

生醫影像研究方法

Tue AM 9:10-12:00 @EC8037

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中山電機系

關於這門課

- 定位：從事醫學影像研究的基本入門課程
- 兩大主軸：數位影像處理、工程統計學
- 份量精實，選課前請三思

參考教材

- “Digital Image Processing”, Rafael C. Gonzalez and Richard E. Woods, Prentice Hall 2017 (4th edition)
- “Digital Image Processing for Medical Applications”, Geoff Dougherty, Cambridge University Press 2009 (1st edition)
- “Engineering Statistics”, Douglas C. Montgomery, George C. Runger, and Norma F. Hubele, Wiley 2006 (4th edition)
- 課程網頁：
 - http://bmilab.ee.nsysu.edu.tw/lab/course_mii.html

What else?

- 預修課程：
 - 信號與系統、數位訊號處理*
- 評分
 - Homework (MATLAB programming): 70%
 - Term project: 30%

數位影像技術在醫學上的應用

Digital image processing on
medical applications

數位影像的發展背景

1920s

新聞照片傳送

1960s

美國太空計畫
醫學影像應用

1980s

VLSI 技術發展
個人電腦應用技術

1990s

網際網路興起

1920s – News photo



FIGURE 1.1 A digital picture produced in 1921 from a coded tape by a telegraph printer with special type faces. (McFarlane.[†])

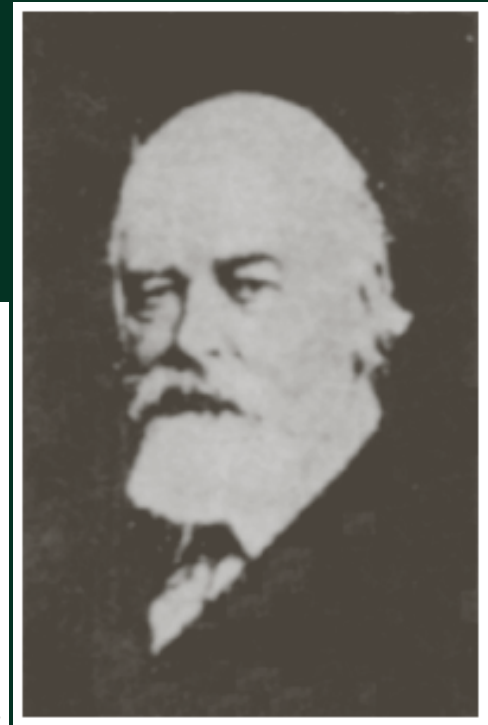


FIGURE 1.2 A digital picture made in 1922 from a tape punched after the signals had crossed the Atlantic twice. (McFarlane.)

