



## Short Course on October 7, 2012

Title: **Signal Processing and System-on-Chip Designs for Ultrasonic Imaging Applications**

Instructors: **Jafar Saniie**, Department of Electrical and Computer Engineering at Illinois Institute of Technology, Ramazan Demirli, Center for Advanced Communications, Villanova University, Erdal Oruklu, Department of Electrical and Computer Engineering, Illinois Institute of Technology

### **Course Description**

In this short course, we present signal processing algorithms and system-on-chip designs for ultrasonic imaging applications. Topics includes (1) ultrasonic signal modeling and echo classification, (2) time-frequency analysis and split-spectrum processing, (3) order statistics and neural networks for flaw detection, (4) chirplet echo estimation, (5) detection and deconvolution using expectation-maximization and matching pursuit methods, (6) discrete wavelet transform for 3D ultrasonic data compression, and (7) system-on-chip implementation of detection, estimation, and compression algorithms using FPGA devices. This course will cover several case studies such as detecting defects in steam generator tubes used in nuclear power plants, transducer pulse-echo wavelet estimation, thickness sizing of thin layers, and flaw detection in large grained materials.

**Jafar Saniie**, IEEE Fellow for contributions to ultrasonic signal processing for detection, estimation and imaging, received his B.S. degree in Electrical Engineering from the University of Maryland in 1974. He received his M.S. degree in Biomedical Engineering in 1977 from Case Western Reserve University, Cleveland, OH, and his Ph.D. degree in Electrical Engineering in 1981 from Purdue University, West Lafayette, IN. In 1981 Dr. Saniie joined the Department of Applied Physics, University of Helsinki, Finland, to conduct research in photothermal and photoacoustic imaging. Since 1983 he has been with the Department of Electrical and Computer Engineering at Illinois Institute of Technology where he is the Filmer Professor, Director of the Embedded Computing and Signal Processing (ECASP) Research Laboratory, and Associate Chair and Director of the Graduate Program. Dr. Saniie's research interests and activities are in ultrasonic signal and image processing, statistical pattern recognition, estimation and detection, data compression, time-frequency analysis, embedded digital systems, digital signal processing with field programmable gate arrays, and ultrasonic nondestructive testing and imaging. Dr. Saniie has been a Technical Program Committee member of the IEEE Ultrasonics Symposium since 1987 (currently he is the chair of Sensors, NDE and Industrial Applications), Associate Editor of the IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control since 1994. He has over 230 publications and supervised 28 Ph.D. dissertations.

**Ramazan Demirli** received his M.S. and Ph.D. degrees in 1995 and 2000, respectively, both in Electrical Engineering from the Illinois Institute of Technology, Chicago, IL. From 2000 to 2010 Dr. Demirli has worked in the industry, first at BrainMedia, LLC., New York, NY, assuming a major role in the development of a proprietary audio codec, then at Canfield Scientific, Inc., Fairfield, NJ, as a senior scientist involved in the research and development of skin imaging systems and software. Since June 2010, he has been with the Center for Advanced Communications, Villanova University, Villanova, PA, where he is now a Research Assistant Professor and the Director of the Acoustics and Ultrasound Lab. He specializes in statistical signal processing with extensive emphasis on ultrasound signal modeling and parameter estimation. His research interests include acoustic signal processing, ultrasound imaging and nondestructive evaluation, and image processing. Dr. Demirli is a Senior Member of IEEE.

**Erdal Oruklu** received his B.S. degree in Electronics and Communications Engineering from the Technical University of Istanbul, Turkey in 1995, his M.S. degree in Electrical Engineering from the Bogazici University, Istanbul, Turkey in 1999 and his Ph.D. degree in Computer Engineering from the Illinois Institute of Technology,

Chicago, Illinois in 2005. He joined the Department of Electrical and Computer Engineering, Illinois Institute of Technology as an Assistant Professor in 2005 where he is the director of VLSI and SoC Design Research Laboratory. Dr. Oruklu's research interests are reconfigurable computing, advanced computer architectures, hardware/software co-design, embedded systems and high-speed computer arithmetic. In particular, he focuses on the research and development of system-on-chip (SoC) frameworks for FPGA and VLSI implementations of real-time ultrasonic detection, estimation and imaging applications. Dr. Oruklu has more than 85 technical publications. He is a senior member of IEEE.

**Conference website:** [http://ewh.ieee.org/conf/ius\\_2012](http://ewh.ieee.org/conf/ius_2012)

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