

Date: November 12, 2010
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Topic: Ultrasonic Signal Processing for Detection,
Estimation and Imaging



Abstract

In ultrasonic imaging systems, the patterns of detected echoes, often complex and non-stationary, correspond to the shape, size, and orientation of the reflectors and the scattering properties of the propagation path. Therefore, signal modeling and parameter estimation of the nonstationary ultrasonic echoes is critical for image analysis, target detection, object recognition, deconvolution and data compression. Here we present (1) modeling and classification of reverberant echoes, (2) time-frequency analysis and chirplet echo estimations, (3) statistical signal processing techniques based on split-spectrum processing for detecting flaw echoes masked by high grain scattering noise, and (4) system-on-chip realization of detection and estimation algorithms using reconfigurable FPGA devices. In particular, we present case studies such as detecting defects in steam generator tubes used in nuclear power plants, pulse-echo wavelet estimation, and flaw detection in large grained materials.

Biography

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 Chair 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, embedded digital systems, digital signal processing with field programmable gate arrays, and ultrasonic nondestructive testing and imaging. In particular, he has performed extensive work in the areas of frequency-diverse ultrasonic flaw enhancement techniques, ultrasonic data compression, ultrasonic imaging of reverberant multilayer structures, time-frequency analysis of ultrasonic signals, and applications of neural networks for detecting flaw echoes and classifying microstructural scattering. 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 200 publications and supervised 25 Ph.D. dissertations.