



ADVANCES in CONTROL, CHEMICAL ENGINEERING, CIVIL ENGINEERING and MECHANICAL ENGINEERING

**European Conference of Chemical Engineering (ECCE '10)
European Conference of Civil Engineering (ECCIE '10)
European Conference of Mechanical Engineering (ECME '10)
European Conference of Control (ECC '10)**

**Puerto De La Cruz, Tenerife
November 30-December 2, 2010**

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Table of Contents

Keynote Lecture 1: Cognitive Engineering & Religious Emotions: A Mathematical Equivalence of Dynamics and Teleology <i>Leonid Perlovsky</i>	11
Structural Robust Design Optimization of Steel Frames with Engineering Knowledge-Based Variance-Reduction Simulation <i>David Greiner, Jose M. Emperador, Blas Galvan, Gabriel Winter</i>	13
Experimental Stress Analysis on a Wagon Model for Railway Vehicles <i>T. St. Manescu, N. L. Zaharia, M. D. Stroia, S. D. Avram, M. N. Tiganasu</i>	19
One-Room Fire Models Analysis <i>T. Manescu, E. M. Afronie, M. D. Stroia, A. I. Chivu, T. Manescu Jr., F. Pomoja</i>	22
Designing Method for Stamps used in Automotive Parts Manufacturing <i>S. D. Avram, M. D. Stroia, M. N. Tiganasu, T. St. Manescu</i>	25
Influence of Polymers on Concrete Damping Properties <i>S. F. Nabavi</i>	28
Mathematical Modeling of Material Removal Rate for Ti-5Al-2.5Sn through EDM Process: A Surface Response Method <i>M. M. Rahman, Md. Ashikur Rahman Khan, K. Kadirgama, M.M. Noor, Rosli A. Bakar</i>	34
Ion Plating Process of Applying Thin Layers <i>Ciprian Manescu, Ionita Gheorghe, Carmen Popa, Ivona Petre</i>	38
Mathematical Aspects in Determining the Configuration of the Coaxial Coupling Between a Circular and a Polygonal Section <i>Ivona Petre, Alin Pohoata, Carmen Popa</i>	41
Methods for Determining the Unfolding of the Constructions Used in Industrial Installations <i>Carmen Popa, Stefania Iordache, Ivona Petre, Magda Gabriela Bratu, Ciprian Manescu</i>	46
Minimization by FEM of the Transient Electrical Contact Resistance and Contact Temperature of Power Automotive Connector <i>Amine Beloufa</i>	50
Influence of Ligand Exchange on the Structural and Optoelectronic Properties of CdSe Nanocrystals <i>Nguyen Tam Nguyen Truong, Chinho Park</i>	59
Real-Time Control of Electron Density in Low Pressure Plasma <i>Yang Zhang, Anthony Holohan, Bernard Keville, Stephen Daniels</i>	63
Radiative Entropy Generation in a Cylindrical Enclosure <i>F. Ben Nejma, A. Mezgar, K. Charrada</i>	67

