Dr. LEONID I. PERLOVSKY

Harvard University, 33 Oxford St, Rm 336, Cambridge MA 02138, 617-495-7871
Leonid@deas.harvard.edu
AFRL, 80 Scott Drive, Hanscom AFB, MA 01731-2909 781-377-1728, fax 781-377-8984
Leonid.Perlovsky@hanscom.af.mil.
Home 111 Jordan Road, Brookline, MA 02446, 617-232-7588, LPerl@rcn.com;

EXECUTIVE SUMMARY

Scientist with a track record in developing, directing and conducting first-class research and development in computational intelligence, neural networks, intelligent systems, integrated sensor-communication systems, integrated language and cognition, self-evolving systems, bio-inspired and cognitive algorithms, object recognition, tracking, fusion, image processing, signal processing, speech recognition, emotional intelligence, natural languages, search engines, biotechnology, financial engineering. Conducts research at Harvard University. Provides technical leadership to AFRL/SNHE. Program Manager for the DOD Semantic Web program and for other programs. In the past Chief Scientist of a 5,000-employee company; President and Founder of startup companies. Authored a monograph on intelligent systems and neural networks (Oxford University Press), 5 book chapters, and over 250 journal and conference papers. Currently three more books under contracts with publishers for 2007. Received IEEE awards. Associate Editor for IEEE "Transactions on Neural Networks," Editor-at-Large "Natural Computations," Editor-in-Chief "Physics of Life Reviews." US citizenship. Secret clearance.

FIELDS OF TECHNICAL EXPERTISE

Cognitive Algorithms; Neural Networks; Intelligent Systems; Integrated Systems; Self-Evolving Systems; Quantum Computation; Signal Processing; Sensor Systems; Automatic Target Recognition; Missile Defense; Multisensor Multiplatform Fusion; UAV Swarms; Electromagnetic Scattering; Acoustic Underwater Propagation; Wave Propagation in Complex Media; Inverse Scattering; Statistical Pattern Recognition; Biotechnology; Drug Design; Language Evolution; Emotional Intelligence; Language and Cognition; Self-Evolving Intelligent Systems.

PROFESSIONAL EXPERIENCE

2006-Present   HARVARD UNIVERSITY, Cambridge, MA
            Visiting Scholar

2001-Present   AIR FORCE RESEARCH LABORATORY/SNHE, Hanscom AFB, MA
            Principal Research Scientist and Technical Advisor

1999-2001   ASCENT CAPITAL MANAGEMENT, Boston, MA
            President

1986-99   NICHOLS RESEARCH CORPORATION, Boston, MA
            1993- Chief Scientist & Senior Fellow
            1988- Chief Scientist

1987- Fellow Member of the Technical Staff
1986- Senior Member of the Technical Staff

1988-89	BOSTON UNIVERSITY, Boston, MA
	Adjunct Professor

1985-86   ADVANCED MRI SYSTEMS, Woburn, MA
            Principal Research Scientist

1980-85   EXXON PRODUCTION RESEARCH COMPANY, Houston, TX
            1984- Senior Research Specialist
            1982- Research Specialist
            1981- Senior Research Physicist
            1980- Research Physicist

1979-80   NEW YORK UNIVERSITY, New York, NY
            Research Professor, Psychiatry Dept., Brain Information Processing Laboratory.

1975-78   SIBERIA ENGINEERING INSTITUTE, Novosibirsk, USSR.
            Associate Professor, Applied Mathematics Dept.

1974-75   NOVOSIBIRSK UNIVERSITY, Novosibirsk, USSR.
            Assistant Professor, Physics Dept.

