WUWNet Presentation Script

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Good afternoon everyone. Today I’m presenting this paper on behalf of the authors, who could not make it to the conference because of visa problem. If you have any question, please contact the authors directly.

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In underwater communication, narrowband interference in the environment include both neutral and hostile types and may severely affect information transmitted on OFDM subcarriers. TDS-OFDM is a transmission scheme that uses PN sequence as guard interval and can achieve high spectral efficiency. The PN sequence can be used for channel estimation and NBI estimation. IM-OFDM is an index-modulation scheme that convey information by both QAM symbols and active subcarrier indices. Although it has been proposed in underwater acoustic communication, it may be more susceptible to NBI and demands effective cancellation. In this work, the authors propose a compressed-sensing based NBI estimation algorithm for dual-PN-padded TDS-OFDM system in underwater acoustic communication. They also derive the NBI and IBI cancellation process for payload reconstruction. Lastly, they evaluate the performance for IM-OFDM scheme.

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The first figure shows the dual-PN-padded TDS-OFDM frame structure, where two identical PN sequences come before the data block, and the shaded triangles represent the length-L inter-block interference caused by the multipath channel. The second figure is the receiver structure. The received PN is used for both channel estimation and NBI estimation. The NBI and IBI are then eliminated from the received signal to recover payload. Finally symbol detection is conducted.

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The frequency domain NBI signal is modeled as K sources on the N subcarriers with the support set denoted by Omega. A time domain correlation property is assumed, which means that NBI has fixed support and amplitude across several frames. This is because NBI usually changes much more slowly than data frames. Besides, if the channel impulse response has a length L shorter than M, then the second PN will have no IBI, and the differential of two consecutive frames will only have an interference term and a noise term. Therefore, the estimation problem can be solved by compressed sensing.

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The proposed algorithm is called initialization-enhanced sparsity-adaptive subspace pursuit. Although sparsity K is unknown, a trial from 0 sparsity will be too complicated, so the support is initialized as follows. The differentials are aggregated in the frequency domain to enhance inference-to-noise ratio, and then the peaks are located to form the initial support.

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Then CS algorithm is conducted. The algorithm has an outer loop for sparsity adaption, and an inner loop for iterative estimation. It ensures a decreasing residue and terminates iteration promptly.

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Then NBI and IBI are eliminated with some simple addition and subtraction calculation, making use of the PN sequence again.

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Finally, a Maximum-Likelihood detector is adopted for symbol detection. The IM-OFDM scheme with group interleaving is shown in the figure. Note that the subcarrier and symbol combination for each group in the OFDM block needs to be detected.

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We investigate the following questions: is IM-OFDM more susceptible to NBI? And is NBI cancellation more effective for IM-OFDM? Simulation results show that there is indeed a greater gap between no cancellation and perfect cancellation performance for IM-OFDM. Moreover, the proposed method also provides greater enhancement for IM-OFDM, which is about 6 dB in high SNR region shown by the red lines.

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These are the references.

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For any question, please contact the author Mr. Zhang. Thank you very much.