University of Waterloo

Electromagnetics Seminar Series
Wednesday, September 17, 2014 @ 10:00 am
EIT Building, Room 3142

"As Time Goes By," Backwards!

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Hidden messages recorded backwards on a phonograph record could be deciphered by playing the record on a reversed turntable. However, the science and technology of playing sounds, or electromagnetic waves, backwards in time turns out to be far more interesting than any of those old backmasked messages on Beatles albums. Exploiting time-reversal invariance of the lossless wave equation leads to some surprising effects and is enabling remarkable new technologies. The forward/backward symmetry of wave propagation is exploited in a device known as a "time-reversal mirror." Such devices actually operate best under conditions where the waves are strongly and randomly scattered, making time-reversed wave propagation of great practical utility. Furthermore, the time-reversed waves can be made to collapse in a very brief time interval and in a very localized manner in space. I will give an overview of the science and technology of this remarkable symmetry of nature, including development of a new sensor paradigm for detecting changes in complex environments, directed wireless communication, and wireless power transfer.

Steven M. Anlage is a Professor of Physics and faculty affiliate of the Department of Electrical and Computer Engineering at the University of Maryland, College Park. He received his B.S. degree in Physics from Rensselaer Polytechnic Institute in 1982, and his M.S. and Ph.D. in Applied Physics from the California Institute of Technology in 1984 and 1988, respectively. His graduate work concerned the physics and materials properties of quasicrystals. His post-doctoral work with the Beasley-Geballe-Kapitulnik group at Stanford University (1987 - 1990) concentrated on high frequency properties of high temperature superconductors. In 1990 he was appointed Assistant Professor of Physics in the Center for Superconductivity Research at the University of Maryland, then Associate Professor in 1997 and Full Professor of Physics in 2002. He was the interim Director of the Center for Nanophysics and Advanced Materials (2007-2009), and is a member of the Maryland NanoCenter. In 2011 he was appointed a Research Professor at the DFG-Center for Functional Nanostructures at the Karlsruhe Institute of Technology in Germany. His research in high frequency superconductivity has addressed questions of the pairing state symmetry of the cuprate superconductors, the dynamics of conductivity fluctuations and vortices, and microwave applications such as superconducting negative index of refraction metamaterials. He has also developed and patented a near-field scanning microwave microscope for quantitative local measurements of electronic materials (dielectrics, semiconductors, metals, and superconductors) down to nanometer length scales. As part of this work he has developed a statistical prediction model for effects of high-power microwave signals on electronics. With a former student he has also patented a method to distinguish nominally identical objects using concepts from wave chaos.

Please contact Professor Omar M. Ramahi (oramahi@uwaterloo.ca) with any questions concerning this or any other Electromagnetics Series seminars.