context by thinking that no one instrument can fully assess thinking and learning, because we can have a

combination of assessment strategies. Now is the time for us as educators, administrators and practitioners to answer Eisner's (1998) call of deepening of the "artistry" of teachers.

Ilker Ors
Teaching Staff, Selcuk University, Turkey
Murat Ciniviz
Teaching Staff, Selcuk University, Turkey
Ali Kahraman
Teaching Staff, Necmettin Erbakan University, Turkey
&
Bahar Sayin Kul
Lecturer, Selcuk University, Turkey

Using Biofuels in a CI Engine as Alternative Fuel

Nowadays, researchers have focused to alternative and renewable energy sources due to decrease of petroleum reserves. Besides, use of cleaner energy sources such as sun, wind, wave and biomass has pervaded due to increase greenhouse gases on world. Biomass is an important method for produce of alternative fuels. Biofuels such as biodiesel, bio-alcohols and biogases can produce owing to it. The aim of this study is investigate use of biofuels (biodiesel and bioethanol) produced from local feedstock in a diesel engine as experimental. In this study, blends of biodiesel produced from safflower with bioethanol produced from sugar beet used as fuels. Bioethanol added as volumetric 5% into biodiesel. Bioethanol decreased engine power due to its low calorific value. But, it decreased especially NOx and smoke emissions. Besides, bioethanol improved biodiesel's fuel properties such as density, viscosity and cold flow.

Elitsa Peltekova
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&
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Associate Professor, Sofia University "St. Kliment Ohridski", Bulgaria

Stem Teaching and Learning – A Journey from Virtual to Real World

Paper is about virtual reality (VR) enhanced teaching in Science, Technology, Engineering and Mathematics (STEM) domain. Study encompasses development and testing of the VR enhanced (VR device, mobile phone and VR mobile application) scenarios for in-service educators. These scenarios are based on inquiry-based learning (IBL) model and are part of European Union project "Enhancing Learning in Teaching via e-inquiries" (ELITe). The two scenarios designed during our study are about Physics (astronomy) and phobia overcoming. With their testing we aim STEM teachers to get to know with the new existing technologies and how they can enhance their teaching and learning process. Also how they can develop a design of "non-traditional" training (virtual reality and other ICT) and "reality" (real places for educational visits) and how both of them can enrich the learning process, increasing students' performance on the STEM disciplines is another important goal. Generally, the study examines how the "reality" in STEM discipline teaching could be improved by VR.

Mazen Qaisi
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Power Series Solution to Strongly Nonlinear Oscillators

This paper compares the accuracy of the power series approach with that of the modified Lindstedt-Poincare method for strongly nonlinear vibration. The free vibration of an undamped Duffing oscillator is considered because it has an exact solution. In the power series approach, the time variable is transformed into an 'oscillating time' which reduces the governing equation to a form well-conditioned by the power series method. The results show that the power series approach provides extremely accurate vibration frequencies, even at large values of the nonlinear parameter, compared with errors of up to nine percent for the modified Lindstedt-Poincare method. The Duffing equation

$$u + u+\epsilon\, u3=0, \quad (1)$$

with initial conditions $u\ 0 =A$, $u\ (0) = 0$, is transformed using the time variable

$$\tau = \sin\omega t \quad (2)$$

into

$$\omega2\ 1-\tau2\ u''- \omega2\tau\ u'+ u+ \epsilon\, u3=0,\ u\ 0 =A, u'\ 0 =0. \quad (3)$$

Applying the power series method to eq(3) leads to the recurrence formula

$$an+1= \omega2(2n-2)2-1\ an-\epsilon bn2n(2n-1)\omega2,\ n=1,2,\ldots. \quad (4)$$

between the series coefficients. Rayleighs energy principle is used to compute the oscillating time frequency ω. The Table below compares the vibration frequency obtained using different methods for various values of the nonlinear parameter ϵ. The results show that the power series method provides extremely accurate frequencies even at large nonlinearity. The error of the modified L-P technique [1] exceeds the 7 % limit predicted by the author but remains within 9 % of the exact values for the range of ϵ considered.

