THE ATHENS INSTITUTE FOR EDUCATION AND RESEARCH

Abstract Book

2nd Annual International Conference on

Mechanical Engineering

23-26 July 2018, Athens, Greece

Edited by

Gregory T. Papanikos

2018

Abstracts

2nd Annual International Conference on Mechanical Engineering

23-26 July 2018

Athens, Greece

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TABLE OF CONTENTS

(In Alphabetical Order by Author's Family name)

Preface

This book includes the abstracts of all the papers presented at the *2nd Annual International Conference on Mechanical Engineering (23-26 July 2018)*, organized by the Athens Institute for Education and Research (ATINER).

In total 26 papers were submitted by 27 presenters, coming from 12 different countries (Austria, Egypt, Estonia, France, Jordan, Mexico, Singapore, Taiwan, Turkey, UK, Ukraine, and USA). The conference was organized into 8 sessions that included a variety of topic areas such as Computer Design, Network and Applications, Energy Production, Analysis and Materials, Engineering 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

2nd Annual International Conference on Mechanical Engineering, 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 2nd Annual International Conference on Mechanical Engineering were the following:

1. Gregory T. Papanikos, President, ATINER.
2. Nikos Mourtos, Head, Mechanical Engineering Unit, ATINER & Professor, San Jose State University, USA.
3. Bala Maheswaran, Head, Electrical Engineering Unit, ATINER & Professor, Northeastern University, USA.
4. Marcos Rodrigues, Professor, Sheffield Hallam University, UK.
5. Alexandre De Bernardinis, Research Scientist, IFSTTAR, France.
6. Ionel Tifrea, Professor, California State University, Fullerton, USA.
7. Ethel Petrou, Academic Member, ATINER & Professor and Chair, Department of Physics, Erie Community College-South, State University of New York, USA.
8. Haiduke Sarafian, Professor, The Pennsylvania State University, USA.
9. Christine Condaris, Professor, Massachusetts College of Liberal Arts, USA.
10. Lampros Pyrgiotis, Chemical Engineer, Delegate of the Assembly Presidium, Technical Chamber of Greece.

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
2nd Annual International Conference on Mechanical Engineering
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 B): Computer: Network, Design and Applications

Chair: Nikos Mourtos, Head, Mechanical Engineering Unit, ATINER & Professor, San Jose State University, USA.

1. Marcos Rodrigues, Professor, Sheffield Hallam University, UK. Improving Product Classification using Generative Recurrent Networks.
2. Panagiotis Artemiadis, Associate Professor, Arizona State University, USA. Dynamics, Modeling, Simulation and Control of Mid-flight Coupling of Quadrotors.
3. Huidan Yu, Associate Professor, Indiana University–Purdue University Indianapolis (IUPUI), USA. Image-based Engineering Assessment for Patient-specific Cardiovascular Diseases toward Precision Medicine.
4. Mark Lin, Graduate Student, San Jose State University, USA & Periklis Papadopoulos, Professor, San Jose State University, USA. Application of Computer Aided Design Tools in CFD for Computational Geometry Preparation.

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

14:00-15:30 Session VIII (Room B): Special Topics

Chair: Marcos Rodrigues, Professor, Sheffield Hallam University, UK.

1. Scott Grenquist, Associate Professor, Wentworth Institute of Technology, USA. Ancient Dimensions and Units: Ancient Greek Unitary Systems and Their Evolution from Earlier Systems of Measurement.
2. Yung-Cheng Ma, Assistant Professor, Chang-Gung University, Taiwan. Power-Gated Processor Architecture for Dark Silicon.
3. Richard Wainwright, PhD Student, Sheffield Hallam University, UK & Alex Shenfield, Senior Lecturer, Sheffield Hallam University, UK. Human Activity Recognition on Smartphones Making Use of Long Short Term Memory Techniques.

