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- European Conference of Circuits Technology and Devices (ECCTD '10)
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Table of Contents

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.