Vocoder Project B Presentation 1

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Objectives

Design and implement the following:

- Generate a spectrogram from a recorded voice
- Generate a file for the recorded voice by passing through a LPC vocoder
- Recover the speech from the file using a synthesiser
- Compare the synthesiser output with the original signal
- Estimate the pitch using two different approaches

Objectives (contd)

The designed vocoder must be able to do the following:

- Encode and decode at different code rates
- Convert a male voice to a female voice and vice versa

Research

- **Cepstrum Pitch Determination, (1967).** A Michael Noll - A paper with fundamental design concepts and techniques about Cepstrum Pitch Detection.
- **Pitch Detection Algorithm: Autocorrelation Method and AMDF, (2003),** Li Tan and Montri Karnjanadecha, - A paper about pitch tracking techniques using autocorrelation method and Average Magnitude Detection Function to extract the pitch pattern.
- **On the Use of Autocorrelation Analysis for Pitch Detection, (1977)**, Lawrence R. Rabiner - Another paper describing types of autocorrelation to determine the pitch of a speech signal
- **Wideband Speech Coding with Linear Predictive Coding (LPC), 2002**. Abeer Alwan, Ozgu Ozun, Philipp Steurer, Daniel Thell. - A project carried out at University of California, Los Angeles for the department of Electrical Engineering. Interesting in that it gives a sense of how another group approached this same design and can offer insights into our own design. They also have some examples of MATLAB script. While we will write our own, it can be helpful to see how another group approached the same problems that may come up.

Research

- **Voice Excited Lpc for Speech Compression by V/Uv Classification**, (2016) Veena T K , Dr. D. Geetha https://pdfs.semanticscholar.org/29b4/5bb323a5b34d07373c688e960291f0ff0686.pdf
- **Voice and Unvoice Decision**, (from Rice, no author, no date) https://www.clear.rice.edu/elec532/PROJECTS00/vocode/uv/uvdet.html
- **Separation of Voiced and Unvoiced using Zero crossing rate and Energy of the Speech Signal,** Bachu R.G., Kopparthi S., Adapa B., Barkana B.D. https://www.asee.org/documents/zones/zone1/2008/student/ASEE12008_0044_paper.pdf
- **An Introduction to the Phase Vocoder , 1975.** Gordon, J. W. , and J. Strawn - Although not directly related to LPC-vocoders, reading about phase vocoders gives an alternate approach, providing insights into how speech can be synthesized.

Research

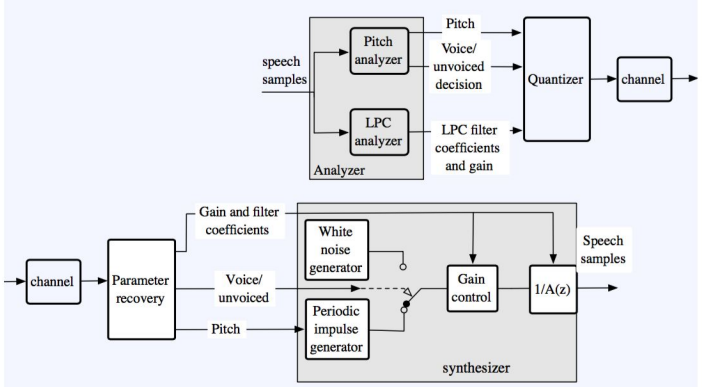
- **Efficient codebook search for CELP vocoders, 1991** (US Patent). William C. Yip, David L. - We won't implement this vocoder, but it is a design that improves the fidelity as compared to the LPC that we are designing.
- **Linear Predictive Coding LPC-10 VoCoder** - Term Project -ECE 252A- speech Compression, Winter 2017 UCSD - An interesting handbook on the components of an LPC and how they can be implemented

