

EE425/EE453: Image Processing & Analysis

Summary Syllabus¹ (Level 8²)

Section	Indicative Content
Introduction	Introduction to Matlab for Image Processing & Analysis, IPA Pipeline, Learning Outcomes, Module Protocol, Reassessment Requirement, Matlab Code Development, Support Material & Website, Software Tools, Human/Computer/Machine Vision, Ethics, Case Studies.
Basic Techniques	Image Representation, Pattern Recognition using Feature Extraction, Point-by-Point Operators, Thresholding, Convolution, Deconvolution, Linear Local Operators, Non-linear Local Operators, Gradient and Difference based Edge Detectors - Marr-Hildreth Edge Detector, Canny Edge Detector, Comparison of Edge Detectors, Corner Detection - Template Matching, N-tuple Operators, Measures of Similarity, Histograms, Look-up Tables, Binary Image Processing, Run Code, Freeman Chain Code, Simple Shape Descriptors, Concavity, Distance Metrics, Distance Transform, Video Sequence Processing - Graphic File Formats, Imaging Modalities Overview, Image Noise, Noise Metrics - Example applications and case studies.
Morphology	Study of Form and Structure, Binary Morphology, Erosion, Dilation, Duality, Idempotency, Opening, Closing, Skeletonization, Structuring Element Decomposition, Hit-and-Miss Transform, Grey Scale Morphology, Top-Hat Transform, Morphological Gradient, Point-Pairs SE, Covariance, Conditional Dilation, Geodesic Transformations, Reconstruction by Dilation, Worked Examples.
Transforms	Global Image Transforms, Interpolation, Hough (Linear, Circular, Generalised), Two-Dimensional Discrete Fourier Transform, DFT Filtering, Discrete Cosine Transform, Worked Examples.
Classification & Performance Characterization	Classification/Clustering, Supervised vs Unsupervised, Feature Selection, Nearest Neighbour Classifier, K-Nearest Neighbour, K-Means Clustering, Maximum-likelihood Classifier, Automated Thresholding, Evaluation of Classifier Performance, Worked Examples. Algorithm Performance, Ground Truth, Receiver-Operator Characteristic Analysis, Hazards of Significance Testing/Screening.
Colour	Human/Mammal Perception of Colour, Essential Rules of Colorimetry, Colour Spaces (RGB, Opponent Process Representation, Ohta/Polar, HSI, YIQ/YUV, ...), Colour Scattergrams, Coarse Colour Discrimination (Programmable Colour Filter), Applications (Green Screen, Tracking), Worked Examples.
Texture	Structural Approaches, Fourier Spectral Analysis, Auto-Correlation Function, Histogram Features, Spatial Grey Level Dependence Method (Co-occurrence Matrix), Morphological Texture Analysis, Pseudo Monte-Carlo Method, Texture Spectrum Method, Local Binary Patterns (LBP), Worked Examples.
EE453 ONLY	EE453 students must undertake an additional IPA project

This is an introductory module.

See [EE544: Computer Vision](#) for an advanced Level 9 module in this area.

¹ Indicative content – details may vary from year to year.

² NQF Level 8 – Honours Bachelor's Degree.