

ELEC 532: Multidimensional Digital Signal Processing

Outline

A. Two Dimensional Signals and Systems

- Basics of 2D signals
- Basics of 2D discrete systems
- Review of 1D Fourier Transforms
- 2D discrete space Fourier Transform
- Spatial and temporal frequencies

B. 2D Sampling

- Rectangular sampling of band-limited signals
- Sampling of signals using general nD sampling geometry
- Basics of Lattices
- Sampling over Lattices
- Sampling of video signals
- Sampling rate conversion

C. Linear 2D Systems

- 2D z-Transform
- 2D linear shift invariant system stability
- 2D state-space models

D. 2D Discrete Transforms

- 2D Discrete Fourier Series
- 2D Discrete Fourier Transforms
- 2D Discrete Cosine Transforms

E. 2D Filter Design

- 2D FIR versus 2D FIR filter design
- Review of 1D FIR filter design based on window functions
- 2D FIR filter design using 2D window functions
- 2D FIR fan filter design
- 2D FIR filter design based on transformations
- Implementations of 2D FIR filters

F. Image Processing Basics

- Light, luminance and color
- Human visual system characteristics
- Image Enhancement
 - Noise filtering
 - Contrast and dynamic range modification
 - Homomorphic processing
- Image Sharpening and Edge detection
 - Gradient based methods
 - Laplacian based methods
- Image Restoration
 - Algebraic Approach to restoration
 - Filtering 2D a random field
 - Estimation for random fields
 - Wiener filters

G. Applications in Array Processing

- Analysis of Space-Time signals
- Region of Support in Frequency Domain
- Basics of Beamforming
- 2D Filtering for seismic signals