CONIC

Carrier Optimization for Noisy and Interference Channels

EE3701- COMMUNICATION SYSTEMS LAB

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REFERENCES

- **A Channel-Aware Adaptive Modem for Underwater Acoustic Communications**- S. Mangione, G. E. Galioto, D. Croce, I. Tinnirello and C. Petrioli.
- **Prediction-based Adaptation (PRADA) Algorithm for Modulation and Coding**- Shou-Pon Lin, Jhesyong Jiang, Wei-Ting Lin, Ping-Cheng Yeh, Hsuan-Jung Su

PS

P1

Implement OFDM and tune for different media

Need to tune the OFDM parameters to match different acoustic media. The idea is to come up with a self sustaining mechanism which then automatically changes some parameters, say padding length.

P2

Create a simulation tool for waves

For checking funcitoning of P1 across different media, we need data points, which we will generate by simulating the media. Aim to do basic sim interface, not accounting for interfaces.

P3

Implement Channel Estimation

Need to create ML based Channel estimation, and create metrics to encode in CSI, and implement a backwards control path

P4

Reduce feedback frequency

To minimise the power consumption, we can use ML based methods to figure out the least number of times we transmit the CSI / update the modulation while keeping the SNR Optimal.

P5

Implementation on SDR/USRP

Finally, we will implement this on an hardware peripheral, for the final presentation.

P6

Testing and Validation

The hardware will be tested against real-time inputs and the outputs will be validated. Relevant changes will be made to improve the performance of the device.

W1-2

Foundation & Literature Review

Weeks 1-2

- Study OFDM fundamentals and underwater acoustics
- Deep dive into the original paper
- Set up MATLAB/Python development environment
- Research multi-medium acoustic propagation

W5-6

Adaptive Modem Core

Weeks 5-6

Implement adaptive rate and power control

Channel quality assessment algorithms

JANUS standard integration

Performance optimization

Risk Assessment

Potential Challenges

Technical Risks

Complex Channel Modeling

Risk: Difficulty in accurately modeling different acoustic mediums
Possible Solution: Start with simplified models, use existing literature, implement incrementally

Real-time Processing Requirements

Risk: Computational complexity may exceed available processing power
Possible Solution: Try to implement proof-of-concept w/o real time, and optimise later.

Limited Validation Data

Risk: Lack of real-world data for some acoustic mediums
Possible Solution: Rely on simulation framework

Timeline Risks

Learning Curve

Risk: Steep learning curve for communication systems concepts
Possible Solution: Weeks 1-4 spent for studying properly about what we are implementing.

Implementation Complexity

Risk: Underestimating implementation time for adaptive algorithms
Mitigation: Build incrementally, focus on core functionality first, have backup simplified versions

Contingency Plan

If full multi-medium implementation proves too ambitious, focus on perfecting one additional medium (air acoustics) with comprehensive analysis and comparison to underwater scenario.