אורט בראודה
ORT Braude College

THE 14TH INTERDISCIPLINARY RESEARCH CONFERENCE

Book of Abstracts

Dear guests and colleagues,

It is our pleasure to welcome you to ***The 14th ORT Braude Interdisciplinary Research Conference****, being held at the Pastoral Hotel, Kfar Blum in the Upper Galilee.*

This annual conference brings together researchers from ORT Braude College and guests from Israel and abroad, for presentations and discussions of their research. It is also an opportunity to socialize and become acquainted with colleagues from diverse fields of research.

The conference includes a special lecture on a breakthrough on the IceCube neutrino, invited plenary talks, special sessions on Education, parallel sessions, and a social event.

This year we are blessed to have three distinguished plenary lecturers contributing to the conference:

Prof. Tsvi Piran*, Schwartzman Chair for Theoretical Physics, Racah Institute of Physics at The Hebrew University of Jerusalem; the Head of the I-Core Research Center in Astrophysics, an Inter-University Center of Excellence in Astrophysics;*

Dr. Yossi Chalamish*, MD, Co-Founder of Brainways; and*

Dr. Ilana Waisman, *RANGE Center, Faculty of Education, University of Haifa.*

Our social event includes an enthralling lecture by ***Danny Or Fox****, spiced with humor and full of optimism. Danny is the director and founder of "Corner of Animals" in Kishorit, an informal counseling center for parents of children with special needs.*

We wish everyone a pleasant and enlightening conference and hope that it will open doors to a better future for Education and Research collaboration.

Conference Organizing Committee

Jacobzon Fiana (chairperson), Dafne Guetta, Marcela Viviana Karpuj, Kobi Ganor, Henya Ashkenazi

SHORT PROGRAM

Wednesday, 17.10.2018	
9:00 – 10:00	Registration and welcome
10:00 – 10:15	Greetings : Prof. Arie Maharshak, President, ORT Braude College
10:15 – 11:05	Plenary: Prof. Tsvi Piran, Schwartzman Chair for Theoretical Physics, Racach Institute of Physics, The Hebrew University of Jerusalem.
11:05 – 11:20	Breakthrough: IceCube neutrinos point to long-sought cosmic ray accelerator, Prof. Dafne Guetta, Physics and Optical Engineering, ORT Braude College
11:20 – 12:10	Posters and coffee break
12:10 – 12:50	Plenary: Dr. Ilana Waisman, RANGE Center, Faculty of Education, University of Haifa
12:50 – 13:50	Session: Engineering Education
13:50 – 16:00	Lunch and check into hotel
16:00 – 16:50	Updates: Prof. Arie Maharshak, President, ORT Braude College
16:50 – 17:50	Excellence awards ceremony
17:50 – 20:00	Leisure time and dinner
20:00 – 23:00	Evening's social activities: 20:00: Lecture of Mr. Danny Or Fox, "Corner of Animals", Kishorit 21:00: Music in hotel lobby 22:00: Latin dance party
Thursday, 18.10.2018	
7:00 – 9:00	Breakfast
9:00 – 10:20	Parallel sessions
10:20 – 11:00	Coffee break and checkout of hotel
11:00 – 11:50	Plenary: Dr. Yossi Chalamish, MD, Co-Founder, Brainways
12:00 – 13:00	Parallel sessions
13:00 – 14:15	Lunch
14:15 – 15:35	Parallel sessions
15:35 – 16:05	Session: Engineering Education
16:05 – 17:30	Updates and closing: Prof. Sarit Sivan, Vice President, ORT Braude College Mr. Ahiav Golan, CEO, ORT Braude College
17:30	Departure

KEYNOTE SPEAKERS

Plenary lecture at 10:15, 17.10.18

GRAVITATIONAL WAVES - A NEW WINDOW ON THE UNIVERSE

Prof. Tsvi Piran, Schwartzman Chair for Theoretical Physics, Racach institute of Physics, The Hebrew University of Jerusalem ; The Head of the I-Core Research Center in Astrophysics, Inter-university center of excellence in Astrophysics.

The research of Professor Tsvi Piran is in relativistic astrophysics.
The link between astrophysics and fundamental theories: relativity and high-energy physics.
This enables using astronomical observations to explore physics under extreme conditions that cannot be explored otherwise on Earth.

Plenary lecture at 12:10, 17.10.18

CAN MATHEMATICAL EXPERTISE SERVE AS AN INDICATOR OF MATHEMATICAL GIFTEDNESS? – ERP EXAMINATION OF BRAIN ACTIVITY

Dr. Ilana Waisman, Haifa University.

Ilana Waisman is a researcher at the Neuro-cognitive laboratory for the investigation of creativity, abilities and giftedness located at the RANGE center, Faculty of Education University of Haifa.
She is working in the new emerging field of interweaving mathematics education with cognitive neuroscience. Her research projects focus on the investigation of brain functioning associated with the mathematical problem solving as well as on the examination of differences between individuals during this process. To do so she employs EEG methodology.

Plenary lecture at 11:00, 18.10.18

THE BRAIN PLASTICITY

Dr. Yossi Chalamish, M.D., Co-Founder, Brainways

Yossi Chalamish was trained as a medical doctor at the Technion, having gained a post-doctorate in brain research from
the Weizmann institute;
He has been working as a brain researcher and clinical hypnotist for over a decade.
Yossi works passionately to apply the findings of brain research for the improvement of overall wellbeing.

ABSTRACTS
(by department)

Applied Mathematics

SET GAME: A WINDOW INTO THE MIND

Mark Berman[1]

[1]*Department of Mathematics, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1951, Fax: 972-4-990-1802, E-mail: berman@braude.ac.il*

Keywords: Cognition, perception

SET is a card game based on patterns. It is unique in that it requires simultaneous identification of similarities and differences. This makes the game ideal for studying the interplay between cognitive and perceptive processes in the mind. I will describe ways in which SET game can be applied to detect cognitive processes in healthy subjects and in those with neurological disorders.

PHYSICALLY FEASIBLE DECOMPOSITION OF ENGINO® TOY MODELS: A GRAPH-THEORETIC APPROACH

Aviv Gibali[1], Efstathios N. Antoniou[2], Adérito Araújo[3] and Miguel D. Bustamante[4]

[1]*Department of Mathematics, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, E-mail: avivg@braude.ac.il*

[2]*Department of Information Technology, Alexander Technological Educational Institute of Thessaloniki, Greece, E-mail: mailto:antoniou@it.teithe.gr*

[3]*CMUC, Department of Mathematics, University of Coimbra, Portugal, E-mail: mailto:alma@mat.uc.pt*

[4]*Institute for Discovery, School of Mathematics and Statistics, University College Dublin, Belfield D4, Ireland, E-mail: mailto:miguel.bustamante@ucd.ie*

Keywords: Feasible decomposition, toy models, graph theory

During the 125th European Study Group with Industry held in Limassol, Cyprus, 5–9 December 2016, one of the participating companies, Engino.net Ltd., posed a very interesting challenge to the members of the study group. Engino.net Ltd. is a Cypriot company, founded in 2004, which produces a series of assembly kits for children and youth—the Engino® toy sets—consisting of a number of building blocks, which can be assembled by pupils to build toy models. For each particular kit, the company has developed a number of models that can be built utilizing the blocks present in the set; however, the step-by-step assembly manual for each model could only be composed manually.

The goal of the challenge posed by the company was to develop a procedure to automatically generate the assembly instructions for a given kit. In this talk, we propose a graph-theoretic approach to model the problem and provide a series of results that employ modified versions of well-established algorithms in graph theory. An algorithmic procedure to obtain a hierarchical, physically feasible decomposition of a given model, from which the assembly instructions can be recovered, is proposed.

REPRESENTATIONS OF $sl(\infty)$

Crystal Hoyt[1], Ivan Penkov[2] and Vera Serganova[3]

[1]*Department of Mathematics, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, E-mail: crystal@braude.ac.il*

[2]*Department of Mathematics, Jacobs University Bremen, Campus Ring 1, 28759, Bremen, Germany, E-mail: i.penkov@jacobs-university.de*

[3]*Department of Mathematics, University of California Berkeley, Berkeley, CA 94720, USA, E-mail: serganova@math.berkeley.edu*

Keywords: Lie algebra, super category O, integrable $sl(\infty)$-module, socle filtration, injective module

We introduce and study new categories, $T_{g,k}$, of integrable $g = sl(\infty)$-modules that depend on the choice of a certain reductive subalgebra $k \subseteq g$. The simple objects of $T_{g,k}$ are tensor modules, as in the previously studied category T_g of tensor modules; however, the choice of the subalgebra k provides more flexibility in the nonsimple modules. We then fix a subalgebra k with two infinite-dimensional diagonal blocks, and show that for each $m, n \in \mathbb{N}$, a certain injective object $K_{m|n}$ in $T_{g,k}$ realizes a categorical $sl(\infty)$-action on the integral category O of the Lie superalgebra $gl(m|n)$. We show that the socle of $K_{m|n}$ is generated by the classes of projective $gl(m|n)$-modules in O, and we compute the socle filtration of $K_{m|n}$ explicitly.

SPLINE FUNCTIONS, THE DISCRETE BIHARMONIC OPERATOR, AND APPROXIMATE EIGENVALUES

Haggai Katriel[1] and Matania Ben-Artzi[2]

[1]*Department of Mathematics, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-908-6433, Fax: 972-4-990-1802, E-mail: katriel7@braude.ac.il*

[2]*Institute of Mathematics, The Hebrew University of Jerusalem, Jerusalem 91904, Israel, E-mail: mbartzi@huji.ac.il*

Keywords: Discrete biharmonic operator, splines, eigenvalues

The biharmonic operator plays a central role in a wide array of physical models, notably in elasticity theory and the stream function formulation of Navier-Stokes equations. The need for corresponding numerical simulations has led, in recent years, to the development of a discrete biharmonic calculus. The primary object of this calculus is a high-order compact discrete biharmonic operator (DBO). The numerical results have been remarkably accurate, and have been corroborated by some rigorous proofs. There remains, however, the "mystery" of the "underlying reason" for this success. Our work is a contribution in the direction of resolving this mystery, showing the strong connection between cubic spline functions (on an interval) and the DBO. It is shown in particular that the (scaled) fourth-order distributional derivative of the cubic spline is identical to the action of the DBO on grid functions. A remarkable consequence is that we find that the kernel of the inverse of the discrete operator is (up to scaling) equal to the grid evaluation of Green's function of the biharmonic operator, providing an explicit expression for the DBO matrix of the DBO. We use these results to study the relation between the (infinite) set of eigenvalues of the fourth-order biharmonic operator on an interval and the finite set of eigenvalues of the discrete biharmonic operator. The discrete eigenvalues are proved to converge (at an "optimal" $O(h^4)$ rate) to the continuous ones.

THE TWISTED GROUP RING ISOMORPHISM PROBLEM

Ofir Schnabel [1] and Leo Margolis [2]

[1]*Department of Mathematics, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1801, Fax: 972-4-990-1802, E-mail: osmath2519@gmail.com*

[2]*Department of Mathematics, Vrije Universiteit Brussel, Belgium, E-mail: leo.margolis@um.es*

Keywords: Isomorphism problems, representation theory, twisted group rings

We propose a variation of the classical isomorphism problem for group rings in the context of projective representations. We formulate several weaker conditions following from our notion and give all logical connections between these conditions by studying concrete examples. We introduce methods to study the problem and provide results for various classes of groups, including abelian groups, groups of central type, p -groups of order p^4 and groups of order p^2q^2 where p and q denote different primes.