EDUCATION
1971-74   JOINT INSTITUTE FOR NUCLEAR RESEARCH, Moscow, USSR
            Ph.D. in Theoretical and Mathematical Physics
1966-71   NOVOSIBIRSK UNIVERSITY, Novosibirsk, USSR
            M.S. in Physics, summa cum laude

RESEARCH
2001-   AIR FORCE RESEARCH LABORATORY/SNHE, Hanscom AFB, MA
            Provides technical leadership to AFRL/SNHE, including integrated sensor systems, self-evolving systems, UAV swarms, bio-inspired and cognitive algorithms, signal processing, quantum computation and communication, image and signal exploitation, ATR, electromagnetic phenomenology, multi-static radar fusion, electromagnetic (EM) wave propagation in complex media, integration of sensor phenomenology and signal processing. Program manager for SoA Platform (Web 2.0 DoD-wide project). Leads the development of advanced signal processing and information extraction techniques for integrated systems. Dynamic logic algorithms overcame computational complexity of classical maximum likelihood detection and tracking and improved performance by two to three orders of magnitude in terms of signal-to-noise ratio. Phenomenology-based inverse scattering. Cramer-Rao Bounds for optimization of integrated multi-component systems in design and operation. Organizes and leads collaborative research with universities, including Harvard, MIT, Northeastern Univ., Boston Univ., Universities in Japan, Russia, England, Italy, Brazil, commercial companies, and DoD organizations including DARPA, JFCOM, ARO, CECOM, NUWC, NASIC, AFOSR, and AFRL cross-directorate re-

search. Leads technology transfer (to more than 25 companies). Organizes IEEE conferences (as General Chair, Program Chair), publishes papers, delivers IEEE Tutorials, is invited as plenary and keynote speaker worldwide. Participates in SBIR programs with ESC, MDA, AFRL, including topic formulation, technical evaluation and contract monitoring. Received IEEE Award "Distinguished Member", numerous technical achievement awards and a patent award.

1999-2001   ASCENT CAPITAL MANAGEMENT, Boston, MA

Managed company operations and business development. Developed new pattern recognition, signal processing and prediction methods and applied to financial market prediction, financial risk reduction and portfolio management. Attracted investors, researchers, and partners. Predicted market crash following 9/11 and helped SEC in the follow-up investigation of suspect Alqaeda trades in international markets.

1986-99   NICHOLS RESEARCH CORPORATION, Boston, Massachusetts.

Led research and determined research directions of a $500M defense contractor. Participated in business development and in formulating policies encouraging cross-discipline corporate-wide collaborations. Managed programs, developed corporate educational and technical capabilities, led technical reviews and evaluations, and conducted original research and development in integrated sensor systems, including radars, sonars, EO/IR, acoustic, electromagnetic EM field modeling, electromagnetic scattering, IR FPA, and other sensors and materials; multi-sensor fusion, radar system simulations and schedulers, radar signal processing; multi-band EO/IR; sensor fusion, wave propagation; ATR; algorithmic complexity; algorithmic information-theoretic performance limits; sonar systems; underwater propagation. Improved sonar matched-field processing by matching information content of models and acoustic fields. Developed novel types of Cramer-Rao Bounds for target tracking. Developed a theory of wave propagation and absorption in the Arctic region. Developed Maximum Likelihood Adaptive Neural System (MLANS), a novel neural architecture for integrating multi-sensor systems, exploiting computational intelligence, combining adaptive learning with a priori knowledge, which approaches theoretical bounds on performance limits. Applied these techniques to concurrent detection and tracking of low signal targets in SAR, OTH radar, MMW radar, IR sensors, sonars, inverse scattering problems. Patent applications. Received best paper awards at IEEE conf., commendations from DARPA, Los Alamos Laboratory, MDA, Navy, Army, and Air Force program managers.

1985-86   ADVANCED NMR SYSTEMS, Woburn, Massachusetts.

Supervised research and development of the world's fastest MR imaging system installed at Yale University Hospital. Coordinated efforts of engineers, mathematicians, and programmers. Optimized integrated system including RF antenna, pulse sequences, and signal processing for superfast self-corrected imaging. Simulated and optimized design of all aspects of the MRI imaging system: RF antenna, electromagnetic fields and system response, signal processing, image corrections and enhancements, operations optimization of MRI system. Developed proprietary signal and image processing algorithms. Authored patent applications.

1980-85   EXXON PRODUCTION RESEARCH COMPANY, Houston, Texas.