Properties of Fiber Reinforced Concrete Using Recycled Aggregates	71
<i>V. Vytlačilova, J. Vodicka</i>	
Effects of Isolation Damping and Stiffness on the Seismic Behaviour of Structures	76
<i>A. Abrishambaf, G. Ozay</i>	
Engineering on the Nanoscale: Enrichment and Separation of Elements Using Membrane-Based Technologies	82
<i>Kurt E. Geckeler</i>	
Reverse Micellar Synthesis, Characterization & Antibacterial Study of Nickel Nanoparticles	88
<i>Harish Kumar, Renu Rani, Rajkumar Salar</i>	
Fuzzy Linear Multi-objective Programming	95
<i>Said. Davar, Said. Ghasrodashti</i>	
Porous Iron and Ferric Oxide Pellets for Hydrogen Storage: Texture and Transport Characteristics	99
<i>Karel Soukup, Jan Rogut, Jacek Grabowski, Marian Wiatowski, Magdalena Ludwik-Pardala, Petr Schneider, Olga Solcova</i>	
Control of Chaos in Nonlinear Gyros Via Optimal Backstepping Method	104
<i>A. R. Khalilzadeh, M. Taleb Ziabari</i>	
An Intelligent Controller For A Single Link Flexible Joint Manipulator	109
<i>A. R. Khalilzadeh, M. Taleb Ziabari</i>	
Sorption Isotherms of Mango (<i>Mangifera Indica</i> L.) Pulp Freeze-dried.	114
<i>Rangel–Marron M., Welti–Chanes J, Cordova–Quiroz A. V., Ceron-Breton J. G., Anguebes–Franseschi F., Moreno-Martinez V.</i>	
Studies on Optimization of Withdrawing Cylinder at Vertical Continuous Casting of Steel	119
<i>M. Tufoi, I. Vela, C. Marta, D. Amariei, A. I. Tuta, C. Mituletu</i>	
Analysis on the Operation of Gas Regulators and Optimization of their Operation	125
<i>A. I. Tuta, I. Vela, M. Tufoi, D. Amariei, C. Mituletu, L. Suci</i>	
Control Lorenz Chaos Using Optimal Backstepping Method	131
<i>A. R. Khalilzadeh, M. Taleb Ziabari</i>	
Removal of CO₂ from Gas Mixture Using Hollow Fiber Membrane Contactors Fabricated from PVDF/Triacetin/Glycerol Cast Solution	136
<i>N. Ghasem, M. Al-Marzouqi, R. Al-Marzouq, A. Dowaidar, M. Vialatte</i>	
Mobile Robots Navigation Based on Graph Search Techniques	142
<i>Radu Robotin, Petru Dobra, Gheorghe Lazea</i>	
Modeling and Simulation of Autonomous Logistic Processes	148
<i>Bernd Scholz-Reiter, Daniel Rippel, Steffen Sowade</i>	
Cold Rolling Shape Defects of Stainless Steel Wide Strips	154
<i>Chiran Andrei, Moisa Bogdan, Nicolescu Georgian, Priceputu Ionut, Bacinschi Zorica</i>	

Stainless Steel the Environment Friendly Choice	159
<i>Moisa Bogdan Alexandru, Chiran Andrei, Constantin Marian, Bacinschi Zorica, Rizescu Cristiana Zizi, Stoian Elena Valentina</i>	
Phase Field Theory Modeling of CH₄/CO₂ Gas Hydrates in Gravity Fields	164
<i>M. Qasim, B. Kvamme, K. Baig</i>	
Two-and Three-dimensional Organization of Gold Nanoparticles	168
<i>Toyoko Imae, Shoichi Ohishi, Masaki Ujihara</i>	
Predicting of Minimum Fluidization Velocity of a Binary Density System Using Pressure Fluctuation in a Fluidized Bed	172
<i>Rafail L. Isemin, Alex V. Mikhalev, Dmitry M. Viryasov, Sergey N. Kuzmin</i>	
Intelligent Control and Modelling of a Micro Robot for In-pipe Application	176
<i>Y. Sabzehmeidani, M. Mailah, M. Hussein, A. R. Tvakolpour, M. R. Safizadeh</i>	
Creep of Cement Paste Preloaded by High Temperature	182
<i>P. Padevet, P. Bittnar</i>	
Kinematic Analysis of an Assistive Robotic Leg for Hemiplegic and Hemiparetic Patients	188
<i>M. R. Safizadeh, M. Hussein, K. F. Samat, M. S. CheKob, M. S. Yaacob, M. Z. MdZain, Y. Sabzehmeidani</i>	
Time Dependence of Mechanical Properties of Specimens Made from “Grey Gypsum”	195
<i>P. Padevet, P. Tesarek, T. Plachy</i>	
Assessment of the Depth of Anaesthesia in Animals for Automatic Control	201
<i>B. A. Costa, R. Figueiredo, J. M. Lemos, A. Silva, S. Campos, L. Antunes</i>	
Optimization of the Parameters for Galvanic Deposition of Silver/Diamond Dispersion Coatings	206
<i>I. V. Rigou, G. Marginean, C. V. Campian, D. Frunzaverde, W. Brandl</i>	
Characteristics of Aerodynamics Forces Acting on Two Square Cylinders in the Streamwise Direction and its Wake Patterns	209
<i>A. Etminan, M. Moosavi, N. Ghaedsharafi</i>	
Mixed H₂ and H_∞ Performance Analysis of Networked Control Systems with Fading Communication Channels	218
<i>Adrian-Mihail Stoica</i>	
Smart Gun with Implantable RFid Match System - A practical approach	223
<i>Gazziro M. A., Almeida L. O. B., Pedrazzani C. D., Machado C. G. C. F.</i>	
Effect of Deposition Temperature on the Crystalline Structure and Surface Morphology of ZnO Films Deposited on p-Si	227
<i>Seval Aksoy, Yasemin Caglar, Saliha Ilican, Mujdat Caglar</i>	
Characterization of a Multilayer GaAs/AlGaAs Broadband Quantum Well Infrared Photodetectors	232
<i>Hulya Kuru, Burcu Arpabay, Tugce Karakulak, Bulent Arkan, Bulent Aslan, Ugur Serincan</i>	

