

# Digital Signal Processing Course - Matlab Project

*Deadline: December 29*

*23:59 – 1403/10/09*

---

## Project Overview

In this engaging and practical DSP assignment, you will harness Matlab to process a critical speech recording that's been marred by sinusoidal noises from a siren. The project simulates a real-world scenario where DSP techniques are vital in extracting usable information from corrupted audio data. Your task will combine theoretical knowledge with practical application to eliminate the unwanted noise and retrieve the original speech.

## Evaluation Criteria

Each submission will undergo a detailed review, focusing on the efficacy of the noise removal, the innovativeness of the approach, and the clarity of documentation. Standout projects will not only demonstrate technical proficiency but also creativity and critical thinking.

## Project Steps

### 1. Data Acquisition and Initial Listening

- Use the provided 'projectDSP.wav' file
- Utilize Matlab to load (`wavread('projectDSP')`) and play (`wavplay(x, Fs)`) the file, getting a sense of the noise characteristics.
- Pay attention to parameters like 'Fs' (sampling rate), 'Nbits' (bit depth), and 'x' (the signal array), as they will be crucial in your processing.

### 2. Spectrum Analysis

- Implement a Discrete Fourier Transform (DFT) to reveal the frequency content of the signal.
- Carefully examine the magnitude spectrum to identify the siren noise frequencies. Look for unusually high peaks that represent the sinusoidal interference.

### 3. Filter Design

- Design a suitable FIR filter to target and eliminate the identified noise frequencies. ( NOTE: Compare result of different Filters and windowing techniques and finally come up with the best design.)
- Document your design process, explaining the choice of filter order, the FIR design method used, and the rationale behind your decisions.

#### 4. Frequency Response Analysis

- Accurately compute and illustrate the frequency response of your filter. This should include both magnitude and phase response plots.
- Analyze how your filter will alter different frequency components of the signal.

#### 5. Signal Processing

- Use Matlab's convolution function (`conv`) to apply your filter to the signal.
- Experiment with different post-processing techniques like scaling and truncation to refine the audio quality.
- Assess the effectiveness of your processing by listening to the output and comparing it to the original.

#### 6. Documentation

- Compose a comprehensive report detailing each step of your process, from analysis to processing.
- Include Matlab scripts, plots, and any supplementary materials that demonstrate your methodology and results.

### Submission Instructions

- Compile your report, scripts, and the processed audio file (named as 'LastName-StudentNo.zip').
- Email these documents in the specified formats to [alirezasalahshor.2001@gmail.com](mailto:alirezasalahshor.2001@gmail.com) by the deadline.

**Reminder:** This project is an opportunity to apply your DSP knowledge creatively. Experiment with various approaches, analyze their effectiveness, and learn from the process. Good luck and have fun with the assignment!