Led projects in Seismic Exploration Division, developing various aspects of integrated phenomenology, signal processing, and modeling wave propagation. Developed statistical methods for calculating mechanical properties of rocks and seismograms from their electrical

3

resistivity. Developed new methods for identifying lithologies from seismic compressional and shear wave data. Program manager for wavefield acoustic borehole measurements and processing in the Reservoir Engineering Division. Developed techniques for predicting rock permeability, fracturing and lithologies. Developed a novel theory of rock rigidity phase transition and waveform propagation near phase transition; these results were crucial for understanding shear-wave seismic exploration and affected conduct of a $5B exploration program.

TEACHING
2000- Present. IEEE Tutorial courses. University Lectures

2006, *Bio-inspired and Cognitive Algorithms - For Recognition, Data Mining, Tracking, Fusion, Prediction, and Language Understanding.* IEEE fall course, Central New England Council.

2006, *Dynamic Logic, Neural Fields, Engineering Applications, and The Mind.* EE Seminar, Harvard University.

2006, *Computations in the Mind: Dynamic Logic and Joint Evolution of Cognition, Language, and Cultures.* Invited Plenary Lecture. The IASTED International Conference on Computational Intelligence, CI 2006, San Francisco, California, USA

2006, *Biologically Inspired Methods for Array Signal Processing.* Plenary Distinguished Lecturer at Fourth IEEE Workshop on Sensor Array and Multichannel Processing (SAM 06), Waltham, MA.

2006, *Neural Network Mechanisms for Cognition and Language.* The Official Seminar, Russian Neural Networks Society.

2006, *Co-evolution of Cognition and Language.* Systems Analysis Inst., Russian Academy of Sciences. Moscow.

2006, *Integration of Cognition and Language.* St. Petersburg Inst. Informatics & Automation, Russian Academy of Sciences.

2006, *Co-evolution of Consciousness, Cognition, Language, and Music.* Tutorial lecture course at Biannual Cognitive Science Conference, St. Petersburg, Russia.

2006, *Co-Evolution of Cognition and Music*. Art Theory Inst., Russian Academy of Sciences, Moscow.

2006, *Co-evolution of Consciousness, Emotions, and Music.* Cognitive Science Seminar, School of Music. Univ. Ohio, Columbus, OH.

2006, *Non-linear Evolutionary Dynamics of Cognition, Emotions, Consciousness, and Music.* Santa Fe Institute. Santa Fe, NM.

2006, *Computational Intelligence and Higher Cognitive Functions.* Daniel D. McCracken Computational Sciences Seminar Series, Central Washington University, Ellensburg, WA.

2005, *Computational Intelligence: Natural Information Processing.* IEEE XELL Project (Multi media corporate tutorial series).

2005, *Integrating Language and Cognition.* Tutorial lecture at International IEEE and INNS Joint Conference on Neural Networks (IJCNN'05). Montreal, Quebec, Canada.

2005, *Biologically-Inspired Cognitive Architectures.* Tutorial Lecture at IEEE Int. Conf. On Integration of Knowledge Intensive Multi-Agent Sys., Waltham, MA.

2005, *Bio-inspired and Cognitive Algorithms: Recognition, Data Mining, Tracking, Fusion, Prediction, And Language Understanding.* IEEE fall course, Central New England Council.

2005, *Computational Intelligence. Role of Conceptual and Emotional Processing in Perception and Cognition.* Invited Tutorial Lecture, University of Arizona, Tempe, AZ.

2004, *Emotions and Concepts in Cognition and Language*. Invited Lecture, University of Edinburgh, Edinburgh, UK

2004, *Computational Intelligence. Integrating Language and Cognition.* Invited Tutorial Lecture, University of Arkansas, Fayetteville, AR.

2004, *Integration of Information in Human Brain. Current Ideas in Computational Intelligence.* IEEE fall course, Central New England Council.

2004, *Computational Intelligence Integrating Language and Cognition.* Tutorial Lecture at IEEE Joint Robotic and Automation and Computational Intelligence Chapter Meeting.

2003, *Structures Of The Mind: Concepts, Emotions, Instincts, Conscious And Unconscious.* Tutorial, Int. Conf. Integration of Knowledge Intensive Multi-Agent Systems, Cambridge, MA.