Electrochromic Nanocomposite of Silica/Polyaniline Prepared from a Water-In-Oil Microemulsion Solution	236
<i>Taejin Hwang, HeungYeol Lee, Hohyeong Kim, Gyuntak Kim</i>	
An Approximate Solution Corresponding to a Quasi-Stationary State during Nitriding	241
<i>J. L. Bernal, F. Castillo, J. Oseguera, A. Fraguera, A. Medina, L. Bejar, A. Barranon, A. Juanico</i>	
Authors Index	249

Keynote Lecture 1

Cognitive Engineering & Religious Emotions: A Mathematical Equivalence of Dynamics and Teleology



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Abstract: The talk discusses a mathematical theory for cognitive engineering, which significantly improves solutions of many engineering problems and at the same time models spiritual feelings in the human brain-mind. This convergence of scientific, engineering, and religious theories indicates a possibility of signal developments. C. Jung wrote that schism between science and religion points to a psychosis of contemporary collective psyche; survival of culture demands repairing of this schism. Many outstanding scientists are trying to mend this schism. Many books are written arguing that the newest scientific discoveries in molecular biology, evolution, and cosmology do not contradict the main tenets of the world's religions. But there is no scientific theory, explaining spiritual dimension of the mind-brain. "Every one who is seriously involved in the pursuit of science becomes convinced that a spirit is manifest in the laws of the Universe." This Einsteinian statement remains outside of science. Understanding of the mind mechanisms today came close to explaining spirituality from scientific point of view. The talk tells about the knowledge instinct, driving growth of the mind, responsible for our higher mental abilities of abstract symbolic thinking, for beautiful and sublime, and for evolution of cultures. A mathematical theory is presented. This theory is a mathematical breakthrough that overcame decades of limitations in AI, pattern recognition, neural networks, and other attempts to solve complex problems by modeling the brain-mind. Solutions of engineering problems are presented that overcome previous difficulties of computational complexity, and result in orders of magnitude improvements in detection, prediction, tracking, fusion, and learning situations. This theory is extended to higher cognitive functions. It models the knowledge instinct operating on the hierarchy of the human brain-mind. At the bottom of the hierarchy are simple objects, higher up are situations, general and abstract concepts, unifying contents of lower levels. At the top are concepts unifying our entire knowledge; we perceive them as concepts of the meaning and purpose of our existence. The mathematical theory explains why these concepts are inherently vague and unconscious and our consciousness is in great doubt about their very existence. When we feel that we have understood them a bit better or our belief in their existence got a bit firmer, we feel the emotion of beautiful. In parallel with the concepts of understanding the meaning and purpose, we have concepts of behavior needed to realize the beauty in our life. When we feel that we have understood these behavioral concepts a bit better or our belief in their existence got a bit firmer, we feel the emotion of spiritually sublime. Science explains that beautiful and sublime are not final notions. It follows from Godel theory, that mechanisms of the highest aspirations of human spirit are not logically reducible to finite statements. Attempts to compute them logically exceed in complexity all elementary interactions in the Universe in its entire lifetime and therefore choices of beautiful and sublime involve more information than is available in the Universe. A possibility of these choices is called a miracle in traditional language. A computational theory of these choices goes together with a proof that science is not reducible. Laws governing our highest values would not be reduced to laws governing a leaf flying with the wind. Hamiltonian formulation of the fundamental laws of physics leads to what is commonly considered a scientific causality: particles and fields move under forces, and the next moment is a consequence of the previous one. Lagrangian formulation leads to teleological formulation: particles and fields move toward a purpose, maximum of Lagrangian function ("minimum of energy" in the parlance of the middle school physics). The Lagrangian equivalence of causality and purpose exists in physics of few particles, but it does not exist in statistical physics of complex systems. The mathematical theory of the knowledge instinct made equivalent causality and teleology for very complex systems, the human mind and culture evolve causally according to dynamic logic and evolve teleologically toward maximization of knowledge. This defines the new "arrow of time." The talk discusses brain imaging experiments conducted at Harvard Brain Imaging Lab confirming this theory. Contents of