Nonlinear Parameter ϵ	Modified L-P	Power series	Exact solution
1	1.2553	1.3178	1.3178
10	2.6253	2.8666	2.8666
20	3.5799	3.9240	3.9240
30	4.3291	4.7516	4.7516
40	4.9665	5.4548	5.4547
50	5.5309	6.0762	6.0771

Haiduke Sarafian
Professor, The Pennsylvania State University, USA

Two-Dimensional Nonlinear Oscillations in an Electrically Charged Rectangular Frame

Motion characteristics of a point-like charged particle projected within the interior plane of a two dimensional electric field of a uniformly charged square and/or rectangular frame is intuitively unpredictable. This investigation quantifies its kinematics. Two scenarios are considered. First, the charged particle is projected along the frame's symmetry axis. Second, it is projected at an arbitrary direction. In both cases the equations of motion are challenging nonlinear differential equations. Applying Computer Algebra System (CAS), specifically Mathematica, these equations are solved numerically. The first scenario results in weak nonlinear oscillations along the symmetry axis. The second case is conducive to a two dimensional nonlinear oscillations sensitive to the orientation of the initial velocity. For visual comprehension of nonlinear oscillations, we utilize Mathematica's innate animation feature for both scenarios to simulate the oscillations.

Francis Stonier
Associate Professor, University of West Georgia, USA
&
Jill Drake
Professor and Department Chair, University of West Georgia, USA

Chinese Pre-Service Teachers STEAM Engagement through Legos

This paper will share findings from a cross-cultural study that explored changes in Chinese and American pre-service teachers' dispositions and pedagogical content knowledge regarding implementing STEAM activities with children following a series of professional development sessions based on Lego Education Kits. As STEM has only recently become a part of the national Chinese curriculum, changes in participants' interest and awareness of STEM/STEAM concepts and their classroom application will be of particular interest. The professional development experiences will center on creative problem solving and engineering design tasks.

The STEM content will focus primarily on alternative energy utilization through design, engineering, and optimization of solar and wind power. Each professional development session will afford participants the opportunity to observe how elements from all areas of STEAM are achieved through engagement in well- developed design tasks. The study will take place at a single Chinese university though there may be an additional opportunity to engage with local schools. Regardless of scope, findings should lay the groundwork for a number of future comparative studies. Participants will be grouped as much as possible by their educational program areas. Data will be collected in February and March of 2018.

Ionel Tifrea
Professor, California State University, Fullerton, USA

Thermoelectric Effects in Gapped Monolayer Graphene

We study the electronic contribution to the main thermoelectric properties of gapped monolayer graphene systems. The system electrical conductivity, Seebeck coefficient, and the thermal conductivity, are numerically calculated based on a Green's function formalism. To describe the free electrons in gapped-graphene we used two possible scenarios, the massive gap scenario, and the massless gap scenario, respectively. In all cases, we obtained the system's figure of merit and comment on possible thermoelectric applications for monolayer gapped graphene systems.

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&
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Adaptation of the Questionnaire that Measures Students' Motivation toward Science Learning (SMTSL) into Bulgarian version of Students' Motivation toward Chemistry Learning Questionnaire (BG SMTCLQ)

In educational research, the availability of a validated version of an original instrument in a different language offers the possibility for valid measurements obtained within the specific educational context and in addition it provides the opportunity for valid cross-cultural comparisons. The present study aimed to adapt the questionnaire that measures students' motivation toward science learning (SMTSL) for application to a different cultural context (Bulgaria), a different age group (secondary school students) and with a focus on chemistry learning. Subsequently, the Bulgarian version of students' motivation toward chemistry learning questionnaire (BG SMTCLQ) was used in order to investigate Bulgarian secondary school students' motivation to learn chemistry for the first time. The sample consisted of 250 secondary school students. Confirmatory factor analyses provided evidence for the validity of BG SMTCLQ. The five motivation components of the original instrument namely self-efficacy, active learning strategies, chemistry learning value, performance goal, achievement goal and learning environment stimulation were used. Findings of the study defined the validity of the BG SMTCLQ questionnaire and its reliability for Bulgarian secondary students. The results and the implication for using the BG SMTCLQ questionnaire in research and in classroom are discussed in the paper.