2003, *Cognitive algorithms for recognition and tracking*. Invited Tutorial Lecture, Mitsubishi Electronic Research Laboratory, Cambridge, MA.

2003, *The Mind: Structure and Evolution*. Series of Lectures, Novosibirsk University, Novosibirsk, Russia.

2000, *Mathematical models of cognitive functions*. Series of Lectures, Beijing University, Beijing, China.

1988-89   BOSTON UNIVERSITY, Metropolitan College, Boston, MA.
            Computer Science department. Taught a course in discrete mathematics.

1979-80   NEW YORK UNIVERSITY, New York, New York.
            Taught courses in mathematical methods of signal and image processing. Developed new estimators for parameters of stochastic signals. Research in statistical multivariate analysis, developed new methods for detecting patterns in eye movements for schizophrenia diagnostics.

1980-85   EXXON PRODUCTION RESEARCH COMPANY, Houston, Texas.
            Corporate continuing education program. Developed and taught courses in statistical estimation, signal processing, wave propagation, borehole acoustic signal processing and applications, and in statistical analysis of geophysical data.

1975-78   SIBERIA ENGINEERING INSTITUTE, Novosibirsk, USSR.
            Developed and taught courses in algorithms, signal processing, probability theory, mathematical statistics, design of experiments, mathematical methods in economics, operations research, computer languages, and numerical methods.

1974-75   NOVOSIBIRSK UNIVERSITY, Novosibirsk, USSR.
            Taught courses in electrodynamics, elasticity, molecular physics, thermodynamics, mechanics, quantum mechanics. Research in elementary particle physics.

INVITED LECTURES and KEYNOTE PRESENTATIONS
2006, Harvard University, Cambridge, MA.
    Dynamic Logic, Neural Fields, Engineering Applications, and The Mind.
2006, International Conference on Computational Intelligence, San Francisco, CA.

Computations in the Mind: Dynamic Logic and Joint Evolution of Cognition, Language, and Cultures.

2006, Fourth IEEE Workshop on Sensor Array and Multichannel Processing. Waltham, MA.
Biologically Inspired Methods for Array Signal Processing.

2006 Theory of Art Inst., Russian Academy of Sciences. Moscow.
Co-evolution of Cognition and Music.

2006 Systems Analysis Inst., Russian Academy of Sciences. Moscow.
Co-evolution of Cognition and Language.

2006 Russian Neural Networks Society, the Official Seminar, Moscow.
Neural Network Mechanisms for Cognition and Language.

2006 St. Petersburg Inst. Informatics & Automation, Russian Academy of Sciences.
Integration of Cognition and Language.

2005 Defense Applications of Signal Processing Workshop, Midway, Utah.
Bio-Inspired Integration of Sensing and Communication.

2005 Autonomous Intelligent Systems: Agents & Data Mining Conf.: St. Petersburg, Russia.
Evolving Agents: Communication and Cognition.

2005 IEEE Integration of Knowledge Intensive Multi-Agent Systems Conf., Waltham, MA.
Bio-Inspired High Level Sensor Fusion: Sensing and Communication.

2004 IEEE Boston Section, Boston, MA.
Tutorial on Computational Intelligence.

2004 University of Arizona, Tempe, AZ.
Natural Information Processing: Concepts and Emotions .

2004 University of Arkansas, Fayetteville, AR.
Integration of Communication and Cognition .

2003 IEEE Integration of Knowledge Intensive Multi-Agent Systems Conf., Cambridge, MA.
Integration of Communication and Sensory Systems .

2003 Joint Conference on Information Sciences, Triangle Park, NC.
Mathematics of Intelligence and Emotions.

2003 Collaborative Technologies and Systems Conference, Orlando, FL.
Fusion of Language and Sensor Information for CTS .

2002 Theoretical Fundamentals of Intelligent Systems Workshop, Durham, NC.
Semiotic Fundamentals of Information Processing In Human Brain.

