Faculty of Electrical Engineering & Computer Science
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City University of Applied Sciences

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Salauddin

On Channel Identification for Underwater Acoustic Communication Applications.

ABSTRACT - Masterthesis

Underwater reliable communication offers numerous advantageous applications, like for oceanographers, marine researchers, offshore oil production, submarine for defense organizations and many more. As a communication information carrier, electromagnetic wave propagation attenuated by high absorption and optical transmission suffers from heavy scattering in underwater channel. Indeed, in underwater communication, acoustic signal is the best option for transmitting and receiving information till dated.

In this thesis, installed underwater pipe channel in acoustic laboratory at Hochschule Bremen Germany has been identified for acoustic signal communication. Further, conventional method of measuring impulse response with test Linear Frequency modulated "LFM" signal and Aoshima's Time-Stretched Pulse "ATSP" also, Optimum Aoshima's Time-Stretched Pulse "OATSP" that is, the optimized version of ATSP are modeled as test pulses. In addition, these three test pulses have been generated using a signal generator device to estimate the impulse response of underwater tube channel. Before taking underwater channel measurements, impulse response measurement method with these test pulses are verified on simulation platform, by evaluating impulse response of Matlab "fdatool" designed filters. For real time measurement validation, frequency response of practical filters those are present at acoustic laboratory have been measured.

Moreover, using image source method, a multi-path underwater channel approximation has designed for first the four contributions of spherical sound wave propagation from source to receiver. In continuation, a linear Zero Forcing "ZF" channel equalizer has been applied to remove all Inter Symbol Interference "ISI" present in the received pulse due to multi-path propagation inside water. Thereby, the test signal is successfully reproduced at receiver, after transmitting the test pulse over underwater channel and ZF equalizer. In addition, as per test signal's theoretical development, simulation results and determined channel identification results, it has been concluded that better Signal-to-Noise-Ratio is achieved by applying test pulse OATSP.