models of beautiful and sublime are unconscious; they do not belong to our consciousness. They are "collective," outside of consciousness. Consciousness does not control them, they control our consciousness. Therefore, we feel them as a source of agency outside of ourselves. In recent discussions it is called Designer.

Brief Biography of the Speaker:

Dr. Leonid Perlovsky is Visiting Scholar at Harvard University and Principal Research Physicist and Technical Advisor at the Air Force Research Laboratory, Hanscom AFB. He leads research projects on modeling the mind (including cognitive roles of the beautiful, sublime, and music), computing with words, evolution of languages and cultures, fuzzy dynamic logic, neural networks, cognitive and bio-inspired algorithms for signal processing, prediction, detection, tracking, fusion. As Chief Scientist at Nichols Research, a \$0.5B high-tech organization, he led the corporate research in intelligent systems. He served as professor at Novosibirsk University and New York University; as a principal in commercial startups developing tools for biotechnology, text understanding, and financial predictions. His company predicted the market crash following 9/11 a week before the event. He is invited as a keynote plenary speaker and tutorial lecturer worldwide, published more than 360 papers, 11 book chapters, and 3 books, including "Neural Networks and Intellect," Oxford University Press, 2001 (currently in the 3rd printing), awarded 2 patents. Dr. Perlovsky participates in organizing conferences on Computational Intelligence, Chairs IEEE Boston Computational Intelligence Chapter; Co-Chairs IEEE TC on Neural Networks, Chairs IEEE TF on The Mind and Brain, serves on the INNS Board of Governors, where he Chairs Award Committee. He serves on the Editorial Board of five professional journals, including Editor-in-Chief for "Physics of Life Reviews" (which he founded jointly with Nobel Laureate I. Prigogine). He received National and International awards including the Best Paper Award 2001 from Zvezda, a leading Russian literary and essayistic magazine; the Gabor Award 2007, the top engineering award from International Neural Network Society; and the John McLucas Award 2007, the highest US Air Force Award for basic research.

