ECE 4163 / ECE 6183: Digital Signal Processing Lab

Fall 2019
Electrical and Computer Engineering
Tandon School of Engineering, New York University

This course is an introduction to the real-time implementation of digital signal processing (DSP) algorithms, with an emphasis on audio signal processing and audio effects.

The course will use Matlab and Python programming. Some Matlab experience is expected. No experience in Python required; the course will introduce Python as needed. This course can be taken independently of ECE 6113 and ECE 7133 (DSP I and DSP II).

Topics include: Audio input-output and buffering. Filtering (recursive and non-recursive filters, structures). Fast Fourier transform and windowed spectral analysis. Digital audio effects (delay line, amplitude modulation, reverberation, distortion, short-time Fourier transform). Students will learn to implement these algorithms for real-time audio processing in software.

Prerequisites

Signal and Systems (undergraduate level is sufficient) (ECE 3054 or ECE 6113 or equivalent)

Texts

You can read both books online through the NYU Library for free. You will need to login to the library.

1. *Audio Effects: Theory, Implementation and Application*
   Joshua D. Reiss, Andrew McPherson
   CRC Press, 2014
   http://www.crcpress.com/product/isbn/9781466560284

2. *DAFX – Digital Audio Effects*
   Udo Zölzer (editor)
   Wiley, 2002 (1st edition), 2011 (2nd edition)
   http://onlinelibrary.wiley.com/book/10.1002/9781119991298

Software

Matlab: http://www.mathworks.com
Python : http://www.python.org
PyAudio : http://people.csail.mit.edu/hubert/pyaudio/

Outline

1. Review of systems and transforms
2. DSP functions in Matlab
3. Graphical user interfaces (GUI) in Matlab
4. Finite impulse response (FIR) filters
5. Infinite impulse response (IIR) filters
6. Real-time spectral analysis
7. Python and PyAudio
8. Real-time input/output
9. Delay line audio effects
10. Filter design
11. Filter audio effects
12. Amplitude modulation audio effects
13. Graphical user interfaces (GUI) in Python
14. Real-time video processing in Python
15. Short-time Fourier transform

Project

Students will complete a real-time audio programming project and make a class presentation.

Grading Policy (ECE 4163)

40%	Programming assignments (lab)
25%	Midterm
25%	Project
10%	Design project proposal

Grading Policy (ECE 6183)

40%	Programming assignments (lab)
25%	Midterm
25%	Project
10%	Paper report

Instructor

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