REAL TIME IMPLEMENTATION OF SIGNAL PROCESSING ALGORITHMS WRITTEN IN MATLAB ON ANDROID SMARTPHONE

Project Report

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Introduction

The objective of this project is to implement the signal processing algorithms by generating signals during run time of the code and verify the results obtained with MATLAB and achieve a real-time implementation of the basic signal processing algorithms of convolution, Fourier series, Fourier transform, and Discrete Fourier Transform that are written in MATLAB. MATLAB Codes for the above algorithms were taken from the book "An Interactive Approach to Signals and Systems Lab". These codes were modified according to the requirement of the project, for real time implementation each frame of the signal was sent at a time for processing and for 'offline' part of project MATLAB codes were called from script passing and returning required parameters. Then tool from Math works called 'MATLAB coder' was used to convert MATLAB codes to C language codes. Now making appropriate modifications to C code and using the smartphone shells, written in java apps were created to run on smart phone platform in real time. Xml and java coding was done to implement interactive graphical user interface on smartphone. GUI is used to change i/o parameters and graphical displays. Android plot website tutorial is used to draw graph for the results obtained from the shell. Real time apps are capable enough to run for both microphone input and audio files saved in smartphone. With debugging options, values can be stored in text files for verification.

List of algorithms implemented (offline)

1. L3_1 - Convolution property.
2. L3_2 - Convolution between input and impulse function
3. L3_3 – Convolution of two input functions
4. L3_4 – convolution properties
5. L3_5 – convolution for electrical circuits.
6. L4_1 – Fourier series
7. L4_2 – Fourier series for electrical circuits.
8. L5_1 – FS/DFT
9. L5_2 – Modulation and demodulation techniques.
10. L6_1 – Quantization
11. L6_2 - DFT/DTFT
12. DTMF Encoder
13. Echo cancellation

14. Doppler Effect
15. Music synthesis

For the above algorithms signal were generated during the run of the code, hence they are called offline, not real time. For real time I have implemented the following. (Real time)

1. L3_2
2. L3_3
3. L3_4
4. L3_5

For remaining real time implementation, was more or less like computation for each frame instead of the whole signal, without worrying about the results. For chapter 3 problem 1, signal was generated in the code hence real time cannot be implemented, and for fourth chapter, we don't know whether input from the microphone is periodic or not, hence application of fourier series was problem. Same goes with the exercise problem, in music synthesis we need to take 6 inputs of data to generate music for real time. So I had to skip those whose real time implementation is a merely each frame computation.

Conclusion

After working on real time implementation, I understood overlap-save algorithm implementation in c language to get the proper result. I now appreciate the importance of sampling rate and frame size to keep up with the real time processing. I understood frame based processing, and implementation without it. For offline part, I can see the practical implementation of signal processing algorithms, change parameters and play with them. Also I have acquired little knowledge about the android app development and appreciate DSP mobile laboratory.