Spring 2013 / T R 8–9:20 / TBA

EE 323: Introduction to Digital Signal Processing

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Prerequisite: EE 224 (Signals and Systems I).

Lab: R 3:10-6 in 2011 Coover.

Lab TA: TBA.

Textbook: Manolakis and Ingle 2011.

Grading (tentative)

40% Weekly homework assignments and labs (15% + 25%)

30% Midterm exams

15% Project

15% Final exam.

Outline

- Sampling and reconstruction.
- Time-domain representation of discrete-time (DT) signals
  - complex and real sinusoids and exponential signals,
  - impulse, step, and ramp signals,
  - signal energy and power.
- Time-domain analysis of DT systems
  - system difference equations and their solution,
  - system impulse response,
  - obtaining zero-state system response using the convolution sum,
  - computing DT convolution sums,
  - system frequency response.
- Frequency-domain representation of DT signals
  - discrete-time Fourier series (DTFS) of periodic signals,
  - discrete-time Fourier transform (DTFT)
    * DTFT of finite-energy signals,

        * properties,
        * DTFT of sampled continuous-time (CT) signals.
    - relationships between Fourier representations of CT and DT signals
        * continuous-time Fourier series (CTFS), continuous-time Fourier transform (CTFT), DTFS, DTFT,
        * continuous versus discrete, periodic versus aperiodic,
        * duality.

- More on the analysis of DT systems
    - properties of the system frequency response,
    - examples of DT systems,
    - ideal filters: lowpass, highpass, and bandpass,
    - correlators and matched filters.

- review of DT system analysis using z-transforms
    - bilateral z-transform.

- DT filter design
    - infinite impulse response (IIR)
        * time-response matching (time-invariant design),
        * frequency-response matching (bilinear transformation design),
    - finite impulse response (FIR)
        * time-response matching,
        * frequency-response matching (Fourier series design), use of windows,
    - examples of DT filter design.

- implementation of DT linear time-invariant (LTI) systems
    - FIR and IIR systems,
    - direct form type I.

- discrete Fourier transform (DFT) and applications
    - DFT and inverse DFT
        * relationship with DTFS,
    - properties,
    - DT convolution using DFT,
    - spectral analysis of sampled CT signals using DFT,
        * controlling artifacts: use of windows and zero padding,
    - efficient DFT computation
        * decimation-in-time fast Fourier transform (FFT) algorithm.

- Introduction to multirate signal processing (time permitting).

References

Manolakis, Dimitris G. and Vinay K. Ingle (2011). *Applied Digital Signal Processing*. New York: Cambridge Univ. Press. ISBN: 0521110025.