

Advanced Digital Signal Processing

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Course Outline

- Introduction:
 - What is "Digital Signal Processing"?
 - Analog versus digital signal processing.
 - Digital signal processors.
- Digital processing of continuous-time signals:
 - Sampling and sampling theorem.
 - Quantization.
 - AD- and DA-conversion.
- Discrete Fourier Transform and Fast Fourier Transform:
 - DFT and linear/circular convolution.
 - Overlap-save and overlap-add method.
 - Windowing and frequency analysis of stationary signals.
 - FFT algorithms and structures.
 - FFT of real-valued sequences.
- Digital filters:
 - Direct-form, lattice, and cascade structures for FIR filters.
 - Direct-form, lattice, and parallel structures for IIR filters.
 - Coefficient quantization and round-off effects.

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Course Outline

- Design of FIR filters:
 - Design of linear-phase filters using a window function.
 - Frequency-sampling design.
 - Optimum equiripple design (Chebyshev approximation).
- Design of IIR filters:
 - Design by impulse invariance.
 - Bilinear transform.
 - Characteristics of commonly used analog filters.
- Multirate digital signal processing:
 - Basic multirate operation (upsampling, downsampling).
 - Efficient structures for decimation and interpolation.
 - Decimation and interpolation with polyphase filters.
 - Noninteger sampling rate conversion.
 - Efficient multirate filtering.
 - Application: Oversampled A/D and D/A converter.

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Course Outline

- Modulation techniques and applications
- Advance transform techniques:
 - Time-frequency analysis and applications.
 - Windowed Fourier transform and applications.
- Hilbert transform and applications:
 - Application-SSB demodulation.
 - Application-ultrasound (blood flow analysis).
- Wavelet transform:
 - Time-scale analysis.
 - Complex continuous wavelet transform.
- Wavelet transform:
 - Discrete wavelet transform.
 - Complex discrete wavelet transform.
 - Applications – denoising.

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some recommended books

- Any DSP book such as
 - The Scientist and Engineer's and Guide to Digital Signal Processing by Steven W. Smith.
 - Digital Signal Processing: Principles, Algorithms, and Applications by J. G. Proakis and D. G. Manolakis.
 - Multirate Digital Signal Processing by R. E. Crochiere and L. R. Rabiner.
 - Theory and Application of Digital Signal Processing by Rabiner and Gold.
 - Digital Signal Processing by Alan V. Oppenheim and Ronald W. Schaffer.
 - Digital Signal Processing by William D. Stanley.
 - Understanding Digital Signal Processing by Richard G. Lyons.
 - Digital Signal Processing and the Microcontroller by Dale Grover and John R. (Jack) Deller with illustrations by Jonathan Roth.
 - Discrete-Time Signal Processing by A. V. Oppenheim and R. W. Schaffer.
 - Digital Signal Processing in Communication Systems by Marvin E. Fierking.
 - Discrete-Time Signal Processing by A. V. Oppenheim and R. W. Schaffer.
 - Time-Frequency Analysis: Theory and Applications by Leon Cohen
 - Time-Frequency/Time-Scale Analysis, Edited by Patrick Flandrin
 - Time-frequency signal analysis—methods and applications by Boualem Boashash
 - Wavelets and Filter Banks - Gilbert Strang, T. Nguyen
 - A Wavelet Tour of Signal Processing: The Sparse Way, Stéphane G. Mallat

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