

EE538 Digital Signal Processing I

Fall 2022

Topic:

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

Lectures Reading: P&M Te

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- A. Basic Discrete-Time (DT) Signals and Basic DT Systems 1.1-1.4
- B. Discrete-Time Linear Time-Invariant Systems 2.1-2.3
 - 1. Discrete-Time Convolution 2.4.1, 2.4.2, 2.5
 - 2. Autocorrelation, Cross-Correlation. VIP: Matched Filter 2.6
 - 3. Apps: Radar, GPS, Wireless Comm: CDMA, Speech Processing
- C. Z Transform 3.1-3.5
- D. Discrete-Time Fourier Transform/Continuous Time Fourier Transform 4.1-4.5
- E. Frequency Selective Linear Filtering 5.1-5.4
- F. Sampling and Reconstruction 6.1-6.6
- G. Multirate DSP ***most emphasis*** 11.2-11.4
 - 1. Efficient Upsampling/Downsampling 11.5
 - 2. Multi-Stage Upsampling; Noble's Identities 11.6
 - 3. Digital Subbanding 11.9
 - 4. Two-Channel Perfect Reconstruction Filter Bank 11.11
 - 5. M-Channel Perfect Reconstruction Filter Bank 11.11
- I. Apps: CD/DVD Players, Audio Compression

II. Discrete Fourier Transform

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- A. Definition and Properties 7.1-7.4
- B. Fast Fourier Transform Algorithms
 - 1. Divide and Conquer Approach 8.1.1, 8.1.2
 - 2. Radix-2 FFT 8.1.3
- C. OFDM Application (Wireless Comm) 7.3, 8.2-8.3

III. Digital Filter Design

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- A. IIR Filters
 - 1. Common analog filters 10.3.5
 - 2. Bilinear transformation 10.3.3
 - 3. Frequency transformations via All-Pass Filters 10.4
- B. FIR Filters – Equiripple Designs 10.2.4-10.2.6

IV. Nonparametric methods of power spectrum estimation

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- A. Discrete random processes 12.1-12.2
- B. Estimation of autocorrelation sequence 14.1.2
- C. Periodogram; Smoothed periodograms 14.2

V. Model-Based Spectrum Estimation

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- A. Autoregressive (AR) Modelling 14.3
- B. Forward/Backward Linear Prediction 12.3
- C. Levinson-Durbin Algorithm 12.4
- D. Minimum Variance Method 14.4
- E. Eigenstructure Methods I: MUSIC 14.5.2,14.5.3
- F. Eigenstructure Methods II: ESPRIT 14.5.1,14.5.4
- G. Applications in Speech Processing, Communications, and Acoustics