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

Panagiotis Artemiadis
Associate Professor, Arizona State University, USA

Dynamics, Modeling, Simulation and Control of Mid-flight Coupling of Quadrotors

Unmanned aerial vehicles have received increased attention in the last decade due to their versatility, as well as the availability of inexpensive sensors (e.g. GPS, IMU) for their navigation and control. Multirotor vehicles, specifically quadrotors, have formed a fast-growing field in robotics, with the range of applications spanning from surveillance and reconnaissance to agriculture and large area mapping. Although in most applications, single quadrotors are used, there is an increasing interest in architectures controlling multiple quadrotors executing a collaborative task. This paper introduces a new concept of control involving more than one quadrotors, according to which two quadrotors can be physically coupled in mid-flight. This concept equips the quadrotors with new capabilities, e.g. increased payload or pursuit and capturing of other quadrotors. A comprehensive simulation of the approach is built to simulate coupled quadrotors. The dynamics and modeling of the coupled system is presented together with a discussion regarding the coupling mechanism, impact modeling and additional considerations that have been investigated. Finally, the proposed methods are evaluated through an experiment that involved physical coupling and coupled flight of a pair of quadrotors.

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.

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.

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.

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

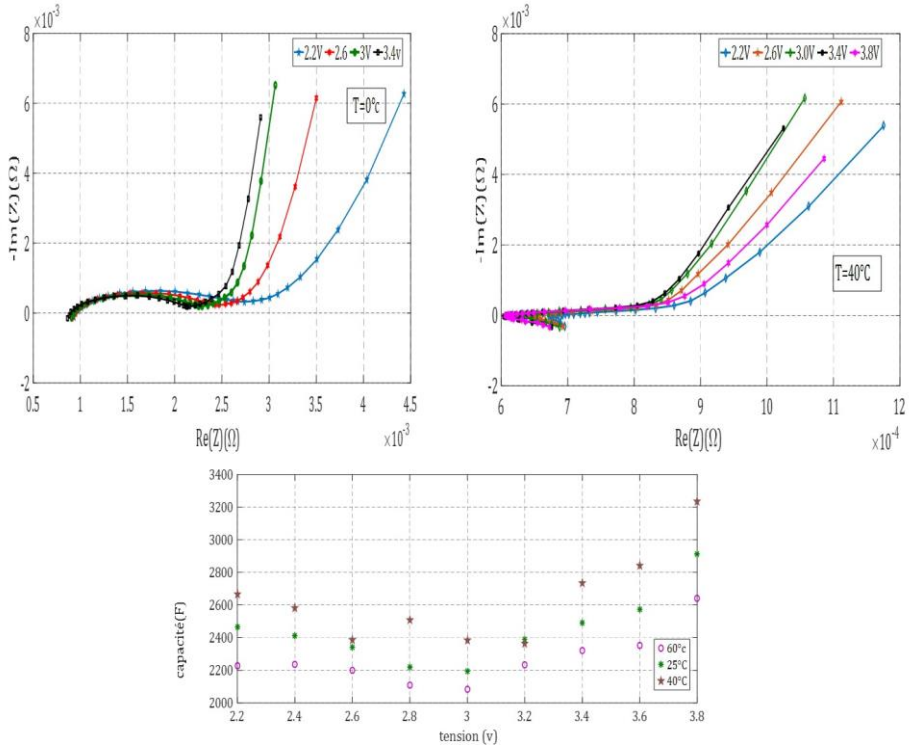

Fig.2. Impedance spectra for 3300F LiC cell under voltage and temperature constraints.

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.

Scott Grenquist
Associate Professor, Wentworth Institute of Technology, USA

Ancient Dimensions and Units: Ancient Greek Unitary Systems and Their Evolution from Earlier Systems of Measurement

Ancient Greek Unitary Systems were composed of units that were both derived locally, or through adoption from other neighboring cultures, such as the Egyptian civilization and the Persian civilization. A hierarchy of Ancient Greek units detailed measurements of length, time and weight that permeated the lives of the individuals that live throughout Greece and the Ancient World. In many cases, the units included in the Ancient Greek units have different characteristics then modern unitary systems. For instance, units for volume were different depending upon whether that volume consisted of a fluid or dry material. This is still true for common units of volume in Japan, as well. Many times, even though the same unit was used for similar measurements throughout Greece, different city-states would have different standard lengths for the same unit. There was little standardization of unitary systems across the entirety of Ancient Greece, but each city-state had a standardized unitary system within its territory. This paper examines how much of the Ancient Greek unitary systems were self-designed, and how much of the Ancient Greek unitary systems were adopted from other cultures. When it is shown that Ancient Greek units have been adopted from other civilizations, those evolutionary roots will also be examined.

