**Faculty of Engineering**

**Electrical and Computer Engineering Department | Communication Systems, ENEE3309**

**Course Project |7/12/2024**

**Project Outline: Using ADALM-Pluto for Monotone and Audio Signal Transmission/Reception with the help of ChatGPT (LSSB)**

This project provides students with hands-on experience using the ADALM-Pluto SDR and software like GNU Radio or MATLAB to implement communication systems. The aim is to design, tune, and analyze a system capable of transmitting and receiving monotone and audio signals. Students will document their work in IEEE paper format.

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**Project Workflow**

**1. Introduction and Background**

- Overview of Software-Defined Radio (SDR) and ADALM-Pluto.
- Basics of AM modulation and demodulation.
- Signal characteristics: monotone signal vs. audio signal.

**2. Objectives**

- Design and simulate a communication system in GNU Radio or MATLAB.
- Transmit and receive monotone and audio signals.
- Fine-tune system parameters for optimal performance.
- Document results and findings in IEEE format.

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**3. System Requirements**

- **Hardware**: ADALM-Pluto SDR
- **Software**:
  - GNU Radio (preferred for flexibility).
  - MATLAB (optional, for additional exercises or comparison).
- **Prerequisites**:
  - Familiarity with modulation techniques.
  - Basic knowledge of SDR concepts.

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**4. Tasks**

**Task 1: Monotone Signal Transmission**

1. Generate a monotone signal (e.g., 1 kHz sine wave).

2. Modulate the signal using the **LSSB modulation**
3. Transmit using ADALM-Pluto.
4. Receive and demodulate the signal to recover the original tone.
5. Visualize the transmitted and received signals using QT GUI in GNU Radio or plots in MATLAB.

**Task 2: Audio Signal Transmission**

1. Capture an audio signal using a microphone or pre-recorded file.
2. Resample and modulate the audio signal.
3. Transmit the modulated signal using ADALM-Pluto.
4. Receive and demodulate to recover the audio signal.
5. Play the recovered audio using the computer's audio output.

**Task 3: Parameter Tuning**

1. Optimize transmit power and receiver gain for clear signal reception.
2. Fine-tune low-pass filter cutoff and transition width to minimize noise.
3. Document how changes in parameters affect system performance.

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**5. Documentation and Deliverables**

**Block Diagrams**

- Include detailed diagrams of the transmitter and receiver flowgraphs.
- Explain the purpose of each block and its configurations.

**Results**

- Spectral analysis of transmitted and received signals.
- Screenshots of GNU Radio/MATLAB outputs.
- Audio quality evaluation (subjective and quantitative metrics).

**IEEE Paper**

Students must write a paper in IEEE format with the following sections:

1. **Abstract**: Summarize the project and findings.
2. **Introduction**: Explain the problem, objectives, and tools used.
3. **System Design**: Detail monotone and audio signals' flowgraph/block diagram.
4. **Experiments and Results**: Present findings with visual aids.
5. **Conclusion**: Discuss results and propose future improvements.
6. **References**: Cite relevant resources (e.g., GNU Radio guides, SDR papers).

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**Evaluation Criteria**

- **Design (40%)**: Correctness of flowgraphs/block diagrams.
- **Implementation (30%)**: Successful signal transmission and reception.
- **Documentation (20%)**: Clarity and completeness of the IEEE paper.
- **Tuning (10%)**: Effectiveness of parameter optimization.