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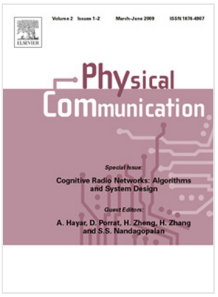

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MIMO-OFDM Underwater Acoustic Communication Systems– A Review

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Abstract

The ever increasing demand for bandwidth, efficiency, spatial diversity and performance of underwater acoustic (UWA) communication has opened doors for the use of Multi-Input Multi-Output (MIMO). A combination of MIMO and Orthogonal Frequency Division Multiplexing (OFDM) has proved to be a promising solution for many scenarios in UWA communication; on the contrary, it also amplifies the design challenges for implementing such schemes to acquire the required bandwidth efficiency. The goal of this study is to provide a comprehensive survey of the latest researches in the field of UWA MIMO-OFDM communication. The previous works are summarized, reviewed and compared according to their years of publication while problems faced by UWA MIMO-OFDM communication are highlighted. The articles are classified according to the focused techniques like channel estimation, equalization, coding and detection. Furthermore the works are compared based on the complexity and performance of the algorithms while some future research issues are identified.

Keywords: Underwater Acoustic Communication; MIMO-OFDM; Channel Estimation; Coding; Detection.

1. Introduction

Electromagnetic and optical waves propagate poorly in sea water which leaves acoustic signaling as the only viable option for long-range underwater communication. Underwater acoustic (UWA) channel is unique, compared to radio communication channels, because of many distinctive features, where limited bandwidth has been the most significant one which drives the algorithm designs for UWA communication [1]. Multiple-Input Multiple-Output Orthogonal Frequency Division Multiplexing (MIMO-OFDM) solves the limited bandwidth problem to some extent but making multipath as the most prominent concern to be taken care of while designing a UWA communication model, as MIMO communication has multiple channels between transmitters and receivers with each signal containing data from all the transmitters and thus simultaneous estimation of all the channels is required [2].

MIMO-OFDM in underwater acoustics is relatively a new research field. Though in radio communication networks, MIMO-OFDM had been used since last 2 decades but in underwater communication networks, it has been introduced in recent past and researchers have proposed many different transmission schemes to improve data rates and reduce bit error rates. Though MIMO-OFDM has numerous benefits however the challenges being faced while implementing such systems are also crucial, which makes MIMO-OFDM system design an intricate job [3, 4].

OFDM is considered as a low-complexity alternative to single-carrier modulation for the next generation of acoustic modems. To mitigate the bandwidth limitation, the use of multicarrier modulation is introduced in the UWA communication, which puts an end to the long-time delays in underwater acoustic channels. OFDM is a promising multi-carrier transmission scheme because of its robustness against multipath,

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