



IMAGE SIGNAL PROCESSING

PROF. A.N. RAJAGOPALAN

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IIT Madras

TYPE OF COURSE : New | Elective | UG/PG

COURSE DURATION : 12 weeks (20 Jul' 20 - 9 Oct' 20)

EXAM DATE : 18 Oct 2020

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