FORMAN'S RICCI CURVATURE: A GEOMETRIC TOOL FOR NETWORK INTELLIGENCE

Emil Saucan[1]**,** Jürgen Jost[2], Areejit Samal[3] and Melanie Weber[4]

[1]*Department of Applied Mathematics, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-908-6408, Fax: 972-4-990-1802, E-mail: semil@braude.ac.il*

[2]*Max Planck Institute for Mathematics in the Sciences, Inselstrasse 22, 04103 Leipzig, Germany, E-mail: jost@mis.mpg.de*

[3]*The Institute for Mathematical Sciences (IMSc), Chennai, India, E-mail: asamal@imsc.res.in*

[4]*Department of Mathematics, Princeton University, Princeton, NJ, USA, E-mail: mw25@math.princeton.edu*

Keywords: Network analysis, Forman-Ricci curvature, Ricci flow, network evolution

Traditionally, network analysis is based on local properties of vertices, such as their degree or clustering coefficient, and their statistical behavior across the network in question. Thus, we concentrate on the elements of the network (nodes), rather than on their interrelations (edges), which define, in effect, the network. We propose an alternative edge-based approach. The geometric tool that enables us to do this is Forman's discretization of the Ricci curvature. We show that in the limit case of 1-dimensional complexes, i.e., networks (or graphs), this notion is still powerful and expressive enough to allow us to capture not only local, but also global properties of networks, both weighted and unweighted, directed as well as undirected. We show the robustness of this notion and compare it to other, more classical graph invariants and network descriptors, both on standard model networks and on a variety of real-life networks. Furthermore, we develop a fitting Ricci flow and apply it in the analysis of dynamic networks, employing it for such tasks as change detection, denoising and clustering of experimental data, as well as to the extrapolation of network evolution. Moreover, we consider not only the pairwise correlations in networks, but also the higher order ones, which are especially important in biological and social networks, and apply Forman's original notion to the resulting complexes (hyper-networks) together with an adapted Ricci flow.

ENDOPHYTES, ORIGINATING FROM CHICKPEA SEEDS, AS A PREVENTATIVE TREATMENT FOR DISEASES CAUSED BY PHYTOPATHOGENIC FUNGI IN PLANTS

Lilach Iasur Kruh[1], Keren Gefen[2], Shahal Abbo[3], Omer Frankel[4], Avraham Gamliel[5] and Maya Lalzar[6]

[1]*Department of Biotechnology Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, E-mail: iasur@braude.ac.il,*

[2]*Department of Biotechnology Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, E-mail: keren.gefen@gmail.com*

[3]*The Robert H. Smith Institute of Plant Science and Genetics in Agriculture, The Levi Eshkol School of Agriculture, The Hebrew University of Jerusalem, Rehovot, Israel, E-mail: shahal.abbo@mail.huji.ac.il*

[4]*Department of Plant Pathology and Weed Research, ARO, The Volcani Center, Rishon LeZion, Israel, E-mail: omerf@volcani.agri.gov.il*

[5]*Department of Agricultural Engineering, Growing, Production and Environmental Engineering, ARO, The Volcani Center, Rishon LeZion, Israel, E-mail: agamliel@volcani.agri.gov.il*

[6]*Bioinformatics Service Unit, University of Haifa, Haifa 3498838, Israel, E-mail: maya.lalzar@gmail.com*

Keywords: Endophytic bacteria, chickpea, fungicide

Chickpeas (*Cicer arietinum*), as other legumes, contain a high quantity of nutrients including proteins, vitamins, fibers and antioxidants. They are, therefore, considered a superfood with great importance in feeding humanity. Among annual seeds, chickpea is ranked 14th in terms of cultivation area and 16th in production. Various fungi, however, cause substantial damage to these crops, leading to continuous and increasing usage of chemical fungicides.

Many endophytic bacteria, which live within plant tissue, contribute to plant disease resistance by suppressing pathogens and/or enhancing the plants' immune system. For this reason, these bacteria are increasingly recognized as bio-control agents, with the advantages of specificity, environmental-safety, and the ability to co-evolve with the target pathogen, thus avoiding the development of resistance, as commonly happens with chemicals.

The aim of my research is to characterize the bacterial community composition in cultivar and wild *Cicer* in a sterile system and screen for isolated bacteria that can suppress destructive fungi.

In the current work, bacteria were extracted from cultivar chickpea and wild *Cicer judaicum* plantlets, following which their ability to inhibit phytopathogenic fungi was investigated. Differences were observed in the bacterial composition between endophytes in wild and cultivar *Cicer*. Isolates, inhibiting the fungi, were identified by 16S rRNA gene sequencing. Most of these bacteria belonged to the *Bacillus* genus. Bacterial seed coating was examined and proved to be an effective application technique method for this biocontrol agent.

THE DISCOVERY OF A POSSIBLE PRION THERAPY LEADS TO A NOVEL LOSS OF FUNCTION TOOL

Marcela Viviana Karpuj[1], Lawrence Steinman[2] and Zena Werb[3]

[1]*Department of Biotechnology Engineering, ORT Braude, Karmiel 2161002, Israel, Tel: 972-58-554-4128, E-mail: mvkarpuj@braude.ac.il.*

[2]*Department of Neurology and Neurological Sciences & Pediatrics, Stanford University, Palo Alto, CA, USA, Tel: +1-650-725-6401, E-mail: steiny@stanford.edu.*

[3]*Department of Anatomy, University of California–San Francisco, CA, USA, Tel:+1-415-476-4622, E-mail: zena.werb@ucsf.edu*

Keywords: Phosphorothioate oligonucleotides, prion protein, membrane protein, cancer, drug screening

Phosphorothioate oligonucleotides demonstrated a low IC_{50} for PrP^{SC} in mammalian cell lines and in preclinical trials. Sets of experiments led us to generate a novel loss of function technology (LOFT) in mammalian cell lines that is rapid, affordable, easy to use, and specifically down-regulates membrane proteins (MP) and their variants (MPVs), without directly affecting their transcript, in a reversible manner. These attributes enable unique kinetic assay performance in a physiologically relevant manner, providing broad applicability including target validation, drug discovery, drug resistance analysis, biomarker identification, and functional analysis. MPVs are associated with disease progression. Nonetheless, studying MPVs in their physiological environment and, specifically, targeting the expression of a particular MPV isoform, is crucial, yet difficult to achieve. This LOFT technology helps overcome these obstacles. This technology was developed for cancer-related MPVs, and we hope to test the adaptation of this technology on MPVs related to neurodegenerative disorders including the effect of various PrP isoforms on prion infectivity.

USING GROUNDWATER DESALINATION CONCENTRATE IN AQUACULTURE

Idan Rom[1] and Sivan Klas[2]

[1]*Department of Biotechnology Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1907, Fax: 972-4-990-1970, E-mail: sivanklas@braude.ac.il*

[1]*Department of Biotechnology Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1907, Fax: 972-4-9901970, E-mail: idanrom25@gmail.com*

Keywords: Aquaculture, desalination, brine, concentrate

The Israeli aquaculture sector faces quality water shortage and low profitability. The current research attempts to investigate whether high value fish and algae can be economically cultivated in concentrate formed during groundwater desalination. The main problem in using concentrates for aquaculture is the $CaCO_3$ precipitation on the organism that prohibits its growth. Ca from concentrate produced in the Kfar Masaryk desalination plant was removed through aeration only. Batch experiments showed that this treatment led to the formation of relatively pure $CaCO_3$ precipitant at a rate of up 1.5 kg Ca-$CaCO_3$ per m^3 (70% removal). Ca removal rates were as high as 0.83 kg Ca-$CaCO_3$ m^3, suggesting that a reasonable hydraulic retention time of 2 h is practical. Aeration rate strongly affected the reaction rate, while seed concentration had little effect on the rates. Survival of fish and algae in treated water is currently being tested.

ENCAPSULATION OF CUO NANOPARTICLES BY PLGA FOR IMAGING AND CONTROLLED DELIVERY

Iris. S. Weitz[1], Sarit S. Sivan[2], Or Perlman[3] and Haim Azhari[4]

[1]*Department of Biotechnology Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1895, Fax: 972-4-990-1839, E-mail: irisweitz@braude.ac.il*

[2]*Department of Biotechnology Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1855, Fax: 972-4-990-1839, E-mail ssivan@braude.ac.il*

[3]*Department of Biomedical Engineering, Technion – Israel Institute of Technology, Haifa 3200003, Israel, Tel: 972-4-829-4145, Fax: 972-4-82-94152, PhD student*

[4]*Department of Biomedical Engineering, Technion – Israel Institute of Technology, Haifa 3200030, Israel, Tel: 972-4-829-4145, Fax: 972-4-829-4152, E-mail: haim@bm.technion.ac.il*

Keywords: CuO, nanoparticles, PLGA, nanospheres, MRI, ultrasound

Biodegradable polymeric nanocarriers such as poly-lactic-co-glycolic acid (PLGA) are widely used as packing materials for controlled distribution of drugs, i.e., the polymer phase protects the drug and releases it in a timed and sustained manner according, mainly, to the polymer biodegradation pattern and the nature of drug used.

To enable further development of copper oxide nanoparticles (CuO NPs) for imaging and therapy purposes, and to reduce their toxicity, we encapsulated the NPs in PLGA, using the double emulsion–evaporation technique. The resulting CuO-loaded PLGA nanospheres (CuO-PLGA NS) were characterized by various analytical tools: (a) DLS measurements indicated a unimodal particle size distribution, with a mean diameter close to 200 nm. (b) TEM images revealed CuO NPs embedded in the PLGA phase. (c) TGA showed that CuO-PLGA NS contain 8% weight CuO, which correlates with the ICP results. The release properties of CuO-PLGA NS were also studied and initial results showed a release rate of ~30 % in the first week with copper levels reaching steady state within five weeks.

This study demonstrates a convenient method for the preparation of CuO loaded nanospheres, which could be used as T1 contrast agents in magnetic resonance imaging (MRI), as well as in combined ultrasound-based imaging and therapeutic procedures.

Acknowledgement: This study was supported by the Ministry of Science, Technology & Space, Israel (MOST, grant no. 311876), and by a seed grant awarded by ORT Braude College.

Enabling dialogue leading to professional identity change of an experienced lecturer: From a knowledge transmitter to a learning facilitator

Yael Furman–Shaharabani[1] and Hana Faiger[2]

[1]*Department of Teaching and General Studies ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1809, E-mail: yaelfsha@braude.ac.il*

[2]*Department of Biotechnology Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1897, E-mail: hfaiger@braude.ac.il*

Keywords: Lecturer identity, teaching for understanding, instructional change

Calls for active learning in higher education are widespread and supported by extensive research. Nevertheless, traditional lectures remain the main vehicle for teaching undergraduate science and engineering. Lecturers' previous experiences with traditional lectures and established habits as well as situational factors are the main barriers to adoption of active learning strategies.

In this research, we retrospectively explored the changing professional identity of an experienced lecturer. The emergent process took place during an intentional modification of instructional methods in an academic course, "Protein Engineering", which combined an *Engaging Lectures* strategy with a *Teaching for Understanding* (TfU) approach. The research involved the course lecturer, with ten years of experience using traditional teacher-centered lectures, and an education specialist who served as the lecturer's advisor.

This retrospective case study sought to characterize significant changes in the course lecturer's professional identity, focusing on the attributes that contributed to effective enabling dialogue and the major constraints. Data sources were the lecturer's weekly notes and reflections and the advisor's weekly notes, and retrospective narratives. Categories emerged from several cycles of content analysis and these were discussed to achieve agreement.

In this presentation, we will describe the individual attributes of the lecturer and the shared attributes of the lecturer–advisor team that contributed to the instructional change process from a retrospective viewpoint, two years after the initiation of the process. For example, open communication, constituting effective dialogue, was perceived as a shared attribute that was a significant contributor to the identity change process. The two major constraints to the process were the lecturer's traditional lecturing habits and lack of knowledge and skills in using active learning methods and strategies.

The lecturer's identity changed gradually from a knowledge transmitter to a learning facilitator. Adopting a new role during the lectures meant separating from the accepted identity of a lecturer. A supportive open dialogue with the advisor and measured ongoing experiences with the new engaging *lectures for understanding* methods and strategies enabled the development of skills and gradual identity change.

Faculty pedagogy was determined to be an important factor in students' satisfaction with the teaching and retention of knowledge. Pedagogy that promotes learning leads to fewer traditional lectures, meaning a massive change in experienced faculty's habits and identity. This research will contribute to the knowledge of the process that supports a change in experienced faculty's professional identity towards becoming learning facilitators focusing on students' learning, and, especially, promoting understanding.

EXPERIENCED ENGINEERS BECOMING MATHEMATICS TEACHERS: PRELIMINARY PERCEPTIONS OF MATHEMATICS TEACHING

Ira Raveh[1] and Yael Furman–Shaharabani[2]

[1]*Department of Teaching and General Studies, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-523-912-166, E-mail: iraveh@braude.ac.il*

[2]*Department of Teaching and General Studies, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-525-369-860, E-mail: yaelfsha@braude.ac.il*

Keywords: Mathematics teaching, pre-service preparation program, engineers, career changers, mathematical understanding

Engineers who choose to change careers and become mathematics teachers are a special group in as far as their mathematics learning in the context of engineering and their previous work experience. This research explores experienced engineers' perceptions of mathematics teaching, before the beginning of their studies in a pre-service mathematics and engineering teacher preparation program. The research explores their perceptions of mathematics as a discipline, good mathematics teaching, and mathematical understanding. The qualitative research involved three mechanical engineers, two industrial engineering and management engineers, and an electrical engineer enrolled in a pre-service program for mathematics and high-school engineering teaching. Semi-structured interviews were conducted at the beginning of the program and analyzed qualitatively. The participants viewed engineering as an applicative and changing discipline while perceiving mathematics as closed, rigorous, accurate, systematic, theoretical and a tool for engineering. The participants addressed mostly general features of mathematics teaching while expressing a more complex view of mathematical understanding. Due to the specific characteristics of the participants, this research may contribute to planning mathematics teacher education programs for engineers.

