

ECE 597IP/697IP : Image Processing

Prerequisites: (Formal) ECE 214 and 213. Knowledge of Matlab and Python Programming
 (Informal) It is desirable to have knowledge of the topics in ECE 315.

Topics	Subtopics
introduction	Image Processing systems, applications, history
Image models, Image transformations, Geometric transformations	Image acquisition with Sensor arrays, A simple image formation model Intensity transformations Affine spatial transformations Image matching
Histogram processing	Histogram equalization Histogram specification
Filtering in the Spatial domain	Convolution, correlation Filter Separability Low Pass filters in spatial domain Laplacian and image sharpening Band, Reject, Notch filters
Continuous Fourier Transform in 1-D (Review)	Properties Some FT pairs
1D DFT	Sampling and Spectral sampling theorem Derivation of 1D DFT from 1D CFT
Continuous Fourier Transform in 2-D (Review)	Additional notes in S&S
2D DFT	Properties Specific properties to the DFT Circular shift Circular convolution
Frequency Domain Filtering	Filtering using the 2D DFT Low pass Laplacian and image sharpening Band reject/pass Notch, Homomorphic filters
Image Restoration (noise only)	noise models denoising filters adaptive filters
Image Restoration from degradation and noise	Degradation modeling, Lens and Motion blur, Inverse filter, Wiener Filter,
Color Image Processing	color perception RGB,HIS, Full color image processing, color transformations, color image smoothing and sharpening, decorrelation stretch, $L^*a^*b^*$, $L^*u^*v^*$
Image Segmentation: clustering	Kmeans Mean Shift SLIC Superpixels,
Graph-based segmentation	n-cuts, Region Adjacency Graphs Felzenswalb's algorithm

Edge detection	Image gradient Laplacian Sobel operator Canny edge detector boundary RAG, hierarchical merging boundary RAG,
Morphological operators and watershed segmentation	grayscale erosion and dilation, opening and closing, morphological gradient 740-741 Watershed segmentation Markers for watershed,
Semantic Segmentation	GrabCuts algorithm