ECE 5961/6961 Course Project Part I Requirements

Task 1: Understand the basics of CP-OFDM and ZP-OFDM:

- Write Matlab codes to implement the baseband discrete-time OFDM transmitter and receiver. Assume general parameters where M is the number of subcarriers, and N is the number of OFDM symbols. You need to implement both CP-OFDM and ZP-OFDM.
- Test the correctness of your codes by the following
  - Generate a sequence of $N \cdot M$ QPSK information symbols $\tilde{\mathbf{d}}$ in the frequency domain, where $M = 16$ is the number of subcarriers, and $N = 4$ is the number of OFDM symbols.
  - Consider a stationary channel given by $h = [0.227\ 0.46\ 0.688\ 0.46\ 0.227]$ with $L = 5$ taps. Transmit $N = 4$ OFDM symbols over this channel to generate the received sequence in the time domain $\mathbf{y}$ and then convert it to the frequency domain to obtain $\tilde{\mathbf{y}}$. Apply the one-tap equalizer in the frequency domain to recover the transmitted symbols $\tilde{\mathbf{d}}$. Make sure that the recovered symbols are identical to the original symbols. You need to do this for both CP-OFDM and ZP-OFDM to verify the correctness of your codes.

Task 2: Underwater data generation and validation

- Follow the steps 1-7 shown in the file underwater_data_gen.pdf to generate passband data for the ZP-OFDM underwater transmission.
- Plot and compare the Fast Fourier Transform of the signal before and after Step 5. After Step 5, is the signal spectrum band-limited to -4k Hz and +4k Hz? If not, explain why.
- Use Matlab "spectrogram" function to show the spectrogram of the transmitted signal after step 7.
- In the absence of an actual underwater channel, follow Step 8 in underwater_data_gen.pdf to validate that the recovered frequency domain symbols are the same as the transmitted symbols.

Project Part I Check off

Our project TA Xiang Huang will meet each team individually for project part I check off. The deadline for project I check off is **Tuesday, Feb. 20th**. However, each team is strongly encouraged to do a **preliminary check off** with Xiang during the week of Feb. 12th to ensure that if something is incorrect, there will be enough time for code corrections and final project check off by Feb. 20th . We encourage in-person meetings for project check off and all team members should be present for the meeting.

Each team will send one copy of the Matlab codes to Xiang prior to the meeting. During the check off, Xiang will do the following.

- Ask you questions about the fundamental principles of CP-OFDM and ZP-OFDM. Ask you to explain the functionality of your Matlab codes.
- Ask you to run your codes to make sure that the outputs are correct.
- Ask you to explain the meaning of the figures or the results that you generated.

  Attention: While you are encouraged to contact Xiang for questions or to double check the accuracy of the results, please do your best to work with your team members to debug your team's Matlab codes. It would overload Xiang if every team asks Xiang to help with debugging. Thank you for your understanding and happy coding!