ESSENTIAL SKILLS – AN ONLINE INTERNATIONAL COURSE: CHALLENGES AND OPPORTUNITIES IN THE EYES OF STUDENTS AND COURSE DEVELOPERS

Miri Shacham[1], Sharon Tidhar[2] and Dvora Toledano-Kitai[3]

[1]*Department of Teaching & General Studies and Teaching and Learning Center, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-908-6446, Fax: 972-4-990-1738, E-mail: mshacam@braude.ac.il*

[2]*Teaching and Learning Center, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1987, Fax: 972-4-990-1738, E-mail: sharont@braude.ac.il*

[3]*Department of Software Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1994, Fax: 972-4-990-1852, E-mail: dvora@braude.ac.il*

Keywords: Essential skills, multicultural teamwork, reflective thinking, problem solving

The on-line international course Essential Skills was developed in the framework of the In2it project funded by Erasmus+, the EU program for education, training, youth and sport. Fourteen higher education institutions from Israel and Europe are participating in the project, which is coordinated by ORT Braude College.

One project objective is the development and delivery of a multidisciplinary international curriculum in the form of four online courses, which will be available to all students. The Essential Skills course is one of these courses, led by a team from ORT Braude College.

The term **'*soft skills*'** (*or* ***essential skills***) is often used to describe the skills that characterize relationships with other people or are about how one approaches life and work. **'*Hard skills*',** in contrast, is a term usually used to describe professional skills such as accountancy or medicine etc. Many employers report that entry-

level employees in a variety of professions lack soft skills that are essential for businesses to move forward. That is why we refer to them as Essential Skills!

The course aims to boost students' employability skills and give them a competitive edge in the workplace and perhaps even in life, to enable them to work in an international and virtual atmosphere, and to enhance their awareness and sensitivity to cultural differences.

The course deals with five main skills: reflective thinking, teamwork, leadership, creative thinking and problem solving.

115 students across seven institutions from Israel, England and Poland participated in this innovative course.

The students studied online, in English, and worked in international and multicultural teams. They had individual sessions where they worked on their own and collaborative sessions where they worked together online. The course site in Moodle included videos, reading material, assessments, individual and group tasks.

In our research, we conducted in-depth interviews with 15 students (from ORT Braude College) and four developers regarding the course relevance, content and format as well as the experience of working in an international multicultural team.

In our talk, we will elaborate on our insights as to how to improve the course.

DEVICE AND ALGORITHMS FOR PHONOCARDIOGRAM ANALYSIS

Leonid Davidov[1] and Samuel Kosolapov[2]

[1]*Department of Electrical and Electronic Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1905, Fax: 972-4-990-1289, E-mail: leondavidov20@gmail.com*

[2]*Department of Electrical and Electronic Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1905, Fax: 972-4-990-1289, E-mail: ksamuel@braude.ac.il*

Keywords: Digital signal processing, phonocardiograph, phonocardiogram

Background**:** A phonocardiogram is a digital record of a high-fidelity analog recording of the sounds made by the heart. A phonocardiograph is an electronic device for recording all the sounds made by the heart during a cardiac cycle. The sounds result from vibrations created by closure of the heart valves. A conventional stethoscope cannot always detect all such sounds, and, generally, provides no records to be processed by modern digital signal processing algorithms at the time of the recording (by using real-time signal processing algorithms) or later (using any relevant signal processing and analysis algorithms).

Device: In its simplest implementation, the phonocardiograph contains a small-size microphone integrated into a standard medical grade stethoscope. The microphone's signal is amplified by an analog amplifier, and routed to the microcontroller's analog-to-digital converter (ADC). The microcontroller, which stores the digitized phonocardiogram, can route it to, say, a PC, or to the "cloud" for further processing and analysis. In a more practical implementation, the microphone is integrated into a specially designed small-size probe that is attached to a patient's body for a prolonged period of time.

Algorithms: The phonocardiogram processing algorithm used in this contribution evaluates the following parameters: time between two adjacent 1st systole peaks, time between the 1st systole and 1st diastole peaks of the same heart cycle and time between the 1st and 2nd diastole peaks of the same heart cycle. The goal of our phonocardiogram processing and analysis algorithms is to reveal instabilities and abrupt changes in the periodicity and shape of the heart's functioning. Instabilities and changes can be used as preliminary markers of severe diseases such as arrhythmia, heart attack and stroke. Thus, using a digital phonocardiograph can provide an inexpensive way to acquire early warning of some heart and coronary diseases.

AUTOMATIC VOLTAGE REGULATOR (AVR) – WHAT DOES IT DO?

Ed Eitelberg[1]

[1]*Department of Electrical and Electronic Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1826, E-mail: eitelberg@braude.ac.il*

Keywords: Electrical generator, voltage, frequency

The system of interest is a three-phase electrical generator and the section of the turbine that is mechanically coupled to the generator axis. If we ignore the changes in the internal energy of the turbo-generator, then the only relevant part is the rotational kinetic energy $J\Omega^2/2$. J is the effective rotational inertia of the turbo-generator and Ω is the angular speed of rotation. The energy transfer rate is power. The turbine receives some of the fuel power P_{fuel} that is combusted (burnt). The fraction of the fuel power that is coupled to the generator can be called the efficiency η. The generator delivers electrical power P_{el}. Thus, the energy balance equation can be written as

$$\frac{d\left(J\Omega^2/2\right)}{dt} = P_{\text{fuel}}\eta - P_{\text{el}} \tag{1}$$

If U and I denote the root mean square (RMS) line voltage and line current, respectively, then the three-phase generator delivers electrical power to a balanced three-phase load according to $P_{\text{el}} = \sqrt{3}\,U\,I\cos\phi$ where $\cos\phi$ is the well-known power factor. ϕ is the phase angle between the sinusoidal phase-voltage and phase-current and is equal to zero for 'real' or resistive loads. Much engineering effort is put into designing and operating electricity grids near a single unit power factor. Hence, $\cos\phi = 1$ is assumed in this paper.

We restrict our attention to the case where a single turbo-generator unit supplies electrical energy to a balanced resistive three-phase load. In addition, we consider the load to be star-connected (Y-connected). If each phase resistance of the load is denoted by R_{p}, then the supply line current is related to the line voltage as $I = U/\left(\sqrt{3}\,R_{\text{p}}\right)$. Hence, $P_{\text{el}} = U^2/R_{\text{p}}$ and

$$\frac{d\left(J\Omega^2/2\right)}{dt} = P_{\text{fuel}}\eta - \frac{U^2}{R_{\text{p}}}. \tag{2}$$

In steady state, the generator rotates at a constant speed Ω and delivers electrical power at the line voltage $U_{\text{ss}} = \sqrt{R_{\text{p}}P_{\text{fuel}}\eta}$. Inside the generator, the generator speed is related to the generated voltage through the magnetic field. Assuming negligible armature winding resistance, this relationship is approximated by $U = k_1\Omega B$ where B denotes the (rotating) magnetic field flux density in the air gap between the rotor and stator poles – $B = k_2\,I_{\text{x}}$. I_{x} is the DC current that may be connected to the rotor coils via slip rings. Power systems practitioners tell us that the excitation current is proportional to the excitation voltage: $I_{\text{x}} = U_{\text{x}}/R_{\text{x}}$. With this understanding, the three equations in this paragraph can be combined into

$$U = k_{\text{x}}\Omega U_{\text{x}}, \quad k_{\text{x}} = k_1k_2/R_{\text{x}} \tag{3}$$

In power systems engineering, there is a myth that field excitation U_{x} controls the generator voltage U. Eq. (2), however, does not allow constant rotor speed in the case of (transient) power imbalances and, in steady state, the excitation cannot affect the voltage in Eq. (3). Instead, it controls the steady state generator speed and the corresponding supply frequency:

$$\Omega_{\text{ss}} = U_{\text{ss}}/\left(k_{\text{x}}U_{\text{x}}\right) = \left(\sqrt{R_{\text{p}}P_{\text{fuel}}\eta}\right)/\left(k_{\text{x}}U_{\text{x}}\right). \tag{4}$$

CAN MORPHOLOGICAL OPERATIONS IMPROVE TRACKING PERFORMANCE?

Amit Itzik[1] and Evgeny Gershikov[2]

[1]*Department of Electrical and Electronic Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, E-mail: amitamit1111@gmail.com*

[2]*Department of Electrical and Electronic Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, E-mail: eugeny11@braude.ac.il*

Keywords: Tracking in video, optical flow, background subtraction, morphological operations, segmentation

Tracking of moving objects in a video sequence is useful for automatic surveillance and information collection as well as automatization of various processes. For example, tracking is used in the field of military surveillance and intelligence, in land traffic control and registration of vehicle motion and velocity as well as in air traffic control and home security systems.

In this work, we sought to recognize moving objects in a video sequence and track their movement. We use optical flow and background subtraction methods to detect the moving objects in each frame and to track their motion in the following frames. The detection of a moving object is more challenging when other objects, moving at a different speed, exist in the same frame, for example, when we need to detect a moving car in a scene that has pedestrians walking along the same street. Another challenge is occlusion of the moving object by stationary or mobile objects. We apply morphological operations and other image processing techniques to improve the detection and tracking performance of our algorithms.

We carry out simulations in a MATLAB programming environment and provide the results of our experiments when using the chosen methods. We draw conclusions about the usefulness of applying morphological operations for the purpose of improving performance when tracking objects in video sequences.

LOGISTICS OF AN ELECTRONIC HOME STUDY PROJECT-BASED COURSE

Samuel Kosolapov[1] and Nissim Sabag[2]

[1]*Department of Electrical and Electronic Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1905, Fax: 972-4-958-0289, E-mail: ksamuel@braude.ac.il*

[2]*Department of Electrical and Electronic Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1905, Fax: 972-4-958-0289, E-mail: nsabag@braude.ac.il*

Keywords: Electronic education, laboratory in electronic education, active learning, project-based-learning

Various educational approaches designed to replace traditional lecture-based courses are known as Active Learning, E-Learning, PBL and other titles. Educators in many famous universities agree that despite significant popularity of these techniques, experience in a real-life laboratory is a critical requirement in the education of an electronic engineer. Although well-known electronic simulation software can be successfully used as a valuable and nearly free educational tool, students who have never handled real electronic components may get the false impression that all cables are always good, all measurement devices are ideal and that electronic components always behave as described in the datasheets. Hence, a classic campus electronic laboratory with measurement equipment, electronic components and cables is still a must, at least for the basic first and second year electronic courses. For some advanced electronic courses, alternative frameworks for courses can be proposed such as a home study project-based course. Recently in ORT Braude, two such elective courses were offered: Electronic Instrumentation and Real-Time DSP. In the framework of these courses, traditional in-class lectures and exercises were provided. Homework (small laboratory experiments), however, was done by pairs of students working in their homes using inexpensive

and small-size electronic kits provided to them by the lecturer. Additionally, students were requested to implement at home and present in class two micro-projects. The micro-projects were prepared by using both simulation software and the above kits. It was our experience with these courses that they increased students' interest in the subject matter and that students acquired a better understanding of important concepts they were meant to learn. Additional advantages were students' time flexibility and reduction in needed laboratory time and space.

WIDEBAND COMPACT WEARABLE NOTCH ANTENNAS FOR WIRELESS AND MEDICAL COMMUNICATION SYSTEMS

Albert Sabban[1]

[1]*Department of Electrical and Electronic Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1905, Fax: 972-4-875-9111, E-mail:* sabban@braude.ac.il

Keywords: Wireless communication systems, notch antennas, medical applications

Wideband compact wearable antennas are crucial in the development of novel wearable Body Area Network (BAN) systems. Notch antennas are low profile and low cost and may be employed in wearable communication systems. Low profile compact antennas are vital in the development of human biomedical systems.

This paper presents design considerations, computational results and measured results for several compact notch antennas for frequencies ranging from 1GHz to 6GHz (Figure 1), having high efficiency for medical applications.