Vladimir Tzvetkov
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The Great Science Teachers of Tomorrow: A Study on Pre-Service Teacher Training from Skills Perspective

Being a great science teacher today is characterised not only by wide multidisciplinary knowledge and inspirational scientific talks and lab demonstrations, but also by the fluent use of inquiry-based learning techniques, creative application of modern technologies and development of exciting project tasks for the students. To achieve that incredible image, a teacher needs to develop the necessary attitudes to face all challenges and also a set of skills that differ from those of the teachers of decades ago.

This study is based on a literature review on the science teacher's role in a constructivist learning environment from John Dewey's works to modern articles. Based on the findings of the review, a model set of skills of the successful teacher is presented, divided in three groups – teaching skills, interpersonal skills and contextual skills. Following this model, the training of 30 pre-school science teachers is observed over a period of one academic year, using classroom observations, interviews, surveys, focus-groups, reflection diaries and other methods. The focus of the observations is to track the development of the predefined skills for great teaching in the pre-school practice. The most representative of the observed pre-school teachers are presented as case-studies, showing that the teacher training programmes are mainly focused on the teaching skills, neglecting the other two groups. The key findings of the study are that although it is not realistic to expect having complete professional teachers in the end of the university education, much more effort needs to be put in development of interpersonal skills and life-long learning attitudes of the future teachers.

Abe Zeid
Professor, Northeastern University, USA

Engineering-Based Learning: A New Methodology for High School Students STEM Learning

Teaching STEM concepts to today's high school students has been challenging to say the least. Today's students are different from students a generation ago. Span of attention is short. Students are glued to their electronic devices. More importantly, they cannot appreciate the abstract method of teaching, meaning covering concepts followed by solving problems from a textbook. Research has shown that students become excited and motivated to learn STEM abstract concepts when they are related to their daily lives and see how these same STEM abstract concepts are applied to products and devices.

Acknowledging this research finding, the question is how to change the traditional high school teaching approach to incorporate hands-on problem solving? Before we answer this question, we must bear in mind the many academic school year challenges and constraints. First, the curriculum is jammed. There is no room to add new courses. Second, it is hard, if not impossible, to add new content to courses. Teachers must prepare students to take mandated standardized state-wide tests. Third, schools operate on tight budgets, making hard to buy materials and supplies for student projects.

One common teaching method that overcomes these challenges, and yet allows students some hands-on experience is problem-based learning (PBL). In a nutshell, a teacher using PBL assigns the students in class an open-ended problem that focuses on some concepts. Students research the problem and solve the problem. The main problem with PBL is that it is not a structured method, meaning there in set of steps that the teachers and students can follow to organize their research and activates to solve the problem.

The author has conceived, developed, implemented, and tested a better method than PBL. It is coined as EBL; engineering-based learning. EBL has the same spirit as PBL in that is an open ended in nature, but it has a structure. It is the structure nature of EBL that makes it much easier to use in STEM classroom teaching than PBL. The structure is based on the well-known engineering design process (EDP).

The paper discusses EBL in more details, the EDP, providing professional development to high school teachers, the implementation of EBL in the City of Boston public schools, the results on students' performance, and future recommendations.

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&
Jacek Senkara
Professor, Warsaw University of Technology, Poland

Joining Aluminum Sheets

As one of the three enabling techniques (machining, forming/shaping, and joining/assembly), material joining is essential to all major manufacturing processes. Light metals have been introduced to the automotive industry for weight reduction in the last two decades. For instance, significant weight savings have been achieved using aluminum alloys for automobile body construction. Unlike steels which have been used as the structural materials since the birth of the automobile industry, aluminum alloys are relatively new to the automotive manufacturing, especially the welding process. Resistance spot welding, the most common joining method in automobile body construction, of aluminum alloys has proven difficult mainly because of their volatile physical properties. In general, welding aluminum requires much tighter process control than welding steels, and it is often augmented with adhesive bonding, which complicates the welding process. Alternative joining methods to welding aluminum alloys have been developed, and the most noticeable is probably friction-stir welding, which has been fairly successful in joining aluminum and other metals. Another alternative to welding, self-piercing riveting, has been adopted in certain applications. In this presentation, the difficulties in resistance welding aluminum and magnesium alloys are discussed, and solutions to overcome them are proposed. Major commercialized alternative mechanical joining approaches are also presented, as well as those currently in the development stage, yet have showed high potential for large-scale applications.