2001 SEE Conference on The Integration of Information Processing, Toronto, Canada.
Physical Theory of Information Processing in the Mind: concepts and emotions.

2000 Joint Information Science and Technology Conference. Atlantic City, NJ.
Computing with Words.

2000 Science and Religion Conference, St. Peterburg, Russia
Mathematical Nature of Sublime in Predictive Systems.

1999 China Academy of Electronics and Information Technology, Beijing, China
Prediction, Recognition, and Intelligence.

1999 Intelligent Control Systems Conference, Cambridge, MA
Mathematics of Emotional Intelligence.

1998 Joint Conference on Science and Technology of Intelligent Systems, Gaithersburg, MD
Mathematical and Philosophical Concepts of Mind.

1997 Intelligent Systems and Semiotics Conference, Gaithersburg, MD
What is Intelligence? (Modeling Fields, Evolutionary Computations, and Hierarchies).

1996   Intelligent Systems and Semiotics Conference, Gaithersburg, MD
        Intelligence of Recognition.
1995   Joint Meeting of the US/Australian MOA on Radar R&D Activities, Chesapeake VA
        ROTHR Tracker Development.
1995   Joint Meeting of the US/Australian MOA on Radar R&D Activities, Adelaide, Australia.
        MLANS Detection and Tracking in Clutter.
1994   Office of Naval Research Technology Review.
        Concurrent Classification, Tracking and Localization.
1993   Information Fusion Workshop, George Mason University.
        Decision Directed Information Fusion Using MLANS.
1992   Applied Mathematics Seminar. University of Massachusetts, Lowell
        Model Based Neural Networks.
1992   Fourth International Conference on Strategic Software Systems. Huntsville AL.
        Fuzzy Decision Directed Sensor Fusion.
1992   Oceans '92 IEEE Conference.
        Transient Signal Processing.
1992   Optical Discrimination Algorithm Meeting. USASDC, Huntsville, AL.
        Unified Approach to Multisensor Surveillance.
1992   Distinguished Lecturers Series. Strasbourg University Geophysical Observatory. Strasbourg, France. *Statistical Estimation in Geophysics, New Directions.*
1991   Massachusetts Institute of Technology, Earth Resources Laboratory Seminar.
        New Concepts in Neural Networks.
1991   Automatic Target Recognition Working Group. *Computational Concepts in Recognition: Neural Networks, Model Based Vision, and Statistical Pattern Recognition.*
1989   BBN Signal Processing Seminar.
        Acoustic Critical Opalescence of the Transitional Under-Ice Layer in the Arctic.
1988   Boston University Engineering Seminar.
        Maximum Likelihood Neural Network and Cramer-Rao Bounds.
1987   Massachusetts Institute of Technology Geophysical Seminar.
        Robust Estimators for Parameters of Oscillating Systems.
1987   DARPA Neural Network Study, Application Panel.
        Neural Network for Adaptive Classification and Sensor Fusion.
1986   Columbia University Distinguished Lecturers' Seminar.
        Critical Scattering of Seismic Waves.
1986   Massachusetts Institute of Technology, Earth Resources Laboratory Seminar.
        Scattering of Seismic Waves by Fluctuations of Rigidity.
1980   Exxon Production Research Exploration Seminar.
        Efficient Estimators for AR Processes.
1980   New York University Laboratory for Mathematical Psychology.
        Biological Clocks in Eye Movements and EEG.
1977   Siberia Agricultural Institute.
        Optimization Methods for Reducing Demurrage During Harvest.
1975   Joint Institute for Nuclear Research.
        Experimental Consequences of Barion Exchange at High Energy.