The ultra-wideband novel wearable notch antennas were analyzed using 3D full-wave software. The antenna bandwidth ranges from 50% to 100% with a voltage standing wave ratio (VSWR) better than 3:1. The computed and measured notch antenna gain is around 3dBi with efficiency higher than 90%. The antenna's electrical parameters were computed close to a human body.

A wideband notch antenna with fractal structure was also designed. The antenna is printed on a dielectric substrate with a dielectric constant of 2.2 and 1.2mm thick. The notch antenna dimensions are 74.5x57.1mm. The antenna's center frequency is 2.75GHz. The notch antenna's VSWR is better than 3:1 for frequencies from 1GHz to 5.5GHz. The antenna beam width is around 84º. The antenna gain is around 3.5dBi.

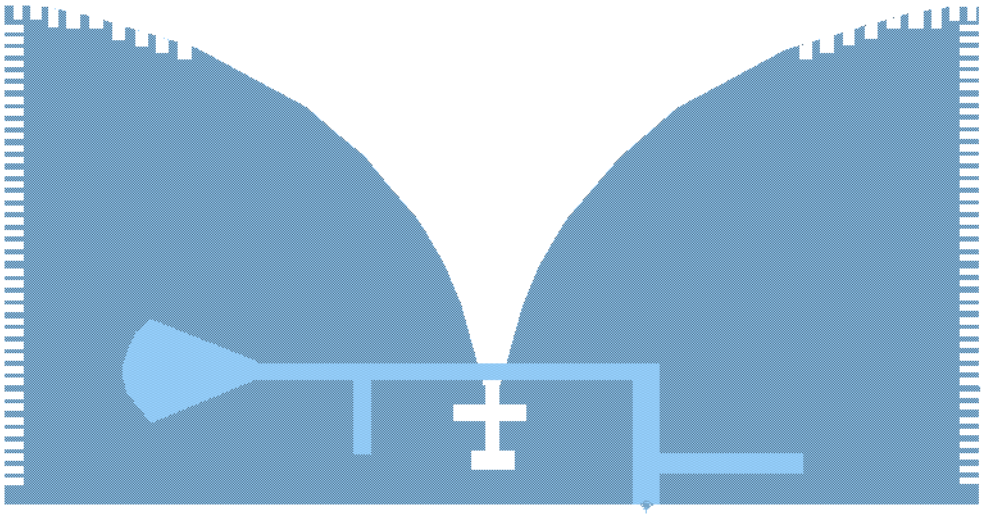

Figure 1: A wideband notch antenna with fractal structure

ANALYTICAL APPROXIMATION FOR PHOTONIC ARRAY MODES IN 2D PHOTONIC DEVICES

Nitzan Shitrit[1], Elena Smith [2], Vladislav Shteeman[3] and Amos Hardy[4]

[1]*Department of Electrical and Electronic Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, E-mail: nitzan455@gmail.com*

[2]*Department of Electrical Engineering – Physical Electronics, Tel Aviv University, P.O. Box 39040, Tel Aviv 6997801, Israel, E-mail: eln.smth@gmail.com*

[3]*Department of Electrical and Electronic Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-908-6436, E-mail: vladsh@braude.ac.il*

[4]*Department of Electrical Engineering – Physical Electronics, Tel Aviv University, P.O. Box 39040, Tel Aviv 6997801, Israel, Tel: 972-3-642-3508, E-mail: hardy@eng.tau.ac.il*

Keywords: 2D photonic crystals, coupled mode theory (CMT), photonic lattice, photonic superlattice, analytical approximation

We present a new, coupled-mode theory (CMT) based analytical approximation for photonic array modes in 2D electro-optical components, based on photonic lattices (arrays of identical coupled waveguides/lasers) and superlattices (periodic sequences of different coupled waveguides/lasers). Our approximation is applicable for the components in which light propagates along the optical axis of the device, such as array coupled waveguides, phased arrays of laser diodes, microstructured fibers etc. The two most popular configurations (square and hexagonal lattices and superlattices) are considered.

The underlying ideas of the analytical descriptions for 2D lattices and superlattices are quite similar. As in the standard CMT analysis (for finite photonic arrays), we proceed from the mode expansion conjecture, which states that an array mode of an array of optically coupled waveguides/lasers represents a linear combination of all guided modes of all individual waveguides, composing the array. In both cases, depending on the symmetry of the original photonic array (rectangular/hexagonal lattice or superlattice), we utilize the eigenmodes (2D standing waves) of a rectangular/hexagonal waveguide with metallic walls for construction of envelope functions and total modal fields in the device. Then we combine the concept of 2D standing waves with the extended CMT formalism (developed for analysis of infinite arrays) in order to approximate the propagation constants of the modal fields.

Our approach allows a simple and fast, yet accurate and comprehensive analytical description of photonic array modes and their related optical properties (i.e., modal area, bandwidth etc.) in 2D photonic lattices and superlattices. In practice, the numerical evaluation can take (using a standard PC) from a few seconds to a few minutes.

Our computations show that the results, received with the analytical approximation, are in a good agreement with those acquired using well-established techniques such as the standard CMT and Helmholtz equation, which served as our benchmarks.

MATHEMATICAL VS. ENGINEERING UNDERSTANDING: ENGINEERING EDUCATORS' PERSPECTIVE

Elena Trotskovsky[1], Ira Raveh[2] and Nissim Sabag[3]

[1]*Department of Teaching and General Studies, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4- 990-1975, Fax: 972-4- 04-990-1751, E-mail: elenatro@braude.ac.il*

[2]*Department of Teaching and General Studies, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4- 990-1975, Fax: 972-4- 04-990-1751, E-mail: iraveh@braude.ac.il*

[2]*Department of Electrical and Electronic Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1905, Fax: 972-4-958-0289, E-mail*: *nsabag@braude.ac.il*

Keywords: Teaching; understanding, pedagogical ways

The paper deals with engineering and mathematics experts' assessment of engineering and mathematical understanding. A qualitative method—a comparative analysis—was chosen for the study. The main research tool was a semi-structured interview, including specific and general questions regarding the participants' perceptions. Two mathematicians and five engineers participated in the study. Most of the lecturers perceive understanding as location—creation of a knowledge system with internal and external connections between its parts. The engineering discipline lecturers emphasize the applicative trait of understanding—the ability to use this system. The participants described different activities and feelings, which might provide for their understanding, and their pedagogical approaches in teaching for understanding. Hence, they expressed doubts about the possibility of knowing for certain that their students understand.

MICROECONOMIC MODEL FOR NON-STEADY-STATE MACROECONOMICS

Ofer Tzur[1]

[1] *Department of Electrical and Electronic Engineering, ORT Braude College, Karmiel 2161002, Israel; E-mail: ofertzur@braude.ac.il*

Keywords: Microeconomics, macroeconomics

Monetary and fiscal policies influence our economy. The question is how and what their affects are. To conduct such an analysis, we need to understand and decide on ways to measure the different parameters and their impact on the market. Once able to measure the required parameters, we must devise a way to incorporate the control mechanisms within the market and the economy. To perform such a microeconomic analysis, we need a simulation tool that allows an analysis of "what if" scenarios through which we can test different control systems. Following our research on similar/not so similar projects, we have begun characterizing a tool that will enable simulation of a dynamic macroeconomic system. This simulation tool will facilitate testing various parameters that affect the market and enable us to define what is needed in order to control the economy with better precision and granularity and to help it comply with the needs of the government and the market.

IMAGE QUALITY IMPROVEMENT IN SOCIAL NETWORKS BASED ON PERCEIVED IMAGE QUALITY PREDICTION

Pinchas Zorea[1]

[1]*Department of Electrical and Electronics Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-54-240-3586, Fax: 972-4-990-1289, E-mail: pini.zorea@gmail.com*

Keywords: Social networks, image quality evaluation (IQE), human visual tests (HVTs), image quality attributes (IQAs), VQEG image quality evaluation tool (VIQET).

People of all ages around the world take photos and immediately upload them to social networks. While smartphones are the vehicles for these communications, the information moves through what are called social network websites. Network websites such as Facebook, Instagram, Twitter, and Snapchat, in tandem with the huge ubiquitousness of smartphones, have become a significant part of our culture and everyday lives. The huge number of photos and videos uploaded to social networks happens regardless of the image quality. This paper proposes a new real-time image quality improvement process, which is based on the results of research evaluating how smartphone users perceive the image quality of their smartphones' embedded camera and display. This process is implemented in a software application that is embedded on the social network websites. This application is one outcome of research on perceived image quality in smartphones.

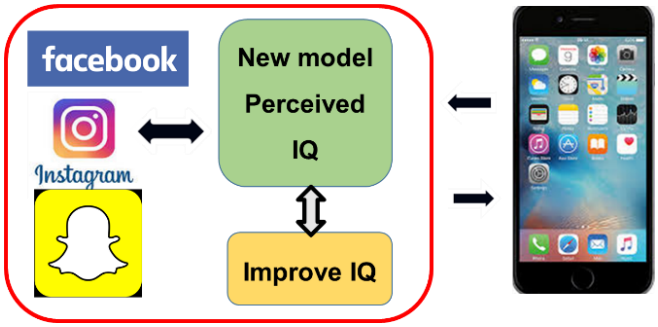

Fig. 1. Real time image quality evaluation and improvement

References

[1] Zorea P., Paladi F., Bragaru T. Prediction of perceived image quality by mobile devices users. In: Moldavian Journal of the Physical Sciences, Vol. 17, Nr. 1-2, 2018.

ENGLISH MEDIUM INSTRUCTION: MYTHS AND LEGENDS

Lauren Berman[1] and Keren Berkovitz[2]

[1]*English Studies Unit, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1832, E-mail: laurenb@braude.ac.il*

[2]*English Studies Unit, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1832, E-mail: kerenb@braude.ac.il*

Keywords: EMI, reading comprehension, myths, legends, general studies

The Myths and Legends course was given in the Department of General Studies at ORT Braude College between the years 2011 and 2018. The course was taught in English to students from all departments for two hours per week. Upon completion of the course, students were awarded two academic credits and the final grade was included in the calculation of the average for their degree. This grade was based on a mini research project and a final exam.

The purpose of the current research was to determine the extent to which students' knowledge of the English language affected their success in the course.

It was hypothesized that:

1. Students registered for the course at a B2 level would achieve higher exam scores, as a compared to students who registered at an A2 or B1 level.
2. Students who had completed their mandatory English courses prior to registration for the course would score higher on the final exam than those who entered directly into the course based on their Amir/Amiram or Psychometric score.
3. Students from the Department of Electrical and Electronic Engineering, whose entry level requirement in English is higher than that of other departments, would score higher on the final exam.

Preliminary results:

1. The majority of students who registered for the course were at a B2 level or above. These students fared better on the final exam than those whose level at registration was lower.
2. Students who had completed their English requirements prior to the course were able to compensate for their lower college entry level.
3. There is insufficient data at this time to prove whether students in the Electrical and Electronic Engineering Department achieve higher scores due to the requirement of a higher English entry level.
4. Students in the Departments of Software Engineering and Information System Engineering who had completed the Applied Technical English course prior to the final exam achieved higher scores.

SOME ASPECTS OF MULTI-AGENT DECISIONS EXPRESSED BY PRIORITIZATION OF ALTERNATIVES

Emil Bashkansky[1] and Yariv Marmor [2]

[1]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1809, Fax: 972-4- 990-1852, E-mail: ebashkan@braude.ac.il*

[2]*Department of Industrial Engineering and Management ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-908-6464, Fax: 972-4-990-1852, E-mail: myariv@braude.ac.il*

Keywords: Decision analysis, preference chain, repeatability, reproducibility, assessing variation

In this research, we focus our attention on evaluation of opinions in a multi-agent prioritization problem setting. We track agents' preference stability and cohesiveness over time. As a case study, we considered a group of agents (or experts) expressing their preferences over a fixed set of alternatives through a weak order (they may have the same preference for two or more different alternatives). A suggested metric for the distance or similarity between each two preference chains was developed, based on cosine similarity. The agents' prioritization performance precision is evaluated in terms of repeatability and reproducibility, following a metrological approach. The evaluation is done by analyzing the distance variation of agents' preferences across different trials of the same prioritization task. The proposed strategy, illustrated through a real case study, involves a group of randomly chosen pizza consumers, who expressed their preferences for a set of pizza types. The research also suggests a novel approach for aggregating multi-agent opinions with equivalent importance (democratic across agents) or hierarchically prominent (semi-democratic) decision–making processes.