1960s – Surface of moon

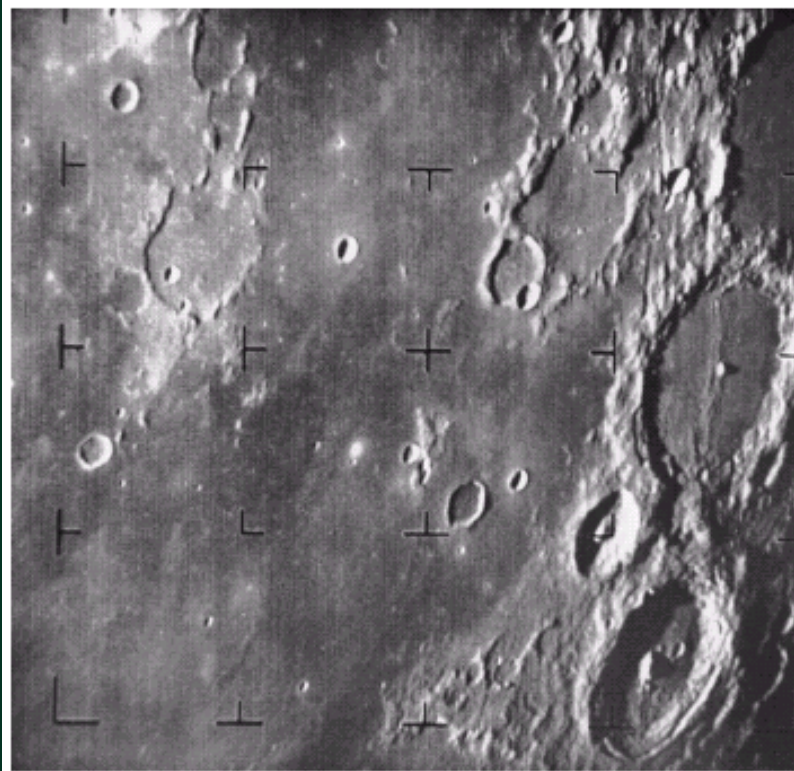
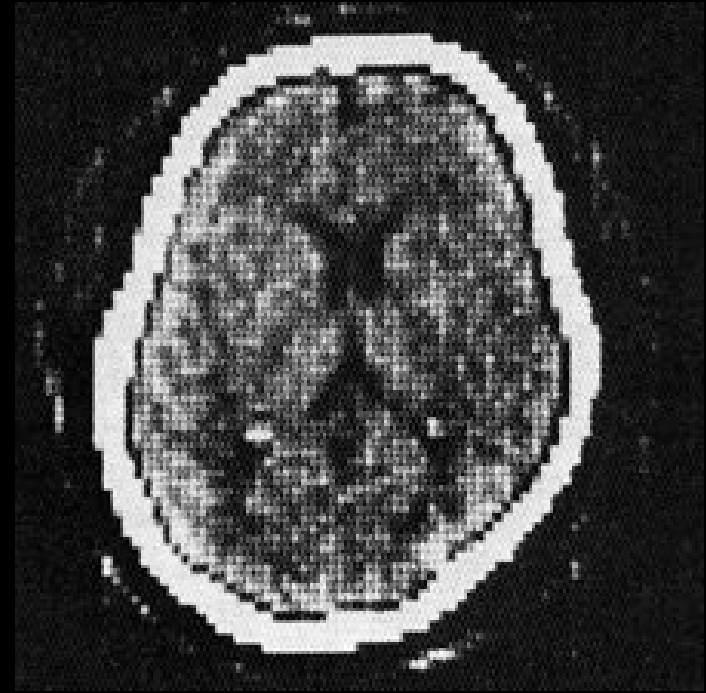


FIGURE 1.4 The first picture of the moon by a U.S. spacecraft. *Ranger 7* took this image on July 31, 1964 at 9 : 09 A.M. EDT, about 17 minutes before impacting the lunar surface. (Courtesy of NASA.)

1970s – Medical imaging



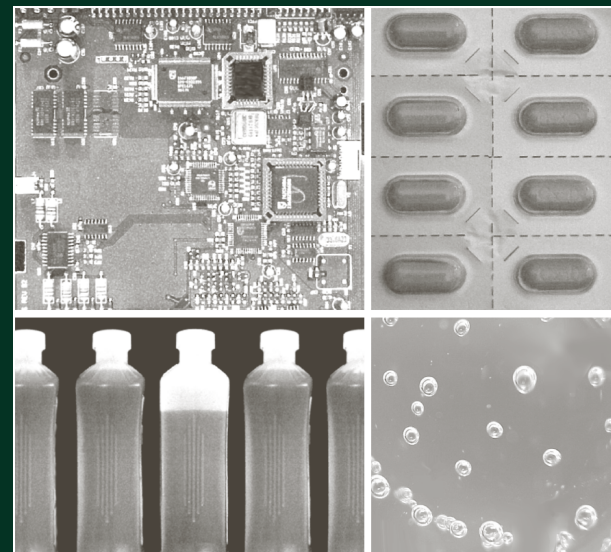
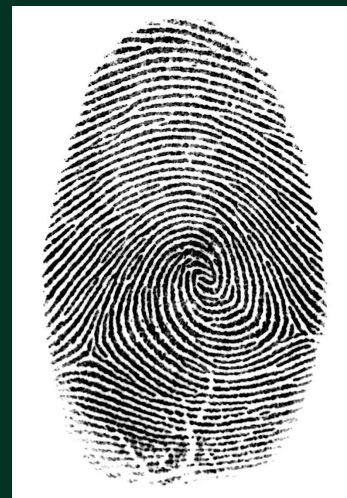
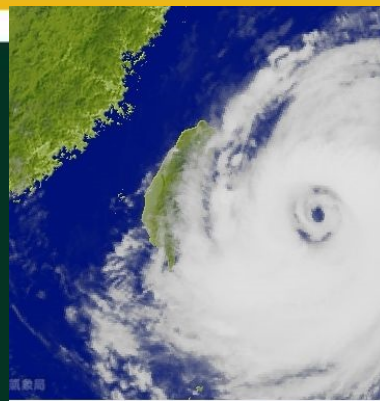
EMI CT1010 (1976)