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.

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.

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Theories of Gravity and Contemporary Observations

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Application of Computer Aided Design Tools in CFD for Computational Geometry Preparation

Computer Aided Design tools (CAD) allow geometries to be constructed in software so they can be used in manufacturing (CAM), analysis (CAE), and measurement (CMM). For Computational Fluid Dynamics (CFD), although a mesh can be constructed from scratch in a meshing software in some cases, more often it is created and imported from a CAD software. The difference lies in that if it's imported from CAD, the geometry would be describing a positive shape of that object, for example a racecar. However, in CFD, the computational domain is the fluid volume surrounding the positive shape, hence a CAD tool is used to extract a negative shape from the positive shape to allow the region of interest to be meshed.

The two CAD softwares used in this study were Solidworks by Dassault Systèmes and DesignModeler by ANSYS. Solidworks was used first as a descriptor of design geometry. It was then exported in the ACIS format (a .sat file) into DesignModeler to be converted into a negative shape. ACIS is the geometry kernel used by DesignModeler, and this format has proven to be more reliable than IGES or STEP. However, while taking the model from Solidworks into DesignModeler, one must ensure that the geometry descriptor contains solid bodies and not surface bodies because surface bodies cannot be used to construct a mesh grid. Frequent sectioning of the geometry in CAD is recommended to ensure the body stay as solids all the way through to the mesher. In this presentation, the detail steps that were performed using CAD tools to prepare a computational geometry for use in computational fluid dynamics analysis will be described. Examples of CAD geometry and the mesh generated will be presented. A CFD-solved case of racecar aerodynamics will also be shown to complete this topic.

Yung-Cheng Ma
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Power-Gated Processor Architecture for Dark Silicon

The pace of Moore's law has been slowing down for a decade. With deep submicron manufacturing process, the rise of leakage current causes the failure of Dennard scaling. At 8 nm technology node, more than 50% of the chip area has to be powered off. We are expecting the coming of dark silicon era.

We propose novel processor architecture for the dark silicon era, featuring intra-core power-gating to improve energy efficiency. The main theme for power-gating control is parallelism adaption, which adapts the instruction-level parallelism to execute a program in a VLIW processor. Previous researchers show that the register file power dominates the total power dissipation in a VLIW processor. To maximize the efficiency of power gating, we propose the PGRF-VLIW architecture featuring distributed and power-gated register files. The architecture relies on compiler support to exploit its energy efficiency. For instruction scheduling, we propose deadline-constrained clustered scheduling (DCCS) algorithm to reduce the energy dissipated on register files and make the processor power scales with parallelism. Based on the DCCS algorithm, we propose global code optimization algorithm to realize parallelism adaption. Loop-based policy is applied to partition the application program and each program segment is assigned its own execution parallelism to improve the utilization of activated hardware. We evaluate our approach with CoreMarkPro benchmark suite. The evaluation shows that our approach saves 30.46% to 64.06% of the energy dissipated on register files.

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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
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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.

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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.

Mazen Qaisi
Faculty Member, University of Jordan, Jordan

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

Marcos Rodrigues
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Improving Product Classification using Generative Recurrent Networks

The issue addressed in this paper is related to machine learning techniques for automatic classification of product descriptions. The problem arises when database entries do no perfectly match and so it is questionable whether a description is related or not to the same item, product, or service. A typical example is merging disparate databases that is required, for instance, when one business buys off a competitor. An obvious solution would be to train an AI system to perform classification. The problem is that AI deep learning networks require vast amounts of training data, normally in tens or hundreds of thousand samples and normally such data are not available. The specific classification problem we are addressing can be illustrated as follows.