NEW INSIGHTS FROM CONSUMER PREFERENCES EXPRESSED BY PRIORITIZATION CHAINS

Emil Bashkansky[1] and Yariv Marmor [2]

[1]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1809, Fax: 972-4- 990-1852, E-mail: ebashkan@braude.ac.il*

[2]*Department of Industrial Engineering and Management ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-908-6464, Fax: 972-4-990-1852, E-mail: myariv@braude.ac.il*

Keywords: Consumer analysis, preference chain, prioritization, decision fusion

It is known that a good understanding of consumer preferences is essential for a successful business. This understanding, to a large extent, depends on the use of appropriate methods by business analysts to collect and process consumer data. Since the collected data is usually based on subjective judgments, e.g., evaluators, the absence of a common scale (for example, zero point) for the entire population makes the comparative analysis of the data somewhat problematic, and sometimes meaningless. Based on a specific case study, we demonstrate how to analyze and generate insights about consumer preferences, expressed by prioritization or preference chains. The main insights are related to the measurement of evaluators' median and extreme prioritizations, subjects' consistency and consensus, and the examination of the homogeneity hypothesis (or the extent of heterogeneity, if the latter is rejected). Moreover, with the help of a distance metric, introduced by the researchers, it is now possible to produce advanced statistical analyses such as bootstrap or cluster analyses.

DEPLOYING PROJECT SUCCESS OUTCOMES – A QFD BUSINESS CASE METHODOLOGY

Shuki Dror[1] and Eliezer Oren[2]

[1]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-72-246-3665, Fax: 972-4-990-1852, E-mail: dror@braude.ac.il*

[2]*Department of Computer Science and Software Engineering, Jerusalem College of Technology, Jerusalem 9372115, Tel: 972-4-998-0905, E-mail: orene10@gmail.com*

Keywords: Project success factors, project performance, quality function deployment (QFD), mean square error (MSE), decision making

Defining Project Success (PS) outcomes and PS factors is not an easy task. A favorable outcome depends on the stakeholders' perspective, the project type, the project life cycle stage, and organizational characteristics. In the present study, focusing on an individual business case, we develop a procedure for quantitative evaluation of the relations between various PS factors and outcomes based on the quality function deployment (QFD) method.

A House of Project Success (HoPS) matrix is created using combined input from various managers and experts. This matrix summarizes the desired improvements in the PS outcomes and connects them to the relevant PS factors. Based on the HoPS matrix, outcomes and factors that maximize the desired results of the PS policy are chosen, using the mean square error (MSE) criterion.

The paper describes the implementation of the above methodology in two organizations and two project types, namely weapons development and an ERP implementation, demonstrating different project success causal structures.

THE EFFECT OF AUGMENTED REALITY AND VIRTUAL REALITY SYSTEMS ON RESOLUTION PERCEPTION

Nirit Gavish[1], Bar Gabay[2], Eran Horesh [3] and Elias Shamilov [4]

[1]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1854, E-mail: nirit@braude.ac.il*

[2]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, E-mail:* bargabay17@gmail.com

[3]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1854, E-mail: eranh@braude.ac.il*

[4]*Economics and SW Engineering, Biosense Webster, Yokneam, Israel, E-mail: elias@intactio.com*

Keywords: Augmented reality, virtual reality, resolution, decision making

Augmented Reality (AR), in which the real world is expanded through the introduction of virtual objects and perceptual information, is used widely in industry, education, training, games, and more. Many perception and decision-making biases that could be connected to Virtual Reality (VR) might be overcome in AR. For example, the tendency to perceive money, which is invested virtually as virtual money, without considering its real value.

In the current research, we evaluate the perception of resolution: whether participants can differentiate between more and less profitable products when using an AR system compared with a VR system. For this purpose, we used a coin machine attached to a computer and integrated in games and tutorials. While using the system, when the participant "earns" game money, he gets real (physical) coins dispensed by the machine (instead of virtual change in a counter on the screen). When he wants or has to pay money according to the

game's scenario, he has to insert the coins into the machine. The scenario was a simple computer game. The player is a seller in a grocery shop, customers come to buy products. The player gives/sells them the products, and then they pay him. A supplier comes each time that a shelf in the store is empty, and the player chooses how many items he wants to buy. The player pays for the products and the supplier delivers them. The selling price is higher than the buying price. Some products are more profitable than others.

Participants were divided into three experimental groups: an AR group, which used the game with the machine; a VR group, which used the virtual game with no machine but with a coin counter on the screen; and a VR group in which the coins were dispersed over the screen. The behavior and strategy of each group were evaluated and compared. The results will be presented.

SUSTAINABLE PRODUCTION PLANNING IN A DETERMINISTIC SETTING

Oran Nahari[1] and Hussein Naseraldin[2]

[1]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1971, Fax: 972-4-990-1852, Student*

[2]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-99-01971, Fax: 972-4-990-1852, E-mail: nhussein@braude.ac.il*

Keywords: Sustainability, supply chain management, production planning, environment, deterministic demand.

Today, sustainability is an important goal for manufacturers, alongside other objectives. Integrating sustainability in the manufacturing process may give a manufacturer an advantage over competitors, apart from the aspects of product quality and financial benefit, as a result of cost savings. In fact, both the consumer and the company may benefit from such a situation because the product will have an added value and the company will be able to capture a larger market share and even minimize its energy footprint.

Following a literature survey that presents the various aspects in the field and maps the various considerations in this niche describing the work environment, a mathematical model was developed that considers a number of operational manufacturing constraints, with reference to a sustainability index. The model was analyzed and an optimal solution was derived. A sensitivity analysis shows which of the setting's parameters are most influential, facilitating the pursuit of a robust solution in future research.

PRODUCTION AND INVENTORY PLANNING IN A 3D-PRINTING ENVIRONMENT

Hussein Naseraldin[1] and Tali Feldman[2]

[1]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1971, Fax: 972-4-9901852, E-mail: nhussein@braude.ac.il*

[2]*Faculty of Industrial Engineering and Management, Technion – Israel Institute of Technology, Haifa 320003, Israel, Graduate student, E-mail: stalifel@campus.technion.ac.il*

Keywords: Additive manufacturing, 3D printing, inventory planning, conventional manufacturing, industry 4.0

Industry 4.0 is the all-encompassing name for the Industrial Internet of Things (IIOT). It is a setting in which the physical world is connected to the cyber world. Things are connected no matter if they are digital or physical. This connection creates the potential to streamline communication and, thus, decision making.

IIOT is no more than a plethora of technologies that take the manufacturing setting to a higher level. We focus on one of those technologies—Additive Manufacturing (AM) and, specifically, 3D Printing (3DP) capabilities that can be brought to the manufacturing environment. The 3DP wave is being led by material development and technology that enables the manufacturing of things in an additive rather than subtractive manner, as has been done so far. Using 3DP, a specialized printer produces the target object by adding (printing) one layer on top of another layer. This setting allows batch production of single items—an ability absent in the mass-production arena. Thus, not only can small new orders be filled but also new designs can be pursued. As a result of such radical changes, assembly work and material costs can be reduced by a double-digit number. In this study, we analyze a stylized setting in which a 3DP line is added to production capability. A key question to answer, when receiving an order, is where should we produce it considering the advantages and disadvantages of each method of production. We present and analyze a model through which one can derive an optimal decision in such a setting.

COORDINATING PRODUCTION WITH EMISSION COSTS IN AN INDUSTRIAL PARK: A DIFFERENTIAL GAME APPROACH

Hussein Naseraldin[1] and Gilla Fruchter[2]

[1]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1971, Fax: 972-4-990-1852, E-mail: nhussein@braude.ac.il*

[2]*Graduate School of Business, Bar-Ilan University, Ramat Gan, 5290002, Israel, E-mail: Gila.Fruchter@biu.ac.il*

Keywords: Sustainable (green) logistics/SCM, operations management, financial and economic modelling, aspects of logistics

Decentralized decision-making is a given in the modern business world. Extensive research has explored its consequences for overall firm profits. We examined the interactions between two decentralized units and analyzed their impact on overall firm profits in two cases: with and without coordination. Production emissions are a major source of environmental pollution generated by the industrial sector. Thus, adjusting production policies to balance operational and environmental forces may lead to better operational decisions. Considering a differential game in which two players are located in an industrial park, we compared the operational decisions and their impact on environmental forces of coordinated vs. uncoordinated strategies. We derived analytical solutions for the dynamic game that specify the optimal production quantities that should be produced at any given point in time as well as the inventory levels that should be maintained. We also derived an analytical term for the game's optimal profit. We conducted a sensitivity analysis of the key parameters. Managerial implications are highlighted. It is clear from the results that incorporating emission costs into operations affects strategy and performance, and that a coordinated approach may help curtail operational inefficiencies.

THE END OF GLOBALIZATION? MNCS' PERFORMANCE IN THE POST GLOBALIZATION ERA: THE MODERATE EFFECTS OF INSTITUTIONAL AND CULTURAL CONTEXT

Hilla Peretz[1]

[1]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1849, Fax: 972-4-990-1852, E-mail: hillap@braude.ac.il*

Keywords: Globalization, multinational companies, performance

It is difficult to overlook how dramatically the world has changed since 2008, when the global financial crisis started and shook the foundations on which the international order was built. Since 2015, we have been witnessing further effects of this crisis, and a dramatic change in the geopolitical world order. The Brexit vote, the results of the 2017 U.S. elections with Trump's "America First" slogan, Catalonia seeking independence, and the rise of nationalist political movements around the world demonstrate these changes. The current changes have created a new term: De-globalization, which is defined as the process of diminishing interdependence and integration between certain units around the world. This new movement challenges MNCs' strategies and performance.

Although studies on the effects of de-globalization on societies have begun appearing in the economics and sociology literature, the mainstream literature of international management has yet to explore how this phenomenon affects organizations in general and multinational companies (MNCs) in particular. An MNC is defined as a large corporation incorporated in one country that produces or sells goods or services in various other countries. The present study tries to close the gap in the literature by examining how and under which circumstances de-globalization affects MNC performance. Specifically, the main question of this study is: *Under which organizational and national-level contexts is the effect of de-globalization on MNCs' performance enhanced or reduced*?

Drawing on the literatures of resource-based theory and institutional theory, in particular, the notion of institutional fit, a multi-level model of the relationships between the environment, de-globalization, and MNC performance was developed. More precisely, the study argues that institutional ambitions such as country innovation, human capital, and institutional flexibility and cultural context (i.e., cultural dimension of uncertainty avoidance); as well as organizational context (i.e., organizations' innovation level), moderate the relationship between de-globalization and MNC performance.

Data for the study were collected from MNCs, all listed companies, in which financial reports are publicly available. The sample included 218 companies located in four continents and 15 countries. *De-globalization* was measured using an index consisting of three indicators: trade to GDP ratio, foreign direct investment and restrictions on the employment of foreigners. *MNC performance* was measured as the increase in revenue. *Human capital* was measured using the World Economic Forum's Human Capital score. *Country innovation* and *Institutional flexibility* were measured using three indicators from the Global Competitiveness Report. *Cultural values* were obtained from GLOBE database and *Organizational innovation* was measured as percentage of R&D expenses. To analyze the data, multilevel modeling, using Mplus 7.2, was used to estimate the hypothesized multilevel relationships.

A RANDOM WALK WITH INSPECTIONS

Rachel Ravid[1]

[1]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1849, Fax: 972-4-990-1852, E-mail: rachelr3@braude.ac.il*

Keywords: Random walk, Poissonization**,** Rook polynomials

A random walk on the integer number line is considered. We assume that the steps sizes are +1, -1 or 0 with probabilities q_1, q_2, q_3, respectively.

The study focuses on the random variable denoting the random walk values at 0 steps.

The analysis is based on Poissonization. We assume that the successive steps are conducted at times distributed according to a Poisson process at a rate of 1.

Under this scenario, the arrival processes of the distinct types of steps are independent Poisson processes, with respective rates, q_i, $\quad i = 1, 2, 3$.

We derive a recursive set of equations concerning the probability mass function of the desired random variable. In addition, we compute the initial condition needed for the computation. Bounds for the probability mass function are also derived.

