

EE538 Digital Signal Processing I

Fall 2017

Topic:

I. Review: Discrete-Time Signals, Systems, & Transforms

Lectures

Reading: P&M Te

24

- A. Basic Sampling Theory and D/A Conversion
- B. Discrete-Time Linear Systems (DT Convolution)
 - 1. Discrete-Time LTI Systems
 - 2. Autocorrelation, Cross-Correlation (VIP)
- C. Z Transform
- D. Discrete-Time Fourier Transform/Continuous Time Fourier Transform
- E. Frequency Selective Linear Filtering
- F. Sampling and Reconstruction
- G. Multirate DSP ****most emphasis****
 - 1. Efficient Upsampling/Downsampling
 - 2. Multi-Stage Upsampling; Noble's Identities
 - 3. Digital Subbanding
 - 4. Two-Channel Perfect Reconstruction Filter Bank
 - 5. M-Channel Perfect Reconstruction Filter Bank
- I. Apps: CD/DVD Players, Radar, Wireless Comm: CDMA, OFDM

1.1-1.4
2.1-2.3
2.4.1, 2.4.2, 2.5
2.6
3.1-3.5
4.1-4.5
5.1-5.4
6.1-6.6
11.2-11.4
11.5
11.6
11.9
11.11
11.11
11.9

II. Discrete Fourier Transform

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- A. Definition and Properties
- B. Fast Fourier Transform Algorithms
 - 1. Divide and Conquer Approach
 - 2. Radix-2 FFT
- C. Sectioned Convolution: Overlap Add/Overlap Save

7.1-7.4
8.1.1, 8.1.2
8.1.3
7.3, 8.2-8.3

III. Digital Filter Design

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- A. IIR Filters
 - 1. Common analog filters
 - 2. Bilinear transformation
 - 3. Frequency transformations via All-Pass Filters
- B. FIR Filters – Equiripple Designs

10.3.5
10.3.3
10.4
10.2.4-10.2.6

IV. Nonparametric methods of power spectrum estimation

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- A. Discrete random processes
- B. Estimation of autocorrelation sequence
- C. Periodogram; Smoothed periodograms

12.1-12.2
14.1.2
14.2

V. Model-Based Spectrum Estimation

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- A. Autoregressive (AR) Modelling
- B. Forward/Backward Linear Prediction
- C. Levinson-Durbin Algorithm
- D. Minimum Variance Method
- E. Eigenstructure Methods I: MUSIC
- F. Eigenstructure Methods II: ESPRIT
- G. Applications in Speech Processing, Communications, and Acoustics

14.3
12.3
12.4
14.4
14.5.2, 14.5.3
14.5.1, 14.5.4