Product	Category	Level 2	Level 3
Actimel Yogurt Drink 0.1% Fat Original 12x100g	Dairy	Yogurts	Actimel
Actimel Yogurt Drink 0.1% Fat Strawberry 8x100g	Dairy	Yogurts	Actimel
Actimel Yogurt Drink Blueberry 8x100g	Dairy	Yogurts	Actimel
Actimel Yogurt Drink Coconut 8x100g	Dairy	Yogurts	Actimel
Actimel Yogurt Drink Kids Strawberry and Raspberry 6x100g	Chilled	Easy Lunches	Lunchbox favourites

Note that while the first four records have been manually classified as 'Dairy', the last entry was classified as 'Chilled' (classification is accepted as correct for all entries). In order to learn the nuances of classification, an AI system needs a vast number of additional samples to be able to distinguish what characterizes Dairy and Chilled. Therefore, we have investigated network models to augment the training data set in a flexible but reliable way. The principle is to train a network with the objective of generating new data similar but not exactly the same as the input data. Validation of the newly generated data is performed by a second network which has been trained on the original data. A simple binary decision (yes/no) is output whether or not generated data has enough or acceptable similarity with the original data. Accepted data would eventually make part of an augmented training set, improving the network ability to classify unseen data. We designed and implemented a recurrent network with Keras, an open source neural network library written in Python. The network is based on the LSTM-Long-Short Term Memory model which has proved useful to a large number of problems with time dependencies. The encoding of product description is character-based so, once trained, the network outputs a character and tries to predict what the next character would be. With an appropriate training set to learn the structure of the data, such networks can output valid vectors. We

set the network to train over 20 epochs outputting the description (with a limited number of characters) at the end of each epoch. At epoch 0 (before training) it can only output random characters:

R22QQQOOVVVV0000000aa33aKTTTTTTTTTT**eLLLePPPPCJJllmvao

At epoch 2, things start to get better as the net begins to learn to separate words properly:

X Crisps and snacks

Supermarket's Crisps and Crisps and Cream

At epoch 3 the data now starts to resemble the training file with one description per line (ignoring the nonsense meaning of generated data such as chicken yogurt):

Chilled > Fresh pasta and sauces > Fresh pasta

British Chicken and Strawberry and Corner Yogurt 4x125g|Dairy > Yogurts > Muller

British Pork Sausages x8 200g|Meat and fish > Fish and seafood > All fish and seafood

Supermarket's British Pork Light and Coconut and Cheese

Network outputs get increasingly better and, at the end of training, valid samples are generated for an augmented database. Note that the generated data are not the same as the original. The main outcome of such generative recurrent network is that it works for text generation, giving us the ability to generate valid data from a limited set of samples. In this paper, we provided a justification for using recurrent networks to solve a significant limitation of small data sets in deep learning. We also showed that LSTMs are a good solution to the problem together with character-based text encoding and these represent the state-of-the-art in recurrent neural networks. Future work involves improvements to the network design model and testing SimpleRNN or GRU-Gate Recurrent Unit in place of LSTMs and fine-tuning of network parameters.

Haiduke Sarafian
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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
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&
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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.

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&
Alex Shenfield
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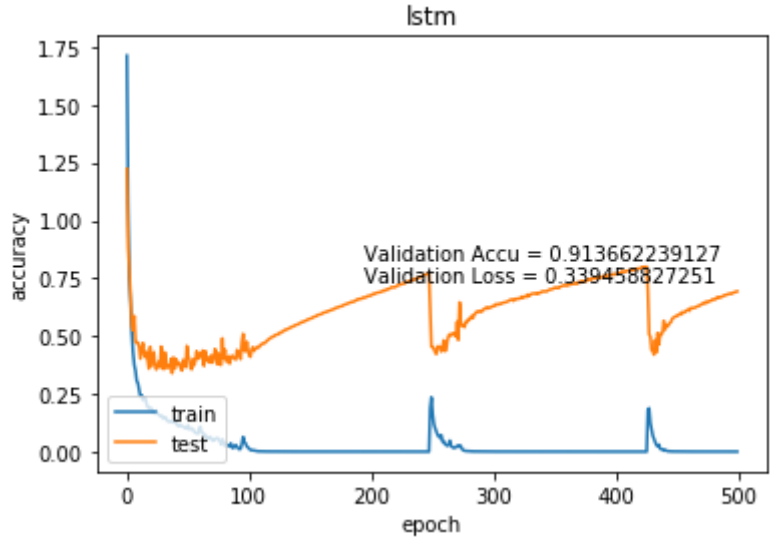
Human Activity Recognition on Smartphones Making Use of Long Short Term Memory Techniques

