Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Focusing Waves at Arbitrary Locations in a Ray-Chaotic Enclosure Using Time-Reversed Synthetic Sonas[1] STEVEN ANLAGE, BO XIAO, THOMAS ANTONSEN, EDWARD OTT, Physics and ECE Departments, University of Maryland — Time reversal mirrors have been widely used to achieve wave focusing in wave-chaotic acoustic and electromagnetic enclosures. A typical time reversal experiment requires that a transmitter be initially present at the target focusing point, which limits the application of this technique. In this presentation, we propose a method to focus waves at an arbitrary location inside a complex (wave chaotic) enclosure using a numerically calculated wave signal. We use a semi-classical ray algorithm to calculate the signal that would be received at a transceiver port resulting from the injection of a short pulse at the desired target location. This pre-calculated signal is then time-reversed and sent into the enclosure by the transceiver, resulting in a time reversed short pulse at the focusing point. Since a physical wave source is not required at the target point, one can focus a signal at any desired location given knowledge of the ray propagation paths. Three parameters are used to quantify reconstruction quality, the peak-to-peak voltage, focus ratio, and energy transfer ratio. It is shown that the values of these quality metrics can be predicted by the statistics of the scattering-parameter |S_21|^2 between the transceiver and target points in the enclosure. We experimentally demonstrate the method using a flat microwave billiard and quantify the reconstruction quality as a function of enclosure loss, port coupling and other considerations.

[1]This work is funded by the ONR under Grant No. N00014130474,

Steven Anlage
Physics and ECE Departments, University of Maryland

Date submitted: 12 Nov 2014 Electronic form version 1.4