A head scan

Why image processing?

- 多媒體的世代
- 到處都是影像與動畫
- 數位影像處理可應用於：
 - 天文、新聞、生物、地理資訊
 - 執法依據、工業檢測
 - 本課堂重點：醫學影像



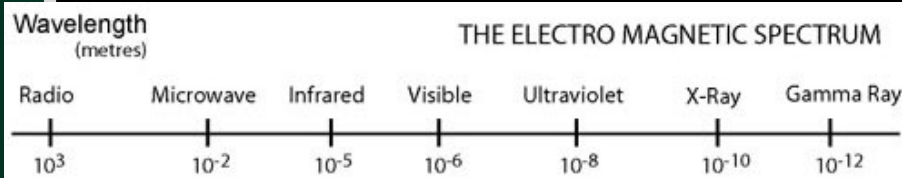
醫學影像技術

- 透視人體的技術
- 訊號的大小反應生物資訊
- 輻射性：X光、電腦斷層掃描、核子醫學影像
- 非輻射性：超音波、磁共振影像

醫學影像技術：核子醫學

SPECT
(^{99m}Tc -HMPAO)

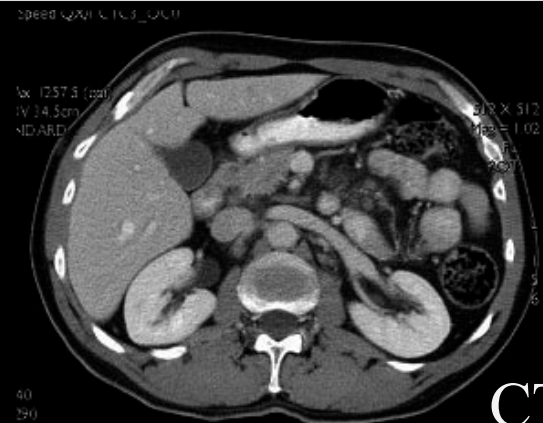
PET (^{18}F -FDG)



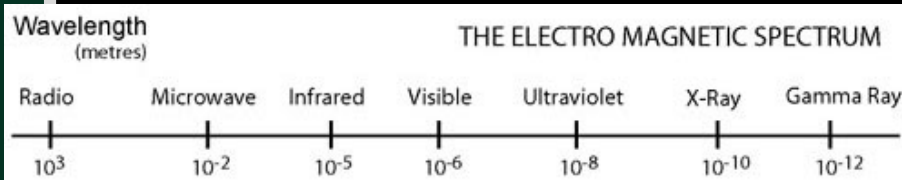
醫學影像技術：X光、斷層掃描



胸部X光

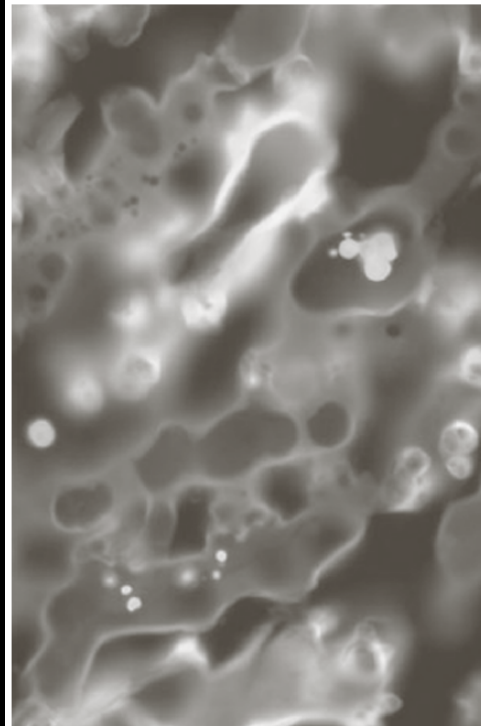


CT scan:
腹部(上)
頭部(下)

