

Underwater Acoustic Communication Simulation and Optimization Using Retro-Focusing

LT Daniel Wang, USN

Dr. Milica M. Stojanovic	Prof. Arthur B. Baggeroer
Thesis Supervisor	Thesis Reader

High data-rate communication can be achieved using transmitter/receiver arrays that communicate through underwater acoustic channels. Such channels can be characterized as rapidly time-varying systems that suffer severe time-varying Inter Symbol Interferences (ISI) due to multi-path propagation and the Doppler Effect. Multi-channel combining and equalization, as well as time-reversal techniques have been tested and proven to be able to reduce the effect of ISI. As an alternative, a retro-focusing technique had been proposed to optimize ISI elimination while reducing computational complexity. Retro-focusing imposes focusing on time-reversal technique thus insure no ISI condition in received signal.

The investigation of the retro-focusing techniques involves analytical work and simulation using MATLAB. Analytically, underwater acoustic channels are modeled using geometrical representations of several paths in channels and documented water column physical characteristics. In addition, Rayleigh and Ricean fading are incorporated to model stochastically varying medium physical characteristics. The analytical model is then constructed in MATLAB code for transmitter, channels and receiver in both uplink and downlink directions. Simulations using Retro-focusing and regular time-reversal techniques are conducted and results compared and documented.