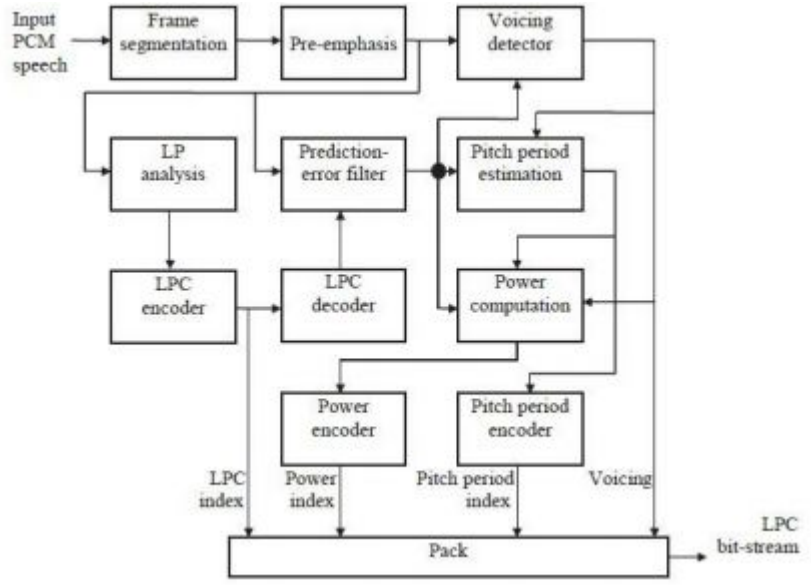
Adopted Methods

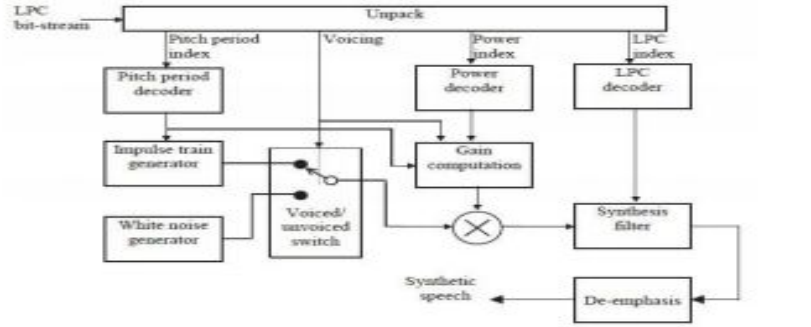
- Generated spectrogram of a recorded signal using spectrogram command in Matlab
- Will be using autocorrelation and Cepstrum analysis to detect the pitch of the recorded signal
- GUI is created using App Designer in MATLAB
- zero-crossing to find voice and unvoiced parts of the speech.
- Altering male to female – altering the quefrencies by adding (male to female) or subtracting (female to male)

Tasks to complete

- Fine tune the pitch detection algorithms.
- Implement the different blocks of the LPC: pre-emphasis filter, voicing detectors, generating LPC filter coefficients.







Demonstrations

Milestones

- Generate a spectrogram - by 28 Feb, 2019 (completed)
- Determine the Pitch using Autocorrelation - by 1 March, 2019 (Incomplete)
- Determine the pitch using Cepstrum Analysis - (completed)
- Design the LPC Analyser - by 3 March, 2019 (Incomplete)
- Design the Quantizer - by 6 March. 2019
- Design the Synthesizer - by 8 March, 2019

Milestones

- Build a GUI for all the functions - by 10 March, 2019
- Test out if everything works in conjunction to each other - by 12 March,2019
- Correct if something is not working properly - by 15 March, 2019 (Optional)
- Final tests - 14 and 15 March, 2019

Group member task division

- Anupam Mohanti - Spectrogram, Pitch detection using Autocorrelation function, LPC Analyser, Synthesizer, GUI
- Mark Allen-Piccolo - Spectrogram, Pitch detection using Autocorrelation function, LPC Analyser, Synthesizer, GUI, updating website

We will share the tasks and delineate depending on what is needed.

Problems

Our autocorrelation algorithm fails to generate the correct pitch.

We haven’t figured out how to implement the cepstrum algorithm yet.

Combining LPC coefficients and pitch coefficients.