Time-reversal techniques applied to communications through unknown obscuring medium

There have been increasing interests in time-reversal techniques, particularly as applied to imaging of objects including eigenmodes, DORT, and stochastic considerations. This paper is concerned with an application of the time-reversal technique to communication through unknown environment and presents a theoretical basis applicable to discrete as well as continuous transmitting and receiving elements in unknown medium. Transmitter consists of N elements array and receiver consists of M element array. The transfer matrix Kmn can be measured even though the medium may be unknown. Using this transfer matrix, the time-reversal transfer matrix will be formed, and its eigenvectors and eigenvalues can be calculated. The transmission efficiency is shown to be equal to eigenvalues and therefore the maximum transmission is achieved by using the eigenvector for the largest eigenvalue. This formulation can be applied to continuous transmitter and receiver elements. This leads to the eigenvalue problem of homogeneous Fredholm integral equation of the second kind. This general formulation can also be applied to communication through random medium with stochastic transfer function and stochastic averages of the power transfer.