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Department of Electronic Engineering

SEMINAR

Time-reversal of Electromagnetic Signals based on Frequency-domain Approach

by

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Abstract:

Time-reversal technique is capable of focusing waves in space and time. Particularly, "time-reversal of acoustic signals" has been successfully implemented for underwater communication and sonar. However to date, no practical systems for "time-reversal of electromagnetic signals" have been reported; the major pertinent bottleneck is the expensive/bulky hardware required by time-reversing electromagnetic signals (whose frequencies are much higher than acoustic signals'). In order to resolve the high-cost difficulty, a novel frequency-domain architecture is proposed to time-reverse electromagnetic signals with low cost. It includes three steps: (i) "Fourier transformation," to obtain discrete spectrum of the input signal; (ii) "Digital signal processing," to carry out complex conjugate operation for the spectral samples obtained in Step (i); and (iii) "Inverse Fourier transformation," to synthesize the time-reversed signal using discrete continuous-wave elements. The proposed architecture is comprised solely of ordinary semi-conductor components like oscillators, multipliers/mixers, band-pass-filters, amplifiers, and switches. As a result, it embodies a compact and low-cost system-on-a-chip implementation. Some of the preliminary results will be demonstrated.

Biography:

Mingyu Lu received the B.S. and M.S. degrees in electrical engineering from Tsinghua University, Beijing, China, in 1995 and 1997 respectively, and the Ph.D. degree in electrical engineering from the University of Illinois at Urbana-Champaign in 2002. From 2002 to 2005, he was a postdoctoral research associate at the Electromagnetics Laboratory, University of Illinois at Urbana-Champaign. He was an assistant professor with the Department of Electrical Engineering, University of Texas at Arlington from 2005 to 2012. He joined the Department of Electrical and Computer Engineering, West Virginia University Institute of Technology in 2012 and he is currently an associate professor. His research interest includes wireless power transmission, radar systems, microwave remote sensing, antenna design, and computational electromagnetics. He was the recipient of the first prize award in the student paper competition of the IEEE International Antennas and Propagation Symposium, Boston, MA in 2001. He served as the chair of Antennas and Propagation Society of IEEE Fort Worth Chapter from 2006 to 2011.

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