AUGMENTED REALITY SYSTEM FOR ACQUIRING MATHEMATICAL SKILLS

Ziv Treiger[1], Nirit Gavish[2], Eran Horesh[3] and Elias Shamilov[4]

[1] *Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, E-mail: ziv365@gmail.com*

[2]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1854, E-mail: nirit@braude.ac.il*

[3]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1854, E-mail: eranh@braude.ac.il*

[4]*Economics and SW Engineering, Biosense Webster, Yokneam, Israel, E-mail: elias@intactio.com*

Keywords: Augmented reality, virtual reality, Intactio

For some children, computer games provide a platform for expression and empowerment, conferring a sense of control and efficacy. Studies show that computer games played by children may have an effect on their present and future cognitive and motor development skills. The focus of the current study is on an augmented reality training system (AR), in which the real world is combined with virtual objects, and its aim is to examine the acquisition of mathematical cognitive skills through an AR versus a VR (virtual) system.

We used a computer game called "INTACTIO", which was developed as an AR system that combines virtual objects appearing on a computer monitor and a tangible coin machine. The AR system is compared to the virtual system, which is based on the AR version, but includes only the computer monitor that dispenses virtual coins. In both versions, the participant serves as a salesperson in a virtual store, in which she needs to sell products to occasional customers for which she is payed and must order goods from a supplier. The research hypothesis is that integrating two different worlds—virtual reality and tangible reality—will lead to better acquisition of mathematical cognitive skills compared to training with the VR system only.

We conducted the study among children aged of 6 to 8, who were divided into two different groups, randomly: VR system and AR system. The results of the study will be presented.

ROBOTICS FOR HANDLING HAZARDOUS MATERIALS

Zohar Vidra[1], Nirit Gavish[2], Yael Ungar[3] and Gilad Einy[4]

[1]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-54-458-8817, Fax: 972-4-990-1839, E-mail:* zoharvidra@gmail.com

[2]*Department of Industrial Engineering and Management, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1854, Fax: 972-4-990-1839, E-mail:* nirit@braude.ac.il

[3]*Department of Biotechnology Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-9901805, Fax: 972-4-9901970, E-mail: uyael@braude.ac.il*

[4]*RescueDose Ltd., 32 Ha'Meginim Ave. Haifa, Israel, 313320, Tel: 972-54-466-7200, Email:* gilad_einy@yahoo.com

Keywords: Hazardous materials, automatic systems, trust in technology, user interface

Hazardous materials are used to a greater extent by modern industry than ever before. These types of materials can be found not only in chemical industries, but in other ones too. The use of hazardous materials can endanger the population and the environment and, as such, safety and risk prevention measures should be taken into consideration when handling them.

The aim of the current research was to examine the option of reducing exposure of workers to hazardous materials by combining robotics in the work process. The robotic system evaluated in the current study was designed to replace simple laboratory protocols, which include the introduction of hazardous materials into designated test tubes. The examined system's main aim was to reduce exposure to hazardous materials by operators, and not necessarily to make the work process more efficient. During the research, we examined if workers who are exposed to hazardous materials would prefer to use a system that can be supervised from a distance or to work with a familiar system that is closely supervised and operated. In the first set of experiments, a game was designed as a model system in order to simulate close by and distant supervision of employees during their lab work routine. The game was divided into two categories, close by and distant supervision, and every participant chose which category he or she trusted more. The experiments showed that participants find it hard to trust distant supervision, but that this trust can increase when the control is active and visible.

Afterwards, a second set of experiments was conducted in ORT Braude labs. These experiments examined the implementation of the robotic system and user interface during routine laboratory work. They demonstrated the importance of the mechanisms of protection and control when dealing with hazardous materials. In addition, it was also found that despite participants' experience, it was necessary to obtain theoretical and practical training for proper handling of hazardous materials.

Finally, after collecting the data and performing the two sets of experiments, we composed guidelines for working with the robotic system. The purpose of these guidelines was to protect employees by raising their awareness of their potential exposure to hazardous materials and the need to integrate a robotic system in the process. Increasing the worker's awareness may change his or her natural tendency to distrust a remote control system. The guidelines can help companies and organizations improve user attitudes by adding features such as visibility and level of involvement, which may give the user a sense of better control over the process.

DEVICE FOR BONE HEALING ENHANCEMENT USING EXTERNAL LOW FREQUENCY VIBRATION – WRIST FRACTURE MODEL

Uri Ben Hanan[1], Nahum Rosenberg[2] and Efi Kashani[3]

[1]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1830, E-mail: ubenhana@braude.ac.il*

[2]*Director, Muscle and Skeleton Laboratory, RAMBAM Health Care Campus, Ha'Aliyah Ha'Shnia 8, Haifa, 3109601, Israel, Tel: 972-4-777-2774, E-mail:* n_rosenberg@rambam.health.gov.il

[3]*CEO, Newton Engineering, Kibbutz Daphna, Israel, Tel: 972-52-235-2793, E-mail: efi@efik.co.il*

Keywords: Mechanotransduction, vibration, bone fracture fusion

From research work done by Prof. Rosenberg of the Muscle and Skeleton Laboratory at RAMBAM hospital, it was shown that applying low frequency vibrations next to a bone fracture could enhance osteoblast proliferation and metabolic activity. Studies of biomechanical vibration stimulation of cultured osteoblast-like cells showed better bone formation. Applying sinusoidal vibrations at frequencies of 20–60 Hz and an amplitude of 25 (±5) μm increased cell proliferation and metabolic activity. In this research, a system for applying sinusoidal vibrations near the bone fracture was developed. This treatment was applied on fractures in the radius or ulna bones close to the wrist. The main reason for choosing this type of bone fracture is the thin layer of skin in this area, which allows good control of the vibrations applied on the bone.

A micro-vibrating motor such as the one used in smartphones was used for applying the vibration. The motor was placed inside a specially designed box, allowing it to vibrate perpendicularly to the bone. The vibrating system is inserted through a hole drilled in the gypsum and placed on the patient's skin near the fracture. A rubber band is used to keep the vibrating system in place while applying the required force. The motor operates at 3 volts and controlled by a micro-controller. The micro-controller is programed to apply the vibrations for certain periods at certain times during the day, according to the required treatment protocol.

The system has been tested on plastic bone printed by a 3D printer while the vibrations applied on the plastic bone were tested using an accelerometer. The accelerometer was placed on different parts of the plastic bone in order to characterize the decay of the vibration amplitude along the bone. In a second set of tests, the vibrating system was tested on an animal leg bone coated with skin. In these experiments, the acceleration at different points along the leg were measured as well as inside the bone. The data acquired were analyzed and used for determining the specifications of the vibrating system. These specifications are required for receiving the Helsinki Committee's approval for using the system in human medical experiments.

Once Helsinki Committee approval is received, the designed vibrating system will be tested on several people. Bone healing will be monitored and the effect of the vibration will be studied.

ADAPTIVE WORKPIECE CLAMPING AND ADJUSTMENT SYSTEM

Uri Ben Hanan[1], Avi Weiss[2], Rafi Wertheim[3] and Efi Kashani[4]

[1]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1830, E-mail: ubenhana@braude.ac.il*

[2]*Head, Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-908-6736, E-mail: avi@braude.ac.il*

[3]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1830, E-mail: wertheim@bezeqint.net*

[4]*CEO, Newton Engineering, Kibbutz Daphna, Israel, Tel: 972-52-235-2793, E-mail: efi@efik.co.il*

Keywords: Micro manufacturing, piezo linear actuator

A key problem in micro-manufacturing (e.g., micromilling, ECM, EDM) is the accurate position assignment between micro-tool and workpiece surface or geometry outline and repeatable and reliable clamping. This is true, in particular, for micro-workpieces and difficult-to-clamp workpieces (e.g., thin-walled workpieces). The processing of complex geometries requiring high levels of accuracy or within multiple setups has to be satisfactorily resolved.

The research focuses on defining ideas to arrange precision clamping, and positioning and orientation adjustment of a micro- or thin-walled workpiece near the working area directly using a new type of adaptive workpiece-holder.

Project idea: Implementation of smart material actuators in connection with clamping elements for the initiation of clamping forces. Optical and/or tactile measuring systems are used for monitoring of workpiece deformation during clamping. The visual systems can be further utilized to control the workpiece adjustment and orientation during manufacturing.

The research is a two-year project in cooperation with Fraunhoffer in Germany. In the first year, the German partners will work on the image processing system. They will develop a method for accurately marking the small workpiece and then analyzing the workpiece's orientation. Simultaneously, the Israeli side will develop a three-jaw chuck for small workpieces. The clamps will be connected to a miniature piezo-electric motor with linear motion resolution of nanometers, capable of applying forces of up 10N when moving and a 20N holding force. Force sensors will be integrated between the motor shafts and the clamps for monitoring and controlling the clamping forces. The three linear motors will allow clamping of the workpiece and moving it in the XY plane.

In the process of the development of the chuck, new technologies for measuring the clamping forces such as piezo-resistive sensors and specially designed strain gage sensors will be tested.

The developed clamping system will be tested on demo parts defined by the end user of the system. Once the first phase of developing the chuck is done, we will move to the next phase of integrating the whole system, the image processing system with the piezo-electric chuck. The integration will include special software for operating the visual servoing. From the vision system, the orientation of the workpiece will be measured and motion commands will be transferred to the XY motion and tilt systems for placing the workpiece in the required pose.

SOOT VOLUME FRACTION MEASUREMENT IN CONCENTRIC FLAMES USING A DIGITAL CAMERA

Victor Chernov[1] and Shir Shapira[2]

[1]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1709, E-mail: chernov@braude.ac.il*

[2]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, E-mail: shirw912@gmail.com*

Keywords: Combustion, soot, laminar flames

Soot is an unwanted product of many combustion systems. It is the second largest contributor to climate change. It is a major health hazard that can cause coronary heart decease, asthma, bronchitis and more. It reduces the lifetime of mechanical parts and is extremely unpleasant and unaesthetic. Fortunately, soot is also an avoidable product—it is possible to have combustion without soot. Therefore, in recent years, soot has received increased attention in industry and academia in order to understand its behavior and find ways to reduce it.

Soot consists of aggregates of small carbon spheres. The spheres are usually of tens of nanometers in diameter. The aggregate size can vary between a few spheres and several dozens. Soot volume fraction is a function of the fuel used and of the flow conditions. There are heavy-sooting fuels (such as acetylene), and there are flow configurations that promote soot creation (such as diffusion flames, which can be found in most combustion applications). In general, soot is created in fuel-rich flame regions. Usual soot volume fractions can vary between a few ppm to dozens of ppm (the latter are considered to be heavily sooting flames).

One challenge in studying soot behavior is to get fast, reliable measurement of soot volume fractions. Low volume fractions and hostile environments make the task non-trivial. This work presents an experimental system for soot volume fraction and temperature measurement in laminar diffusion flames using the Yale burner. The system is based on the Spectral Soot Emission measurement system for laminar diffusion flames. A high-resolution camera and advanced image processing were used to characterize laminar diffusion flames. The sampling time of a single flame was reduced from a day of work to several minutes, while allowing a larger resolution than appears in previous work.

The principle of the measuring system operation will be discussed. Soot volume fractions and temperature fields for ethylene-air co-flowing diffusion flames will be presented.

BALLISTIC LIMIT PREDICTIONS FOR DUCTILE PERFORATION BY RIGID NOSE-POINTED PROJECTILES

Rami Masri[1]

[1]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1812, E-mail: ramim@braude.ac.il*

Keywords: Ballistic velocity**,** cavitation, ductile perforation

The concept of specific cavitation energy (SCE), supplied by internal pressure, was introduced in [1] as a general concept for analyzing cavitation phenomena in solids. In recent years, there has been increasing interest in quasi-static and dynamic elastoplastic cavitation as a basic physical model underlying perforation and penetration mechanics. The impact of hard nose-pointed penetrators (with shank diameter D) on metal plates (with thickness h) are dominated by a ductile hole enlargement process. Under such conditions, the ballistic velocity can be predicted with the aid of the work done by the projectile in expanding the perforation hole. This elastoplastic work is estimated using SCE. Analytical expressions for SCE are known only for spherical and cylindrical (plane strain and plane stress) deformation patterns. For general perforation conditions, however, the SCE is a function of the hole slenderness ratio h/D (normalized plate thickness). The heuristic procedure in [2] exposed a logarithmic dependence between SCE and the hole slenderness ratio.

In a recent work [3], the predictive ability of four variations of ductile hole formation models to characterize the performance of aluminum plates, impacted by 7.62 mm APM2 projectiles, were compared. A large database of ballistic limit tests was used to evaluate the accuracy of these four models. The best performing model was found to be the one suggested in [2] and we will present the comparison results.

