學期	1082
流水號	21040
課號	MA5104
授課教師	陳建隆
課程名稱(中文)	數學影像處理的相關理論及實作專題 II
課程名稱(英文)	The Topics of Mathematical Image Processing and Implementations II
學分	2
課程目標	本課程預計針對數學系的學生，設立一門一學年的數學影像專題課程，將原本資電學院的影像處理課程，帶到數學系來，並應用數學系課程(線性代數、微分方程、機率統計、程式設計、離散數學等)的知識，以建立模型的觀點來理解影像處理，提供一門專為數學

系學生量身打造的跨領域課程，讓學生接觸跨領域的應用知識，並培養學生發掘問題、解決問題的能力。

授課內容

四、課程大網：(須中英對照，中文翻譯不妥，英文亦可)

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. The second semester of this course, we will study the following contents:

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 Image Restoration
5.1 Image Denoising
5.2 Image Deblurring
5.3 Energy minimization methods for image reconstruction
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

7. 實作部分, Mathematical Image Processing and Implementations：Introduce and study some important problems and techniques in the field of image processing. By the basic imaging techniques, students must group and design a set of problem-solving algorithms and report their respective computer programs and coding results. The students can choose the followings topics to do the computer program implementations: 邊緣偵測在車牌

	辨識中的應用、文章彎曲字體校正與辨識、影像與聲音去雜訊、點雲圖資處理、3D人臉辨識相關數學理論內容、指紋辨識理論與實作、QR code 理論與實作、資料壓縮理論與實作, etc.
教科書/參考書	[1] McAndrew and Wang Tseng, Introduction to Digital Image Processing with MATLAB, Asia Edition. [2] An Introduction to Mathematical Image Processing IAS, Park City Mathematics Institute, Utah Undergraduate Summer School 2010. [3] 演算法筆記 http://www.csie.ntnu.edu.tw/~u91029/Image.html [4] 價創計畫：CIVIS 首頁 https://www.civis.com.tw/ [5] 數位影像處理 (Digital Image Processing, 3/e) Rafael C. Gonzalez, Richard E. Woods 著、繆紹綱 譯，ISBN: 9866534103 [6] QR code 2006 標準: http://download.adamas.ai/dlbase/Stuff/%21ISO/ISO_IEC-18004-2006.pdf [7] 曾定章教授影像處理課程 http://ip.csie.ncu.edu.tw/course/course.htm [8] 徐子仁(2016) 基於深度學習的人臉辨識系統 [9] Keras 文件: https://keras.io/ [10] Lai Kang, etc. (2016). Rectification of curved document images based on single view three-dimensional reconstruction [11] Gaofeng Meng, Chunhong Pan, etc. (2012). Metric Rectification of Curved Document Images [12] Ivan W. Selesnick and ˙Ilker Bayram (2010). Total Variation Filtering. [13] Laurent Condat (2012). A Direct Algorithm for 1D Total Variation Denoising [14] C.Y. Yang; Y.C. Zhang; Y.H. Chen and C.W. Huang (2018). Toward semantic loop closure in simultaneous localization and mapping systems [15] V. Blanz; T. Vetter (1999)，A Morphable Model For The Synthesis of 3D Faces [16] S. Osher and R. P. Fedkiw, Level Set Methods. [17] W. Hariri; H. Tabia; N Farah; A Benouareth and D. Declercq (2016)，3D face recognition using covariance based descriptors [18] F. Schroff; D. Kalenichenko; and J. Philbin (2015)，FaceNet: A Unified Embedding for Face Recognition and Clustering
授課方式	講授 研討 實習/實驗
評量	將依據期中、期末報告(理論及實作結果)來評量學生期末成績: 分數佔比為理論理解40%+實作成果60%=100%

配分比重	
辦公時間	Tuesday 10-12 或與教師另商定討論時間
課程領域	計算數學
跨系課程領域	N/A

系所核心能力	強度指數	評量方式
專業知識	(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,
學術研究	(3) 普通	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,
獨立思考	(3) 普通	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,
國際視野	(2) 低	作業練習,口頭報告/口試,出席/課堂表現,
終身學習	(2) 低	作業練習,口頭報告/口試,出席/課堂表現,