Liverpool John Moores University

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Title:	DIGITAL IMAGE PROCESSING
Status:	Definitive
Code:	**6502ICBTBE** (129107)
Version Start Date:	01-08-2020
Owning School/Faculty:	Pharmacy & Biomolecular Sciences
Teaching School/Faculty:	ICBT, Colombo

Team	Leader
Katie Evans	Y

Academic Level:	FHEQ6	**Credit Value:**	10	**Total Delivered Hours:**	47
Total Learning Hours:	100	**Private Study:**	53		

Delivery Options
Course typically offered: Semester 1

Component	Contact Hours
Lecture	30
Practical	6
Tutorial	9

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Exam	Exam	Examination	70	2
Report	Report	Coursework assessment	30	

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.

Learning Outcomes

After completing the module the student should be able to:

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

Learning Outcomes of Assessments

The assessment item list is assessed via the learning outcomes listed:

Examination	1	2	3
Coursework Assignment	4	5	

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, color spaces additive color spaces (RGB).

Image transforms
2D discrete fourier transform, discrete cosine transform (DCT), Hadamard transform, Haar transform, Wavelet transform.

Geometric transforms and Spatial Filtering
Image 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 Domain

Interpreting the 2D DFT of images. MATLAB's fftshift. Frequency-domain filtering. Ideal (box) filtering. Circular (instead of rectangular) filters. Spatial vs. frequency domain tradeoffs. Looking at filters in the frequency domain. Gaussian low-pass filters. High pass filtering. Laplacian filters. Sampling and aliasing.
Edge detection
The 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 effects

Morphological Image processing
Structuring elements, operations on sets of pixels, erosion, dilation, opening, closing, opening and boundary extraction.

Colour Image processing
Color formation, human perception of color, chromaticity diagram, gamma correction, color 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.

Learning Activities

Students will be supported in their learning, to achieve the above learning outcomes, in the following ways:
Mathematical and analytical skills are acquired through lectures, seminars, tutorials and group work.
Lecture notes and module guide in the form of comprehensive guidance notes; include theory examples and Q & A will guide to achieve the outcome.
MATLAB computer simulation used to simulate the mathematical function to cover all the learning outcomes.

Notes

This module is part of the Level 6 of the BEng(Hons) in Biomedical Engineering