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Modeling time-reversal focusing in a multiple scattering medium

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Time-reversal acoustics has been shown to be effective at focusing sound through high-order multiple-scattering media. In addition to signals being refocused, large amplitudes via pulse compression have also been observed. Previously, a statistical model was developed to simulate a time-reversal experiment where an impulse is sent into the scattering medium and the entire response is time-reversed [A. Derode et al., J. App. Phys. 85, 6343-6352 (1999)]. The high-order multiple-scattering process is modeled as a shot noise process. Again postulating a shot noise process the model has been extended to allow for arbitrary input functions and arbitrary windowing before time-reversal. The model has been shown to accurately predict the variance and expectation value of ensembles of simulated data. The analytical model is also tied directly to the governing physical processes, which is useful in attempting to optimize refocused signals. This extension is motivated by a desire to achieve high-amplitude long-pulse focusing, as would be useful in thermal therapies and radiation force experiments. However, the model can find application beyond this specific end-point. The model, it's physical implications, and several time-reversal simulations will be presented.