EE442/EE592 Real-Time Digital Signal Processing
Final Project Proposal Due: 5:00pm, Friday, April 8
Final Project Due: 5:00pm, Friday, April 29

The final project for EE442/EE592 is to be chosen by the student and implemented on the TI TMS320C6416DSK. Components of the final project include project proposal, project codes, and presentation.

Project Suggestions

Although we prefer students come up with their own topics for a final project, attached are some ideas for the final project. Should you wish to use one of these ideas, please notify Prof. De Leon immediately as these are only approved on a first come, first served basis. No two final projects should be the same. Finally, the adaptive notch filter or adaptive line enhancer in the textbook may not be used as a final project.

Grading

The final project proposal, presentation, code are worth 2%, 5%, 20% respectively of the final grade.

Proposal

The proposal will be graded on how well the final project idea is elucidated. This includes background theory, algorithm, MATLAB simulation results, and references. In addition, perceived difficulties and risks should be described. Based on the proposal, the project difficulty will be estimated on a scale of 1 (easy) to 5 (difficult).

Presentation

Final project presentations are rated on a scale of 1 to 5 as follows. Poor = 1 / 5, Fair = 2 / 5, Good = 3 / 5, Very Good = 4 / 5, Excellent = 5 / 5. The average presentation (assuming a nice PowerPoint presentation, good public speaking skills, and smooth demonstration) is typically rated Good/Very Good.

Project

Final projects are graded according to whether they work or not and what the difficulty level is. Listed below are roughly the grades. "Not working" implies a solid coding effort on a well-thought out algorithm which was correctly simulated in MATLAB-lesser efforts scale grade downward.

Code Works Perfectly		Code Does Not Work	
Difficulty	Grade	Difficulty	Grade
5 / 5	100%	5 / 5	80%
4 / 5	90%	4 / 5	70%
3 / 5	80%	3 / 5	60%

Ideas for Final Project

Please see Prof. De Leon for other real-time DSP texts with many ideas for final projects. Listed below are ideas for a final project along with *estimated* difficulties.

- Acoustic echo canceler
- Acoustic impulse response measurement system
- Alien voices using ring modulation
- Cross speech synthesis – blending the human excitation with the resonances of a musical instrument
- Digital synthesis of a plucked string (Karplus-Strong). (3)
- DTMF decoder (4)
- Dynamic range compressor / expander (called a compander)
- FM-based wavetable synthesizer with chords and variable duration notes (3)
- FSK, QPSK, 8-PSK modem (3-5)
- Guitar Hero using actual guitar input and note detector for scoring. (5)
- Guitar tuner - estimates which string is plucked, compares to a reference frequency, and then instructs player to increase or decrease frequency (you decide the interface for increasing or decreasing (maybe a pre-recorded utterance stored in memory that says "higher" or "lower" or LEDs flashing. (5)
- Guitar effects chorusing, flanging, and phasing (3-4)
- Haas Effect (3D audio)
- High-frequency enhancement - many old recordings lack higher frequencies due to the technology used in the recording (listen to an old Miles Davis album to hear this). One can attempt to "restore" the lost higher frequencies as follows. Most instruments which emit high frequencies actually emit a range of harmonics - the harmonics at the high end are not recorded due to the technology. Now use a bandpass filter to isolate some of the harmonics and run this through a non-linearity (I have some ideas) to regenerate higher harmonics. Add the original signal to this new one and presto...high frequencies are back (kind of). Search for audio restoration
- Language recognizer
- Leslie cabinet (digital implementation)
- LPC-based speech coder
- Malah, D. “Time-domain algorithms for harmonic bandwidth reduction and time scaling of speech signals,” IEEE Trans. ASSP, vol. 27(2), p. 121-133, Apr. 1979
- Noise reduction using spectral subtraction (5)
- Pitch scale modification (J. Laroche (1998), "Time and pitch scale modification of audio signals," *Applications of Signal Processing to Audio and Acoustics*, M. Kahrs and K. Brandenburg, Eds. New York: Kluwer Academic, pp. 279-310. (Note: time scaling cannot be done continuously real-time) (4-5)
- Removal of Typed Keystrokes from Speech Signals (*IEEE Sig Proc Letters*, May 2007)
- Reverberation - in addition to the method we used in Project #1 for simulating reverberation there are many other approaches. These include feedback delay networks (see IEEE Trans speech and Audio Jan. 1997, SP Letters Sep. 1997), Jot's reverberator, and waveguide reverberators.
- Sonic motion detector Benzel, D. M, “Build this sonic motion detector,” Radio Electronics, vol. 55, Sept. 1984
- Limited-vocabulary speech recognizer (5)
- Speech recognizer (3-5)
- Speaker recognizer (3-5)
- Spectral subtraction (5)
- Tremolo and Vibrato. Tremolo-- multiply signal by a low freq sinusoid, Vibrato modulate frequency of signal
- Vocoder (http://www.sirlab.de/linux/descr_vocoder.html)
- Voice scrambler (FFT-based) (5)
- Wiener filter for noise reduction (5)