The Ohio State University
Department of Electrical and Computer Engineering

ECE 700 – Digital Signal Processing

Winter 2007

Instructor: Dr. Phil Schniter, Associate Professor
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Web Page: `http://www.ece.osu.edu/~schniter/ee700`

Will contain homework, homework modifications, homework solutions, and relevant handouts.

Lectures: MWF 12:30pm-1:18pm, 120 Caldwell Laboratory

Office Hours: To be posted on course web page.

Objectives: To develop an understanding of digital signal processing concepts useful for research and design, with a focus on the topics of multirate, multiscale, and time-frequency signal processing/analysis.

Text: Available for download on course website.

Optional Texts: S. Mitra, *Digital Signal Processing: A Computer-Based Approach*, 2nd Ed., McGraw-Hill, 2001.

M. Vetterli and J. Kovacevic, *Wavelets and Subband Coding*, Prentice-Hall, 1995.

Outline: *Review*: sampling and reconstruction, CTFT, DTFT, DFT. (3 lectures)

Multirate signal processing: upsampling and downsampling, noble identities, polyphase filters, sample rate conversion, multistage filter design. (8 lectures)

Filterbanks: modulated, alias cancellation, quadrature mirror, perfect reconstruction, tree structured. (5 lectures)

Time-Frequency Analysis: uncertainty principle, continuous STFT, discrete STFT, continuous wavelet tranform. (2 lectures)

Wavelets: review of Hilbert spaces, discrete wavelet transform, multiscale equations, cascade equation, implementational issues, applications. (10 lectures)

Prerequisites: (1) Basic understanding of continuous time and discrete time signal processing in both time and frequency domains (e.g., ECE 352 and ECE 600). (2) Basic understanding of linear algebra and finite dimensional vector spaces (e.g., Math 571-2 or Math 601). (3) Familiarity with MATLAB.

References:

1. C. Burrus, R. Gopinath and H. Guo, *Introduction to Wavelets and Wavelet Transforms: A Primer*, Prentice Hall, 1998.
2. F. Hlawatsch and G.F. Boudreau-Bartels, "Linear and quadratic time-frequency signal representations," *IEEE Signal Processing Magazine*, April 1992, pp. 21-68.
3. J.S. Lim and A.V. Oppenheim, *Advanced Topics in Signal Processing*, Prentice-Hall, 1988.
4. B. Porat, *A Course in Digital Signal Processing*, Wiley, 1997.
5. Proakis, Rader, Ling, Nikias, *Advanced Digital Signal Processing*, Macmillan, 1992.
6. G. Strang and T. Nguyen, *Wavelets and Filterbanks*, Wellesley-Cambridge, 1997.
7. P.P. Vaidyanathan, *Multirate Systems and Filter Banks*, Prentice Hall, 1992.

Grading: The course grade will be based on homework and projects ($\sim 30\%$), an in-class midterm ($\sim 30\%$), and a comprehensive final exam ($\sim 40\%$). Note: These weightings are approximate and may change. Some homework problems will require MATLAB computer programming and not necessarily all problems on each homework assignment will be graded.

Late Policy: No late material (projects, homework, etc.) will be accepted unless prior arrangements have been made. Arrangements need to be made at least 24 hours in advance. Any emergency situation will be handled on a case by case basis.

Attendance: The student is responsible for all assignments, changes to assignments, announcements, and subject material presented during the regularly scheduled classroom lecture. Copies of lecture notes will not made available. If you miss a lecture, please obtain notes from a classmate.

Honor System: All homework and examinations in this course will must be accomplished in accordance with the ECE Honor System. This means that *all submitted work must be your own.* While discussions among students relating to the homework are permitted (and often encouraged), a student's submitted assignment must reflect his/her *own* understanding of the material. Discussion of an exam is strictly prohibited until after the exam is submitted.