

## Electromagnetic Super-resolution Time-reversal Nulling

**D. D. Stancil, A. G. Cepni, B. E. Henty  
Y. Jiang, Y. Wei, J.-G. Zhu, and J. M. F. Moura**  
Carnegie Mellon University, USA

A novel approach to exploiting multipath for communications and radar detection is time-reversal focusing. In this approach, the multipath is used to focus RF energy on a desired receiver or radar target. In a rich multipath environment, the energy can be focused onto a region roughly the size of  $1/2$  wavelength even if a line-of-sight is not present.

With suitable modifications to the time-reversed signals, it is possible to create a situation where the multiple paths interfere destructively at a desired location, resulting in a null rather than a focused spot. This technique can be useful for removing the effects of extraneous clutter in radar applications, or to minimize interference to an unintended receiver in communications applications.

In this talk we describe recent experiments in which we have demonstrated time-reversal nulling in both the frequency and time domains, and applied the technique to enhancing the detection of changes in an environment probed by radar. Two types of experiments are presented. The first type consists of frequency domain experiments using multiple antennas or synthetic aperture arrays, and involve bandwidths of up to 2 GHz. These experiments are performed in an open laboratory environment with controlled amounts of clutter. The second type consists of experiments performed in the time domain using a reverberant cavity formed by sections of HVAC duct capped on both ends. These experiments use single transmit and receive antennas and bandwidths up to 36 MHz.