PROFESSIONAL ACTIVITIES

Editor-in-Chief for Elsevier journal "Physics of Life Reviews." Editor-at-Large for World Scientific journal "Natural Computations." Associate Editor for IEEE "Transactions on Neural Networks," Guest Editor for "Information Fusion" journal. Reviewed articles for IEEE Transactions on Signal Processing, Image Processing, Pattern Analysis and Machine Intelligence, Systems Man and Cybernetics; Information Fusion, Information Sciences, Neural Networks, Navy Journal of Underwater Acoustics, IEEE Journal of Ocean Engineering, Journal of Geophysics, Journal of Mathematical Psychology, Journal of Nuclear Physics. Reviewed book manuscripts for Wiley, Institute of Physics, Elsevier, Taylor & Francis Group. Participated in organizing scientific conferences. Serve on IEEE Neural Network Technical Committee, Emerging Technologies Technical Committee, Computational Intelligence Society Multimedia Tutorial Committee, Organizing Committee IJCNN 2007, World Congress on Computational Intelligence 2006, as Program Chair for CIMSA conference 2004 and 2006, General Chair for IEEE KIMAS conference 2003, 2005, and 2007, Chair IEEE Boston Computational Intelligence Chapter.

CONSULTING
2000-2001   GPC BIO TECH AG. Munich, Germany.
       Bioinformatics.

2000   INNOVERITY.COM. Wakefield, MA.
       Internet search engines and bioinformatics.

1986   MIT EARTH RESOURCES LABORATORY, Cambridge, Massachusetts.
       Signal processing and propagation of waves in complex media.

1986   MIT COMPUTER CENTER, Cambridge, Massachusetts.
       Transportation optimization problem.

1979   THE SOFTWARE FOUNDRY, INC., New York, New York.
       Mathematical methods of market forecast for a portfolio optimization and update system.

1976-8 SIBERIA AGRICULTURAL INSTITUTE, Novosibirsk, USSR.
       Optimization of operations during harvest.

MEMBERSHIPS (present and past)
Institute for Electrical and Electronics Engineers,
International Neural Network Society,
Optical Society of America,
Society for Industrial and Applied Mathematics,
Society for Exploration Geophysics,
Society for Mathematical Psychology,
New York Academy of Science,
American Statistical Association.

PUBLICATIONS
Published more than 60 papers in refereed scientific journals, 220 papers in scientific collections and meetings. Authored approximately 200 reports. Monograph "Neural Networks and Intellect:

model-based concept" published by Oxford University Press in 2001, currently in the 3rd printing. Authored 7 book chapters; three books under contracts for 2007 with various publishers.

INVENTIONS
2006   Detection of Energetic Events in Multispectral Images. Patent application.
2004   Detection of Slow Moving Targets in SAR Images. Patent award.
1992   Maximum Likelihood Adaptive Neural System. Patent application.
1986   Magnetic Field Inhomogeneity Corrections in Fast MRI Systems. Patent application.

HONORS, AWARDS, BIOGRAPHICAL LISTINGS, PRESS INTERVIEWS
2006   Odessa, Ukraine, Culture Channel, TV interview.
2006   St. Petersburg, Culture Radio Station interview.
2005   Distinguished Member IEEE Award.
2004   National Public Radio interview.
2006   Scientific Achievement awards. AFRL.
2005   Scientific Achievement awards. AFRL.
2004   Scientific Achievement awards. AFRL.
2003   Scientific Achievement awards. AFRL.
2002   Scientific Achievement awards. AFRL.
2001   Scientific Achievement awards. AFRL.
2000   Moscow TV Culture channel interview.
1999   Hope Radio Station interview.
1997   Best Paper award. Nichols Research Corp.
1993   Outstanding Scientific Achievement award. Nichols Research Corp.
1993   Best Contributed Paper award. IEEE National Aerospace Electronics Conf., Dayton, OH.
1992   Patent of the Year award. Nichols Research Corp.
1990   Best Technical Paper of the Year award. Nichols Research Corp.
1988   Scientist of the Year award. Nichols Research Corp.
1984-2006 Who's Who.
1966-71 Outstanding Student Merit Scholarships, Novosibirsk University.
1964-6 Winner of the National High School Competitions in Physics.

GRANTS, CONTRACTS, PRORAM MANAGEMENT AND TECHNICAL LEADS
Program Manager for JFCOM COEUS Semantic Web program and multiple SBIR programs.
Technical Lead for AFOSR grants and Lab Tasks.
Winner of $10M competitive bids for research projects as Principal Investigator.
Winner of $30M competitive bids for research projects as Co-Principal Investigator.