Digital Image Processing

Module Information

2022.01, Approved

Summary Information

Module Code	6502ICBTBE
Formal Module Title	Digital Image Processing
Owning School	Pharmacy & Biomolecular Sciences
Career	Undergraduate
Credits	10
Academic level	FHEQ Level 6
Grading Schema	40

Teaching Responsibility

LJMU Schools involved in Delivery
LJMU Partner Taught

Partner Teaching Institution

Institution Name
International College of Business and Technology

Learning Methods

Learning Method Type	Hours
Lecture	30
Practical	6
Tutorial	9

Module Offering(s)

Display Name	Location	Start Month	Duration Number Duration Unit
SEP-PAR	PAR	September	12 Weeks

Aims and Outcomes

Aims	To develop learners' understanding basic concepts, methodologies and algorithms of digital image processing. For the last few decades, image processing has emerged as an important technology to extract useful information for scene understanding. The primary goal of this course is to lay a solid foundation for students to study advanced image analysis topics such as object recognition, wavelet transforms.

After completing the module the student should be able to:

Learning Outcomes

Code	Number	Description
MLO1	1	Investigate and identify the fundamental concepts and types of image processing.
MLO2	2	Solve problems using image processing fundamentals in transformations, spatial filters.
MLO3	3	Solve problems in frequency domain filtering & morphological image processing.
MLO4	4	Investigate, evaluate and analyse DSP techniques used in engineering.
MLO5	5	Simulate and analyse DSP techniques using a suitable software such as MATLAB.

Module Content

Outline Syllabus	Introduction to Image – processing system.Digital imaging modalities: gamma-ray imaging, x-ray imaging, CT (computed tomography) imaging ultraviolet imaging, visible-spectrum imaging, millimetre-wave imaging, radio-band imaging, ultrasound imaging, electron microscopy, information overlays/ human-generated imagery, low-mid, and high-level image processing, anatomy of the human eye, facts about the fovea, brightness perception, optical illusions/perceptual phenomena, facts about rods and cones, colour spaces additive colour spaces (RGB). Image transforms2D discrete Fourier transform, discrete cosine transform (DCT), Hadamard transform, Haar transform, Wavelet transform.Geometric transforms and Spatial FilteringImage histograms, point operations, thresholding, digital negative, contrast stretching, histogram equalization, histogram specification, gamma correction, spatial filters intro to edge detection, geometric operations, translation, scaling, flipping, linear transformations, rotation, shears, affine transformations, projective transformations, example: estimating a projective transformation, bilinear interpolation. Spatial filters connection to convolution, the spatial domain applying spatial filters, smoothing filters, averaging to remove g. Gaussian noise, sharpening filters, general low-pass filters, horizontal and vertical edge detectors, the Laplacian. Enhancing edges, Unsharp masking, Sobel edge detectors, the median filter. Filtering in the Frequency DomainInterpreting the 2D DFT of images. MATLAB's fftshift. Frequency-domain filtering. Ideal (box) filtering. Circular (instead of rectangular) filters. Spatial vs. frequency domain trade-offs. Looking at filters in the frequency domain. Gaussian low-pass filters. High pass filtering. Laplacian filters. Sampling and aliasing. Edge detectionThe Sobel edge detector, image gradients, thresholding gradient, Laplacian-of-Gaussian detector, The Canny edge detector. Edge linking. Boundary following. Chain coding, The Hough transform. Thresholding & segmentation Thresholding, relationship to segmentation, relationship to image histogram, Otsu's algorithm, variable/ adaptive thresholding.Object detection Template matching, cross-correlation, Image features, Shi-Tomasi corner detector, affine invariance, SIFT features, in visual effectsMorphological Image processingStructuring elements, operations on sets of pixels, erosion, dilation, opening, closing, opening and boundary extraction. Colour Image processingColour formation, human perception of colour, chromaticity diagram, gamma correction, colour image segmentation. Image restoration & reconstruction Image degradation model, estimating the noise model, removing periodic noise with a notch filter, adaptive filters, blur/degradation, the inverse filter, the Wiener filter, Introduction to image reconstruction from projections, CT scan geometries, the radon transform, the Fourier-Slice theorem.
Module Overview	
Additional Information	This module is part of the Level 6 of the BEng(Hons) in Biomedical Engineering

Assessments

Assignment Category	Assessment Name	Weight	Exam/Test Length (hours)	Module Learning Outcome Mapping
Exam	Examination	70	2	MLO1, MLO2, MLO3
Dissertation	Coursework Assignment	30	0	MLO4, MLO5

Module Contacts

Module Leader

Contact Name	Applies to all offerings	Offerings
Katie Evans	Yes	N/A

Partner Module Team

Contact Name	Applies to all offerings	Offerings