Introduction to EE-275, Digital Signal Processing
School of Engineering, UVM

Fall Semester 2009

EE-275 Digital Signal Processing serves as the entry course to three other courses in signal processing: (1) EE-295, Advanced Topics in Digital Signal Processing, (2) EE-274 Introduction to Wavelets and Filterbanks and (3) EE-276, Image Processing and Coding. These three courses are typically offered on a rotating basis each year.

EE-275 builds on a background of linear time-invariant signals and systems to provide the fundamental (deterministic) basis for processing of real-world signals. The course may be considered as having three components: (i) the basic mathematical theory (ii) utilization of this theory for the realization of several basic building blocks such as filters, that are generic in almost every practical DSP application and (iii) introduction to the software and hardware that is typically used in the real-world for building DSP systems.

EE-289 Digital Signal Processing Lab follows the course material with simulations using MATLAB. There is also a Real-Time implementation component. All Labs starting Fall 2006 have been rewritten and are different from previous years.

At the end of this course you should have a good understanding of what constitutes DSP. Specifically, what is involved in designing LTI systems (filters) for various (one-dimensional) areas such as speech, communication, audio etc., for applications in noise removal, improving signal-to-noise ratio, modulation, feature detection, speech coding, etc.

Specifically, you should have a good understanding of basic digital filtering issues such as time domain and frequency domain analysis, convolution and correlation, group and phase delay, advantage of linear phase, sampling and aliasing, changing sampling rate, FIR and IIR filters, DFT and FFT. You will learn how to build the “best” filter to meet some specified filter characteristics. Also how to properly interpret the DFT for frequency domain analysis.

DSP-based courses that follow EE-275 are as follows. They are typically offered alternative years. (Note that EE-274 does not have EE-275 as a prerequisite).

EE-295, Advanced Topics in Digital Signal Processing and Filtering looks in depth at many real-time applications including those for optimal filtering, speech coding, adaptive filtering, channel equalization, matched filtering and Wiener filtering. While the course addresses the basic theory of least-squares and least-mean-square filtering, the course emphasis is on the design and prototyping of these systems using Matlab’s Simulink and DSP Blockset. Hence a good portion of the course will be application and simulation-based.
EE-274, *Introduction to Wavelets and Filterbanks* A revised version of this course is being offered in Spring Semester 2009. The revised version will include elements of multiscale systems and their analysis with wavelet-based multiresolution techniques.

Beyond that, the course introduces one to the world of wavelets. There are many situations where the frequency spectrum, as represented by the Fourier transform, is not optimal or even adequate for proper representation of a signal. So we look at wavelet representations, noting that they have found their way into almost every field that uses signal processing. We will focus on the theory of wavelets and their implementation through filterbanks. We will look at applications in both one-dimensional and two-dimensional image processing.

EE-276, *Image Processing and Coding* is being offered in Spring 2008. It is being revised to include Fourier Optics and other material. In previous years it has included image processing in two-dimensions and fundamental 2-D filtering operations. Both deterministic and stochastic models are covered. These filters and models are applied to: image transforms, image representation using stochastic models, image enhancement, image filtering & restoration (deconvolution), image analysis & edge detection.

The required text is:


Other Reference Texts are:

1. Statistical and Adaptive Signal Processing
2. Digital Signal Processing
   T.J. Cavicchi, John Wiley and Sons., Inc., 2000
   Oppenheim and Schafer, Prentice Hall 1999
4. Digital Signal Processing, Principles, Algorithms and Applications,
5. Digital Filters ad Signal Processing
   L.B.Jackson, Kluwer, 1989
6. Digital Filters: analysis and synthesis
   A. Antoniou, McGraw Hill, 1979
7. Digital Signal Processing
   Theory, Applications and Hardware
   R. Haddad and T.W.Parsons, Computer Science Press, 1991
8. Advanced Topics in Signal Processing
   Edited by J.S.Lim and A.V.Oppenheim, Prentice Hall, 1988
9. Digital Signal Processing: theory, design and implementation

10. Theory and Application of Digital Signal Processing
L. Rabiner and B. Gold, Prentice Hall, 1975

11. Voice and Speech Processing
Thomas Parsons, McGraw-Hill, 1986