Digital Image Processing - Web course

COURSE OUTLINE

The course will cover techniques and tools for digital image processing, and finally also introduce image analysis techniques in the form of image segmentation.

The course is primarily meant to develop on-hand experience in applying these tools to process these images. Hence the programming assignments form a key component of this course.

The students would be encouraged to develop the image processing tools from scratch, rather than using any image processing library functions.

Students will also get an opportunity to familiarize with OpenCV image processing library.

Emphasis will be to develop engineering skills and intuitive understanding of the tools used in Image Processing.

COURSE DETAIL

Module	Topics	No.of Hours
Introduction	Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and quantization.	3
Spatial Domain Filtering	Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian.	4
Filtering in the Frequency domain	Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering.	6
Image Restoration	Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections.	6
Image Compression	Encoder-Decoder model, Types of redundancies, Lossy and Lossless	8

NPTEL

http://nptel.iitm.ac.in
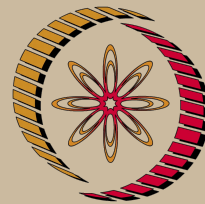
Computer Science and Engineering

Pre-requisites:

1. High school mathematics.
2. C/C++ programming skills.

Additional Reading:

Fundamentals of Digital Image Processing By Anil K Jain.

Hyperlinks:

http://www.ece.arizona.edu/~dial/

Coordinators:

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	compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation	
Wavelet based Image Compression	Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking.	3
Morphological Image Processing:	Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.	5
Image Segmentation	Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation	5

References:

Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education.