We will also present a new ballistic limit formula that is independent of spherical cavitation yield stress and depends directly on the material's stress–strain curve. While this formulation is valid for arbitrary stress–strain relations, further simplifications are given for specific hardening laws. Extensive comparison with available test data is provided in support of the main findings.

[1] Masri R, Cohen T, Durban D. Enlargement of a circular hole in a thin plastic sheet: Taylor- Bethe controversy in retrospect. The Quarterly Journal of Mechanics and Applied Mathematics 2010;63:589-616.

[2] Masri R. Ballistically equivalent aluminium targets and the effect of hole slenderness ratio on ductile plate perforation. International Journal of Impact Engineering 2015;80:45-55.

[3] Shannon R, Long HN, Denver G, Cimpoeru SJ. The scaling law for predicting the ballistic performance of aluminium alloy targets perforated in ductile hole formation. International Journal of Impact Engineering 2018;116:34-50.

MICROSTRUCTURE STABILITY DURING CREEP OF FRICTION STIR WELDED AA2024-T3 ALLOY

Michael Regev[1] and Stefano Spigarelli[2]

[1]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1734, Fax: 972-4-990-1886, E-mail: michaelr@braude.ac.il*

[2]*Department DIISM, Università Politecnica delle Marche, via Brecce Bianche, I-60131 Ancona, Italy, Tel: +39-071-220-4746, E-mail: s.spigarelli@univpm.it*

Keywords: Friction stir welding, AA2024-T3, precipitation, dislocations, DRX

Being a non-fusion welding process, friction stir welding seems to be a promising solution to preserve the microstructure of alloys during welding. Friction stir welding was applied in the current study in order to butt weld AA2024-T3 aluminum alloy plates. Creep tests were conducted on the parent material and on friction stir welded specimens. The microstructure of the AA2024-T3, welded and non-welded specimens, before and after the creep tests, was studied and compared. A comprehensive transmission electron microscopy study together with a high-resolution scanning electron microscopy study and an energy dispersive X-ray spectroscopy analysis were conducted to investigate the microstructure stability. The parent material seems to contain two kinds of Cu-rich precipitates—coarse precipitates having the size of a few microns each and uniformly dispersed fine nano-sized ones. As opposed to the parent material, the crept specimens were found to contain the two kinds of precipitates mentioned above together with platelet-like ones. In addition, extensive decoration of the grain boundaries was clearly observed in the crept specimens. Controlled aging experiments for up to 280 hours were conducted on both parent material and welded specimens in order to isolate the contribution of the exposure to high temperatures to the microstructure changes. A transmission electron microscopy study showed the development of dislocation networks into a cellular dislocation structure in the case of the parent metal. The changes in the dislocation density as a function of the creep strain and the FSW process were recorded. A detailed creep data analysis, taking into account the instability of the microstructure, was conducted.

ACTIVE ROBUST OPTIMIZATION OF A MULTI-ARM ROBOTIC FRUIT HARVESTER

Shaul Salomon[1], Avi Kahani[2] and Gideon Avigad [3]

[1]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1767 Fax: 972-4-990-1886, E-mail: shaulsal@braude.ac.il*

[2]*FFRobotics Ltd., Gesher HaEtz 12 Emek Hefer Industrial Park, Tel: 972-4-485-56310, E-mail: avikahani@ffrobotics.com*

[3]*Vineland Research and Innovation Centre, 4890 Victoria Avenue N, Box 4000, Lincoln, ON, L0R 2E0, Canada, Tel: +1-905-562-0320, Fax: +1-248-477-3349, E-mail: Gideon.Avigad@vinelandresearch.com*

Keywords: Multi-objective optimization, robust optimization, robotics, agriculture

Active Robust Optimization (ARO) is a framework for optimizing changeable products when operating in an uncertain environment. When integrated into the process of product design, the framework can improve the product's robustness to the uncertainty factors through intelligent use of its adaptive features. The performance of a candidate design is measured according to its best configuration at every realization of the uncertainties. This is conducted by solving a bi-level problem. The higher level problem searches for the robust set of design features, while the lower level problem searches for the optimal configuration at any realized scenario under consideration.

This study applies ARO to support the design of a robotic fruit harvester, comprising a number of arms that can move in three directions. The robot can operate autonomously to identify the fruits in front of it, pick them and place them in containers. The optimization is used to identify the most cost-efficient design that minimizes the costs while maximizing the picking rate and percentage of harvested fruits. Design variables such as the number of robotic arms and the length of the robotic platform are searched for, as well as the system's architecture, defining the manner in which the arms can be coordinated.

The unknown fruit distribution is modelled as a set of random variables. To evaluate a candidate design, it is simulated over a large sample from the random fruit distribution. For every sample, the optimal resource allocation and arm coordination is sought and a random variate of performance is constructed. This is then evaluated using statistical quality measures.

The simulation results indicate that most alternative designs require a trade-off between the objectives, which require tools for multi-criteria decision making rather than optimization tools. A pared down set of preferred solutions is identified, and eventually a single robust design is ready for prototyping.

Acknowledgement: This research is supported by the Canada–Israel Industrial R&D Foundation.

A NEW EXPLICIT VERSION OF THE JOHNSON-COOK MODEL FOR FINITE ELEMENT SIMULATIONS

Samy Abu-Salih[1] and Rami Masri[2]

[1]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1888, E-mail: samyas@braude.ac.il*

[2]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1812, E-mail: ramim@braude.ac.il*

Keywords: Constitutive model, Johnson Cook model, numerical modeling of cavity expansion.

The Johnson-Cook (JC) phenomenological model [1] is the most widely used thermo-viscoplastic constitutive model for finite element simulations. The JC model is used in thermo-viscoplastic applications such as perforation and penetration mechanics, machining and crashworthiness. It is well known that plastic transforms partly into heat. The nature of the thermal problem determines the temperature rise: only little temperature rise will be noticed if the generated heat flows away; however, for adiabatic conditions, the temperature can rise noticeably. Unfortunately, the classical JC formulation under adiabatic conditions is implicit and leads to extremely long numerical calculation times by well-known commercial software.

Recently, Masri [2] implemented the effects of adiabatic thermal softening on specific cavitation energy and ductile plate perforation through an explicit rate-independent formulation (thermoplastic formulation) of the JC constitutive model. Moreover, Masri [2] suggested an increase in the static yield stress due to strain rate effects and arrived at a new explicit thermo-viscoplastic formulation of the JC model.

The main goal of the presentation is to demonstrate the efficiency and accuracy of this new explicit formulation by simulating quasi-static and dynamic spherical and plane strain cylindrical cavity expansions using Comsol FE software for the classical JC formulation and the new explicit formulation [2].

[1] Johnson GR, Cook WH. A constitutive model and data for metals subjected to large strains, high strain rates and high temperatures. In: Proceedings of seventh international symposium on ballistics. The Netherlands: The Hague; April 1983. pp. 541e7.

[2] Masri R. The effect of adiabatic thermal softening on specific cavitation energy and ductile plate perforation. International Journal of Impact Engineering 2014;68:15-27.

DEVELOPMENT OF A CUTTING FORCE AND CUTTING POWER PREDICTION PROGRAM BY FINITE ELEMENT MODELLING AND AN EXPERIMENTAL INVESTIGATION INTO PREDICTING CUTTING ZONE TEMPERATURE IN MICRO END MILLING MACHINING OF METALS

Yitzchak Yifrach[1] and Mor Elgarisi[2]

[1]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1903, Fax: 972-4-990-1886, E-mail:* yifrach@braude.ac.il

[2]*Department of Mechanical Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1903, Fax: 972-4-990-1886, Undergraduate student*

Keywords: End milling, cutting force, cutting power, finite element model (FEM)

Most of the energy of machining that passes from the cutting tool to the raw-material (cutting zone) is transformed into heat. The heat transfer from the cutting zone depends on the thermal properties of the raw material and on its configuration. The temperature rise of the cutting zone may limit the cutting speed and the cutting depth, causing tool wear and limiting its life, and creating thermal stress in the raw material and distortions of its surface quality.

It is, therefore, highly desirable to predict the cutting zone temperature and relate it to the cutting performance parameters (depth of cut, cutting velocity, feed, linear speed of cutting progress, power required, specific cutting energy). Due to the nature of metal cutting, it is very difficult and very expensive to measure temperature directly in the cutting zone.

A controlled end milling experiment was compared with a mechanical finite element model (FEM) simulating the actual cutting force distributions and other effects occurring in the cutting zone. The electric milling was controlled by [LabVIEW] software, keeping the torque and rotational speed constant and preventing disruption of fixed air flow. As a reference for the mechanical model, we conducted end milling experiments with aluminum 6061-T6.

To build a reliable mechanical machining model that obviates the need for physical pre-tests, one needs to know, among other things, the cutting power that is transferred from the cutting tool to the raw material. In this research, we show how to predict the cutting power during the machining by finite element analysis (FEA). The cutting power was received indirectly through calculations of the cutting forces that developed during the machining (end milling) in the cutting zone at steady state.

The mechanical model results show that the actual cutting force was periodic, from which we can derive the average machining power in the cutting zone at steady state. The mechanical power was calculated from the actual cutting force. This calculation enabled us to make a reliable prediction, with a five percent error in the evolving mechanical power, in comparison to experiments performed in the past using the same parameters.

In addition, for one of the machining models, providing some cutting performance parameters, we can obtain information about the actual cutting force and the cutting power using different cutting parameter condition without building another machining model.

Acknowledgement: This study was supported by a grant from the ORT Braude College Research Committee.

Physics and Optical Engineering

A MODEL FOR A FIRST COURSE IN ALGEBRA FOR ENGINEERING STUDENTS

Nathan Netzer[1]

[1]*Department of Physics and Optical Engineering, ORT Braude College, Karmiel, 2161002, Israel, E-mail: e-mail netzer@braude.ac.il*

A major problem in Mathematics courses at the college level, and in Algebra in particular, is their tendency to be too formal. There are definitions of new concepts, there are axioms and there are theorems proven on their basis. The reasoning for the various definitions, however, is not always clear. This is exacerbated by the fact that the course consists of several topics such as complex numbers, matrix algebra, vectors and analytic geometry, which do not always seem to students to be interrelated. Moreover, since the course is normally given in first semester, its applications appear only a year or so after it; therefore, its relevance gets lost. In order to link the above topics to each other, it is suggested to use the concept of a group, but without diving deeply into group theory, which may make all these topics look like aspects of the same issue.

ULTRA-SENSITIVE CHEMO SENSORS BASED ON COUPLED PLASMON-WAVEGUIDE RESONANCE IN THE NEAR-INFRARED REGION

Said Mahajna[1], Marie Sammar[2], Fadi Sakran[3] and Atef Shalabney[4]

[1,2]*Department of Physics and Optical Engineering, ORT Braude College, Karmiel, 2161002, Israel, E-mail: said@braude.ac.il*

[3,4]*Department of Natural Sciences, Beit Berl College, 4490500, Israel, Tel: 972-9-747-3107, Fax:972-9-747-6213, E-mail: fadi.sakran@beitberl.ac.il*

Keywords: Surface plasmon resonance, optical biosensors, sensitivity

TBA

THE ROOTS OF DEFICIENT MOTOR EXECUTION IN ADHD: PLANNING AHEAD OR ONLINE MOTION CONTROL?

Anat Dahan[1] and Miriam Reiner [2]

[1]*Department of Software Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 974-54-645-7040, E-mail: anatdhn@braude.ac.il*

[2]*Virtual-Reality & NeuroCognition Lab, Technion – Israel Institute of Technology, Haifa, Israel, E-mail: miriamr@tx.technion.ac.il*

Keywords: ADHD, motor planning, motor control

Attention deficit hyperactivity disorder (ADHD) is the most common neurobehavioral disorder in childhood, primarily characterized by inappropriate activity levels of impulsivity hyperactivity, and inability to sustain attention. It has recently become evident that along with these symptoms, individuals with symptoms of ADHD consistently demonstrate subtle abnormalities in motor performance. In this research, we asked whether these abnormalities are results of inadequate movement planning or deficiencies in online motor control.

