EEC 201: Final Project Interim Report

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Project Objective

The goal is to design and implement an LPC vocoder and synthesizer in Matlab with a GUI. The GUI should be able to record audio data, analyze the spectral content of the data, and synthesize an estimate of the original audio data.
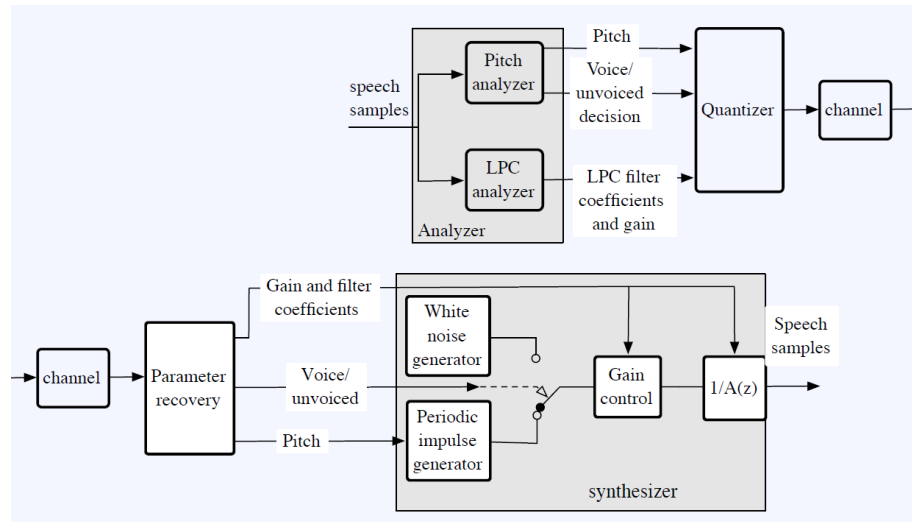
Figure 1: Block diagram for analyzer and synthesizer to be constructed in this project.

Project Tasks

- Make Initial Version of GUI

- Implement recording/playback

- Generate spectrogram of recorded signal

- Implement analyzer with following elements:
    - Pitch analyzer
    - Linear Predictive Coding (LPC) Analyzer

- Implement saving of analyzed signals

- Implement parameter recovery module with following outputs:
    - Pitch estimation (implement two different methods)
    - Voiced/unvoiced
    - Gain/filter coefficients

- Implement synthesizer with parameter recover module values as input

Methodologies

- **Linear Predictive Coding (LPC)**: (2) details a methodology for fixing the coefficients for the autoregressive filter involved in LPC. Figure 1 from the Lecture 7 notes places the LPC analyzer in the context of the architecture of the overall system.

- **Pitch estimation:** To implement two different methods of pitch estimation, two differently sized windows can be used to generate the spectrogram of the signal to be synthesized. Chapter 10 of (1) details the effects of using different window sizes when using the STFT to generate spectrograms.
    - **Large window**: increase in frequency resolution with a decrease in temporal resolution
    - **Small window**: increase in temporal resolution with a decrease in frequency resolution

Division of Labor

Task	Abhinav	Mason
GUI	50%	50%
Spectrogram	75%	25%
Analyzer	25%	75%
Synthesizer	50%	50%
Write Final Report	50%	50%

Milestones/Schedule/Goals

- **February 23**: Initial version of GUI with audio recording capabilities (**Complete**)

- **March 1**: Spectrogram generation (**Complete**)

- **March 8th**: Synthesizer elements finalized

- **March 15th**: Analyzer elements finalized

Preliminary Results

Figure 2 shows the current GUI prototype. The GUI records audio data continuously while the "Record" button is pressed, and the recorded audio can be played back using the "Play" button.

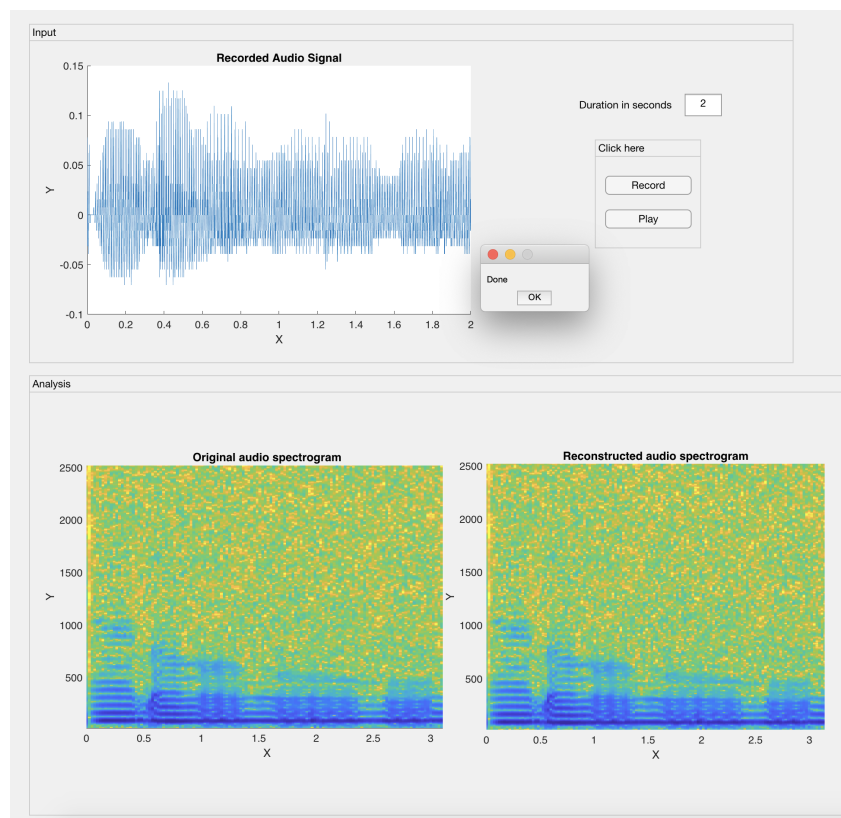

Figure 2: First version of GUI, which is capable of recording and playing-back audio signals.

References

Oppenheim, A., & Schafer, R. (2010). *Disrete-time signal processing* (3rd ed.). Upper Saddle River, NJ: Pearson Higher Education, Inc.

Ozun, O., Seurer, P., & Thell, D. (2002, December). Wideband speech coding with linear predictive coding (lpc).