Authors Index

Abrishambaf, A.	76	Etminan, A.	209	Manescu, T. St.	19, 22, 25
Afronie, E. M.	22	Figueiredo, R.	201	Marginean, G.	206
Aksoy, S.	227	Fraguela, A.	241	Marian, C.	159
Al-Marzouq, R.	136	Frunzaverde, D.	206	Marta, C.	119
Al-Marzouqi, M.	136	Galvan, B.	13	MdZain, M. Z.	188
Almeida, L. O. B.	223	Gazziro, M. A.	223	Medina, A.	241
Amariei, D.	119, 125	Geckeler, K. E.	82	Mezgar, A.	67
Anguebes–Franseschi, F.	114	Ghaedsharafi, N.	209	Mikhalev, A. V.	172
Antunes, L.	201	Ghasem, N.	136	Mituletu, C.	119, 125
Arkan, B.	232	Ghasrodashti, S.	95	Moosavi, M.	209
Arpapay, B.	232	Gheorghe, I.	38	Moreno-Martinez, V.	114
Aslan, B.	232	Grabowski, J.	99	Nabavi, S. F.	28
Avram, S. D.	19, 25	Greiner, D.	13	Nejma, F. B.	67
Baig, K.	164	Holohan, A.	63	Nicolescu, G.	154
Bakar, R. A.	34	Hussein, M.	176, 188	Noor, M. M.	34
Barranon, A.	241	Hwang, T.	236	Ohishi, S.	168
Bejar, L.	241	Ilican, S.	227	Oseguera, J.	241
Beloufa, A.	50	Imae, T.	168	Ozay, G.	76
Bernal, J. L.	241	Iordache, S.	46	Padevet, P.	182, 195
Bittnar, P.	182	Isemin, R. L.	172	Park, C.	59
Bogdan, M.	154, 159	Juanico, A.	241	Pedrazzani, C. D.	223
Brandl, W.	206	Kadirgama, K.	34	Petre, I.	38, 41, 46
Bratu, M. G.	46	Karakulak, T.	232	Plachy, T.	195
Caglar, M.	227	Keville, B.	63	Pohoata, A.	41
Caglar, Y.	227	Khalilzadeh, A. R.	104, 109, 131	Pomoja, F.	22
Campian, C. V.	206	Khan, Md. A. R.	34	Popa, C.	38, 41, 46
Campos, S.	201	Kim, G.	236	Priceputu, I.	154
Castillo, F.	241	Kim, H.	236	Qasim, M.	164
Ceron-Breton, J. G.	114	Kumar, H.	88	Rahman, M. M.	34
Charrada, K.	67	Kuru, H.	232	Rangel–Marron, M.	114
CheKob, M. S.	188	Kuzmin, S. N.	172	Rani, R.	88
Chiran, A.	154, 159	Kvamme, B.	164	Rigou, I. V.	206
Chivu, A. I.	22	Lazea, G.	142	Rippel, D.	148
Cordova–Quiroz, A. V.	114	Lee, H. Y.	236	Rizescu, C. Z.	159
Costa, B. A.	201	Lemos, J. M.	201	Robotin, R.	142
Daniels, S.	63	Ludwik-Pardala, M.	99	Rogut, J.	99
Davar, S.	95	Machado, C. G. C. F.	223	Sabzehmeidani, Y.	176, 188
Dobra, P.	142	Mailah, M.	176	Safizadeh, M. R.	176, 188
Dowaidar, A.	136	Manescu Jr., T.	22	Salar, R.	88
Emperador, J. M.	13	Manescu, C.	38, 46	Samat, K. F.	188

Schneider, P.	99	Tesarek, P.	195	Vytlacilova, V.	71
Scholz-Reiter, B.	148	Tiganasu, M. N.	19, 25	Walti-Chanes, J.	114
Serincan, U.	232	Truong, N. T. N.	59	Wiatowski, M.	99
Silva, A.	201	Tufoi, M.	119, 125	Winter, G.	13
Solcova, O.	99	Tuta, A. I.	119, 125	Yaacob, M. S.	188
Soukup, K.	99	Tvakolpour, A. R.	176	Zaharia, N. L.	19
Sowade, S.	148	Ujihara, M.	168	Zhang, Y.	63
Stoian, E. V.	159	Vela, I.	119, 125	Ziabari, M. T.	104, 109, 131
Stoica, A.-M.	218	Vialatte, M.	136	Zorica, B.	154, 159
Stroia, M. D.	19, 22, 25	Viryasov, D. M.	172		
Suciu, L.	125	Vodicka, J.	71		