This paper proposes, investigates and describes the development of an artificial neural network in order to accurately determine a human activity of a given range. The data set used throughout this project is freely available and standardised. It contains the resulting sensor signals (accelerometer and gyroscope) from the protocol of activities that each of the 30 volunteers completed. There are 12 main classes in the dataset with each class representing a human activity and its postural representation. The core purpose of the research is to provide an effective way for smartphones to determine the human activity that is being carried out and the postural change associated with the activity. This information can be used to change many things such as screen orientation, text size or volume levels in smartphones.

All of the data was standardised and padded with zeroes to ensure all of the data samples were the same size. The data was also split into three groups: training, validation, and testing. Trialing different classifier models of varying layers, number of neuron and epochs produced varying degrees of loss. Additionally, early stopping constraints were used to prevent unnecessary steps when training. Finally, the data was presented making use of loss over time graphs and as validation accuracy with the least amount of loss.

Training the classifier is completed by using a mixture of Tensor flow and Keras loss models. Preliminary results have provided an average of 91% accuracy with losses of 0.3when making use of Categorical Cross entropy to train the classifier. Following the results additional work will be completed to improve the accuracy and loss of the dataset and to present the information in an insightful way. The effectiveness of the model will be demonstrated on an another HAR dataset that will contain the same number of classes using existing research as the benchmark. The results from these experiments will be reported and presented with details about the optimised classifier and the steps required for it to outperform existing research.

The pilot studies completed show that it is possible to identify human activities with a high level of accuracy and a small amount of loss. In contrast to previous approaches, the novel approach for human activity recognition outlined in this paper has shown promise and further development, training and testing will produce results that can improve on prevailing research.



Graph to show test and train accuracy over 500 epochs. Figure legends show best loss and best accuracy over the epochs.

Huidan Yu
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Image-based Engineering Assessment for Patient-specific Cardiovascular Diseases toward Precision Medicine

Patient-specific computational hemodynamics based on CT/MRI imaging has emerged as a powerful research tool to potentially aid noninvasive assessment for the severity of vascular diseases and necessity of vascular treatments in precise medicine. The attractive advantages include (1) the low cost of facility, personnel, and supplies; (2) the fully human subject protection; (3) the amenability to perform parametric analysis, and (4) the direct human subject results. Radiological scanning and animal model experimentation cannot compete with these advantages to achieve similar results with the same investment. We have recently developed a unique computational platform, named *InVascular*, for patient-specific and non-invasive evaluation of in-vivo hemodynamics such as velocity, pressure, flow rate, wall-shear stress, and so on. *InVascular* integrates the advanced modeling technique of CFD based on patient's clinical CT/MRI imaging information with the emerging GPU (graphic processing unit) parallel computing technology, which enable fast quantification of 4-D hemodynamics and massive numerical analysis to assess (1) the severity of vascular abnormalities and (2) the surgical benefits. For the purpose to assure the reliability of the computational outcomes, two types of validation are conducted. The first is the direct comparisons of computational pressure vs. invasively measured pressure. The second is through the concurrent laboratory experiment for blood flow in 3-D printed vessel, in which blood flow and pressure are measured. With three parallel research projects, i.e. (1) noninvasive and patient-specific assessment of the severity of renal arterial stenosis for renal-vascular hypertension, (2) Computational modeling and analysis for the patient-specific optimization of Clinical LVAD (Left Ventricle Assist Device) Implant, and (3) Image-based computational quantification for wall shear stress of Inner choroidal hemodynamics for age-related macular degeneration (AMD), are moving the development of *InVascular* toward an applicable, reliable, and effective tool for cardiovascular clinics.

Abe Zeid
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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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&
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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.