ESE 347. Digital Signal Processing: Implementation

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Location: SOCBEHAV SCI N102 (M, W, 5.30-6:50 PM) **Labs:** Light Eng. Lab., Room 179 (M, 7.00-10.00 PM).

Office hours: Suffolk Hall (South Campus), Room 123 (TU, TH, 12.00-1.30 PM)

Course Overview: This is a course in implementation techniques for Digital Signal Processing, based on the Texas Instruments TMS320F28335 DSP microcontroller.

The course consists of two main parts: lectures and laboratory work. The lectures will cover the basic architecture and features of the TMS320F2833x family of floating-point DSP microcontrollers, an overview of the development tools for this family, and the basic theory of simple DSP algorithms: sampling of continuous-time signals, FIR and IIR filtering and Fast Fourier Transform. The laboratory work will consist of implementing and testing these algorithms on the TMS320F28335, and comparing their performance to that predicted by the theory. Apart from the beginning labs, the implementation will be in real time, with analog input and analog output, and will be done on the Texas Instruments Peripheral Explorer Board".

We will cover the following topics in some detail:

1. Basic DSP concepts; sampling and reconstruction of signals.
2. Architecture and features of the TMS320F28335 and the Peripheral Explorer Board.
3. Program Development Tools - Code Composer Studio™.
4. Interfacing to the microcontroller modules: ADC, PWM and eCAP.
5. Fixed point arithmetic using IQMath library.
6. Signal flow-graphs and digital filter structures.
7. Pulse-Width Modulation.
8. FIR filter design and implementation.
9. IIR filter design and implementation.
10. Discrete and Fast Fourier Transforms (DFT and FFT).
11. Processing of audio signals. Stereo Audio CODEC TLV320AIC23B.

Learning Objectives: At the end of this course, students should know basic techniques and tools of digital signal processing:

1. Detailed knowledge of the architecture of a modern DSP chip.
2. Expertise with a real-time hardware development tool (evaluation module or in-circuit emulator).
3. Expertise with a full set of software tools (compiler, linker, debugger, and integrated design environment) for the real-time development hardware.
4. Understanding of peripheral interface techniques in a high-level language.
5. Ability to implement the basic DSP algorithms (FIR filters, IIR filters, oscillators, FFT) in real time.

Text: There is no required textbook for this course. In preparation for the lab assignments, you will be referenced to chapters from TI "C2000 Teaching ROMs", TMS320F28335 datasheet and C2000 peripheral guides, which can be downloaded from Texas Instruments website. All necessary course materials, including chapters from C2000 Teaching ROMS, peripheral reference guides, lecture slides and class assignments will be posted on the Blackboard.

All necessary theory on Digital Signal Processing will be covered in class. The recommended book for reference on the theory is "Discrete-Time Signal Processing" by A.V. Oppenheim and R.W. Schafer (2nd or 3rd edition).

Software: Code Composer Studio™ will be used in the lab; MATLAB will be used for design and simulation of digital filters.

Examinations: Midterm test and final examination.

Grading: The labs will count for 40% of the overall grade, the midterm and final will each count for 30%. The lab reports must be submitted electronically as PDF files. The reports must be properly formatted and look presentable. The lab will not be graded until the acceptable lab report is submitted. The course portfolio is not required.