IMAGE SIGNAL PROCESSING

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PRE-REQUISITES : Digital Signal Processing. Familiarity with linear algebra and probability theory is desirable.

INTENDED AUDIENCE : Any Interested Learners

INDUSTRIES APPLICABLE TO : Google, Amazon, Facebook, Microsoft, KLA-Tencor, Qualcomm, Intel, Analog Devices, Philips, GE, Siemens and many more.

COURSE OUTLINE :

This course spans both basics and advances in digital image processing. Starting from image formation in pin-hole and lens based cameras, it goes on to discuss geometric transformations and image homographies, a variety of unitary image transforms, several image enhancement methods, techniques for restoration of degraded images, and 3D shape recovery from images.

ABOUT INSTRUCTOR :

Prof. A.N. Rajagopalan is a Professor of Electrical Engineering at IIT Madras and specializes in the areas of Image Processing and Computer Vision. He is a Fellow of national and international academies, and Editorial Board member of flagship journals of IEEE in the above areas. He has co-authored two books.

COURSE PLAN :

Week 1: Introduction to Image Processing, Basics of Imaging, Geometric Transformations

Week 2: Hierarchy of Transformations, Rotational Representation, Homography Computation

Week 3: Research Challenges Involving Camera Motion, Basics of Real Aperture Camera, Lens as LSI System

Week 4: Blur Kernels, Shape from X, Shape from Focus

Week 5: Shape from Focus, Generalized Shape from Focus, Depth from Defocus (DFD) and Motion Blur

Week 6: Unitary Image Transforms, From 1D to 2D Unitary Transforms, Higher Dimensional Unitary Transforms

Week 7: 2D Unitary Transforms, 2D Discrete Fourier Transform, 2D Discrete Cosine Transform

Week 8: Karhunen-Loeve Transform (KLT), Applications of KLT, Singular Value Decomposition

Week 9: Image Enhancement, Adaptive Thresholding, K-Means Clustering, ISODATA Clustering

Week 10: Contrast Stretching, Noise Filtering, Non-local Mean Filtering, Impulse Noise Filtering, Noise Filtering in Transform Domain, Illumination Compensation

Week 11: Image Restoration, Ill-posed Problems, Matrix Conditioning, Matrix Numerical Stability, Inverse filter for Image Deblurring, Regularization Theory

Week 12: Minimum Mean Square Error (MMSE) Estimator, Linear MMSE, Spatial Wiener Filter, Wiener filter in Fourier domain, Image Super-resolution, Super-resolution Examples