We compared (Dahan & Reiner 2017) motor planning mechanisms of ADHD and control subjects based on their effect on later observed kinematic characteristics. We monitored hand movement, following planning conditions that differed in preparation time and evaluated the differences across conditions and participants with/without ADHD. Our findings showed that when there was sufficient planning time, people without ADHD seemed to have a motor plan ready, and immediately initiated a planned movement after a 'GO' cue, with a bell-shaped velocity profile. When planning time was not sufficient, their movement start was delayed, possibly indicating that they needed to complete a movement plan. People with ADHD, however, demonstrated a different behavior. They did not start movement immediately after the GO cue, even when provided with a long preparation time, possibly indicating that even for this planning interval, they did not have a motion plan ready. We further found differences between control and ADHD participants in the velocity profile, variability and jitter of movements. The movement of ADHD subjects was not only delayed, but its velocity profile was not bell shaped and had several peaks. Our results suggest that ADHD motion characteristics are associated with an immature motor plan. Based on the results, we propose a paradigm to evaluate deficiencies in motor planning.

ENHANCED K-MISMATCH SEARCH ENGINE WITH INDELS

Zakharia Frenkel [1] and Zeev Volkovich[2]

[1]*Department of Software Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel; Email: zfrenkel@braude.ac.il*

[2]*Department of Software Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel; Email: vlvolkov@braude.ac.il*

Keywords: Approximate pattern search, k-mismatch, Levenshtein distance

TBA

FORMAL VERIFICATION OF SPECIFICATIONS OF SMARTPHONE APPLICATIONS

Katerina Korenblat[1] and Elena Ravve[2]

[1]*Department of Software Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1845, Fax: 972-4-9901852, E-mail: katerina@braude.ac.il*

[2]*Department of Software Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1845, Fax: 972-4-990-1852, E-mail: cselena@braude.ac.il*

Keywords: Software bug; formal verification; model checking; program verification

A software bug is defined as an error, flaw, failure or fault in a computer program or system that causes it to produce an incorrect or unexpected result, or to behave in unintended ways. Traditionally, verification is the task of bug detection. The main question is whether a program implements the expected behavior correctly, as described in its specification.

In this paper, we deal with another question: Are we sure that our specification is complete or even sound? To answer this question, we propose a new approach, which defines specifications of applications for smartphones automatically in the form of screen diagrams. Then, given the specification, some appropriate logical formalism (sanity check) is coded as LTL formulae. Finally, the LTL formulae are verified on the program graph.

Every program development starts from its specification. Before one starts implementation, the correctness of the specification must be confirmed. Specifications of cellular applications have a very specific manner: they mostly describe transfers from one set of parameter values on a screen to another. We use the specialty of the specifications in order to verify their correctness. This very special kind of applications allows us to present the specifications as graphs. We built a tool that allows the graphical definition of specifications of smartphone applications for an application developer. We represent the specifications as a graph: vertices (locations) are the screens, associated with the corresponding particular values of the parameters; edges (transitions) are marked with the events, which motivate transitions between the screens.

Our tool gets a pre-defined list of requirements, which express the correctness of the specification, which must be verified. We use Program Graph as a formal model of a specification. Our tool translates the specification, defined graphically, into a program graph, which is coded in PROMELA model language. The requirements are automatically translated into LTL formulae. Model checking determines whether the formulae are satisfied by the model. The verification is executed, using SPIN, which is the state-of-the-art model checker. It results in either a confirmation message or in a counterexample, when a requirement fails. We are not aware of any other such a method that verifies the correctness of specifications.

Acknowledgment

We thank our students Ahmad Menasra and Saeed Namih for their technical support of the project.

PATTERN-ORIENTED INSTRUCTION IN THE INTRODUCTION TO COMPUTER SCIENCE COURSE

Orna Muller[1]

[1]*Department of Software Engineering & Teaching and General Studies Unit, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-908-6469, E-mail: ornamu@braude.ac.il*

Keywords: Algorithmic patterns, computer science education, cognitive schemes, problem solving

The development of problem-solving skills is a central goal of computer science (CS) education; an effort is made to integrate the instruction of a programming language and development of students' problem-solving skills. Nevertheless, accumulating evidence suggests that there is a tendency to emphasize the acquisition of programming rules, whereas the study of algorithms and problem-solving strategies is unstructured and hidden.

Among algorithmic problems, there are identifiable generic problems that recur in different contexts. The term *Algorithmic patterns* refers to classification of recurring algorithmic problems according to their goals (i.e., "Extreme Value Computation", "Checking the existence of an item that satisfies a condition"). Patterns are examples of "expert solutions", and they serve as building blocks for developing algorithms to solve new problems. The importance of patterns, in general, has been recognized among practitioners of software development as they serve as a means for interchanging successful solutions to recurring programming and software design problems.

It is widely accepted that the organization of knowledge in memory consists of "cognitive schemas"—interconnected structures that consist of typical solutions to common problems that characterize experts' knowledge-base in their field of expertise. Based on cognitive theories, it is assumed that explicit instruction of patterns may support the building of cognitive schemes that typify experts.

Pattern oriented instruction (POI) is a pedagogical approach that incorporates patterns in CS courses. According to the POI approach in teaching students how to program, the algorithmic problems introduced are organized around patterns and do not relate only to programming features. The pattern oriented approach offers a way to intertwine the instruction of algorithmic problem-solving and programming more effectively.

An Introduction ("ESHNAV") to Algorithms course has been taught according to POI guidelines for more than eight years in the Department of Software Engineering at ORT Braude College. It is designated for students taking the Introduction to CS course who have no previous knowledge of programming.

This study aims to assess the effect of POI. It compares the achievements of students that participated in the ESHNAV course and students that learned in a traditional way. In addition, it evaluates the development of problem-solving skills, abstraction and analogical reasoning among students, as well as other aspects such as motivation, self-confidence and the way the CS field is perceived by students.

Results may be relevant to other fields in which the development of procedures for solving problems and problem-solving skills are central goals.

MUSICAL KEY DETECTION USING A GRAPH SEARCH ALGORITHM

Safwat Halaby[1], Bashar Kablan[2] and Orly Yahalom[3]

[1]*Department of Software Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1900, Fax: 972-4-990-1852, Undergraduate student*

[2]*Department of Software Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1900, Fax: 972-4-990-1852, Undergraduate student*

[3]*Department of Software Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1900, Fax: 972-4-990-1852, E-mail: oyahalom@braude.ac.il*

Keywords: Musical key, music transcription, directed acyclic graph, shortest path problem

Western music consists of notes separated at intervals of half tones. There are 12 notes in each *octave*, which is a set of sound frequencies, determining the *pitch* of the notes (high or low). Frequencies of parallel notes in different octaves are multiples of each other, and sound alike to the human ear. A key is a subset of seven notes, out of the 12 notes in an octave. The key determines which notes (at any octave) are prevalent in a musical composition. A musical piece, however, may include notes outside the key, called *accidentals*. Additionally, some compositions switch between keys at certain points in time.

Thus, key detection is a non-trivial task. Besides the theoretical interest, it is useful in applications such as music transcription, as using the right key eases the reading of the notes.

We present a linear time algorithm for determining the key(s) of a musical piece, as well as the points at which it changes. This is done by converting the problem into a single source search in a weighted directed acyclic graph (DAG).

ASSUME, GUARANTEE, AND REPAIR

Sarai Sheinvald[1]**,** Hadar Frenkel[2], Orna Grumberg[2] and Corina Pasareanu[3]

[1]*Department of Software Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, E-mail: sarai@braude.ac.il*

[2]*Department of Computer Science, Technion – Israel Institute of Technology, Haifa 3200003, Israel*

[3]*Carnegie Mellon University and NASA Ames Research Center, CA, USA*

Keywords: Verification, automatic repair

We present the Assume–Guarantee–Repair (AGR) Framework—a novel framework that not only verifies the correctness of a program against a safety specification, but also repairs the program, should the verification fail. We consider communicating programs, such as simple C-like programs, extended with synchronous communication actions over communication channels.

Our method comprises two main stages. The first, based on the assume–guarantee rule, uses automata learning in order to find the assumption needed for the rule. The second, which is the bulk of our contribution, repairs one of the components in case the verification fails, by constructing an additional component that limits the behavior of the system. The repair is constructed via logical abduction and learning tools. We demonstrate the effectiveness of AGR on several examples using existing SMT solvers, learning, and reachability analysis tools.

SHAPE OPTIMIZATION DEFINITENESS USING NURBS CURVES AND A MULTI-OBJECTIVE OPTIMIZATION SCHEME

Miri Weiss Cohen[1], Frederico G. Guimarães[2] and João B. Zuliani[3]

[1]*Department of Software Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel: 972-4-990-1758, E-mail: miri@braude.ac.il*

[2]*Department of Electrical Engineering, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil, E-mail, fredericoguimaraes@ufmg.br*

[3]*TMT Department de Formacao Geral, Centro Federal de Educação Tecnológica de Minas, Universidade Federal de Minas Gerais, Brazil, E-mail: joao@timoteo.cefetmg.br*

Keywords: Topology optimization, shape optimization, NURBS, genetic algorithm

Topology optimization (TO) tries to find the best distribution of materials inside a region of interest that meets certain desirable criteria fixed a priori. Although TO methods are effective in determining a good initial distribution of material in the design domain, they are a cell-based representation of the topology, which in many cases leads to irregular and vague boundary layouts. A post-processing procedure is usually done to refine the results obtained and increase the efficiency of the TO layout. Many attempts to achieve smoother and definite material boundaries have been studied, most of them done by parameterization of the TO initial distribution leading to Shape Optimization (SO). Shape Optimization is a process in which various methods are used to find the best geometric definitions of the boundaries found in the initial layout, while configurations such as holes and regions of different materials remain unchanged. Given the complexity of the task, SO is of great interest when searching for the most fitted and optimized solution.

It is natural that a proper representation of the boundary shape is essential for efficient optimization. To obtain a flexible solution for the problem, NURBS are applied to define the sections of curves that form the internal boundary of the solutions obtained. In this work, the parameterization process involves identifying the boundaries of different materials and defining theses boundaries by NURBS curves. This approach exploits the ability to define the internal boundary profile to have more flexibility in handling the boundaries of the topologies in the parameterized model and, therefore, to obtain an efficient SO. Once a parametrized model is defined, SO can be performed using the parameters of the boundary curves as the optimization variables. A multi-objective optimization problem (MOOP) is used to optimize the best variables (control points and weights) for achieving the best coordinates of the boundary curves, meeting a fitness function criterion. The method was tested on a C-Core magnet.

Acknowledgments

This research was supported by a Marie Curie International Research Staff Exchange Scheme Fellowship and by SRG–Braude (Grant 500.383.12).

ENERGY EFFICIENT CONTROL OF REDUNDANT SYSTEMS USING EVOLUTIONARY BI-LEVEL OPTIMIZATION

Miri Weiss Cohen[1], Uriel Nusbaum[2] and Yoram Halevi[3]

[1]*Department of Software Engineering, ORT Braude College, P.O. Box 78, Karmiel 2161002, Israel, Tel:972-4-990-1758, E-mail: miri@braude.ac.il*

[2]*Autonomous Systems Program, Technion – Israel Institute of Technology, Haifa 3200003, Israel, E-mail: urieln@campus.technion.ac.il*

[3]*Faculty of Mechanical Engineering, Technion – Israel Institute of Technology, Haifa 3200003, Israel, Tel: 972-4-829-2465, E-mail: yoramh@technion.ac.il*

Keywords: Bi–level optimization, optimal control, genetic algorithm

Redundant manipulators are mechanical systems with more degrees of freedom than required for their task. The problem of total energy minimization is formulated as an optimal control problem and a unique state-transformation, which enables order reduction for energy minimization and perfect tracking. Energy management has a significant role in manufacturing systems where energy efficiency leads directly to cost savings. When a dynamic system is moving, its energy consumption is dominated by two factors. The first is its path and the second is the control signal applied to enforce the motion policy. The sub-tasks in this work are classified into two classes. The first is tracking, representing the useful parts of the motion, and the second is state-to-state transition, which is motion between the "useful" subtasks.

The solution scheme presented includes decomposition of the problem into a bi-level structure. In this bi-level optimization scheme, two optimization problems are nested in a hierarchical structure. The higher level problem is constrained by the lower level one in the sense that only an optimal solution of the lower level problem can serve as a candidate solution for the higher level one. The higher level problem is solved using a genetic algorithm and the lower level one, using optimal control.

The algorithm performs simultaneous scheduling, path planning and control while maintaining performance and physical constraint limitations. The combination of a genetic algorithm and optimal control (autonomous GA) has proven itself superior over manual optimization throughout every scenario examined. The concept of using a high level genetic algorithm for decisions making while optimal control enforces constraints and produces the optimal states' trajectory has significant impact on the final performance of the system and its associated energy efficiency. Comparison of control solutions shows the superiority of the combined evolutionary algorithm to computational feasibility and overall energy savings.