學期	1091
流水號	21092
課號	MA3111
授課教師	陳建隆
課程名稱(中文)	數學影像處理
課程名稱(英文)	An Introduction to Mathematical Image Processing
學分	3
課程目標	影像處理領域有許多重要的問題與技巧，如去雜訊、去模糊、影像增強、影像切割，課程初期將教導學生影像處理方面的技巧及背後的數學理論；在完成基本影像技巧學習後，將介紹各種影像處理問題，讓學生分組實作一套解決問題的演算法，並且在課堂上報告。

	透過這種學習模式，加深學生對於影像處理的認識，同時訓練學生應用數學技巧解決問題的能力。 Image processing is an essential field in many applications, including medical imaging, astronomy, astrophysics, surveillance, video, image compression and transmission, just to name a few. In one dimension, images are called signals. In two dimensions we work with planar images, while in three dimensions we have volumetric images (such as MRI images). These can be gray-scale images (single-valued functions), or color images (vector-valued functions). Noise, blur and other types of imperfections often degrade acquired images. These have to be first processed before any further analysis and feature extraction. In this course we will formulate in mathematical terms several image processing tasks: image denoising, image deblurring, image enhancement, image segmentation, edge detection. We will learn techniques for image filtering using first- and second-order partial derivatives, the gradient, Laplacian, and their discrete approximations by finite differences, average filters, convolution operators, the Fourier transform, low-pass and high-pass filters.
授課內容	1 Fundamental Steps in Digital Image Processing 2 A simple image formation model: Image sampling and quantization 3 Intensity transformations and spatial filtering 3.1 Histogram equalization 3.2 Spatial Linear Filters 4 The Fourier Transform and Filtering in the Frequency Domain 4.1 Principles of Filtering in the Frequency Domain 5.3.1 Computation of the first order optimality condition in the continuous case 6 Image Segmentation 6.1 The gradient edge detector 6.2 Edge detection by zero-crossings of the Laplacian (the Marr-Hildtreth edge detector) 6.3 Boundary detection by curve evolution and active contours 6.3.1 Curve Representation 5 Image Restoration 5.1 Image Denoising 5.2 Image Deblurring 5.3 Energy minimization methods for image reconstruction
教科書/	References: (1) (3) Related References and Lectures: e.g., S. Osher and R. P. Fedkiw, Level Set Methods, etc.

參考書	(2) McAndrew and Wang Tseng, Introduction to Digital Image Processing with MATLAB, Asia Edition. (3) Gilles Aubert and Pierre Kornprobst, Mathematical Problems in Image Processing, Partial Differential Equations and the Calculus of Variations, 2nd Edit.
授課方式	講授 研討 實習/實驗
評量配分比重	Exercises(30%)+Implementation(40%)+Representation Report(30%)
辦公時間	Monday, 13:30-14:30 or make a point with teacher early.
課程領域	理論數學,計算數學,機率統計
跨系課程領域	N/A

系所核心能力	強度指數	評量方式
發掘問題	(4)高	作業練習,口頭報告/口試,專題研究報告(書面),實作/實驗,出席/課堂表現,作品/創作展演,

邏輯分析	(4) 高	作業練習,口頭報告/口試,專題研究報告(書面),實作/實驗,出席/課堂表現,自我評量/同儕互評,作品/創作展演,
演算能力	(4) 高	作業練習,口頭報告/口試,專題研究報告(書面),實作/實驗,出席/課堂表現,作品/創作展演,
電腦應用	(4) 高	作業練習,口頭報告/口試,專題研究報告(書面),實作/實驗,出席/課堂表現,作品/創作展演,
語文溝通	(3) 普通	口頭報告/口試,出席/課堂表現,作品/創作展演,
獨立思考	(4) 高	作業練習,口頭報告/口試,專題研究報告(書面),實作/實驗,出席/課堂表現,作品/創作展演,
團隊合作	(4) 高	作業練習,口頭報告/口試,專題研究報告(書面),實作/實驗,出席/課堂表現,作品/創作展演,
博雅通識	(3) 普通	作業練習,口頭報告/口試,作品/創作展演,