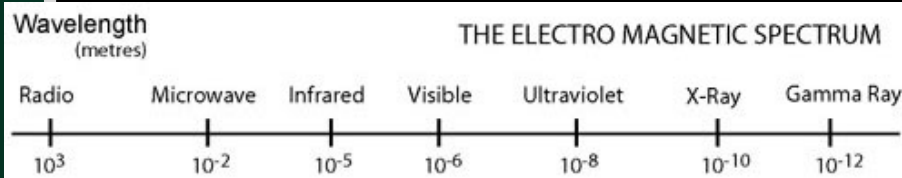
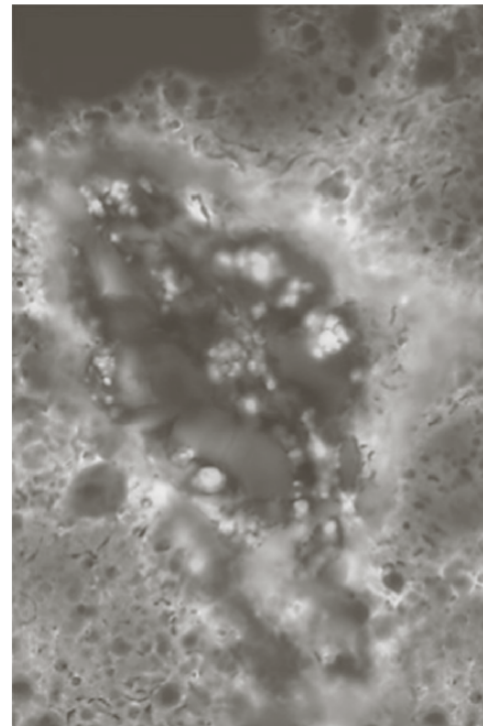


醫學影像技術：螢光顯微影像

Normal corn

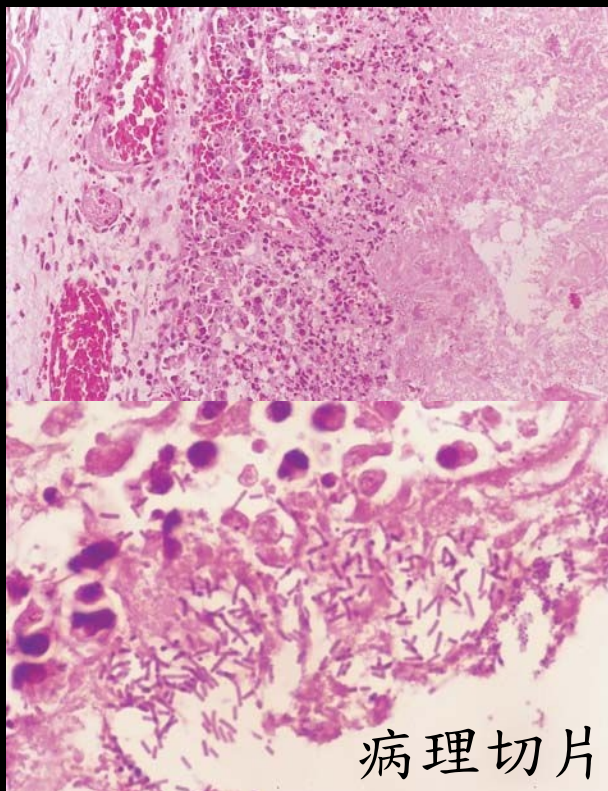


Smut corn

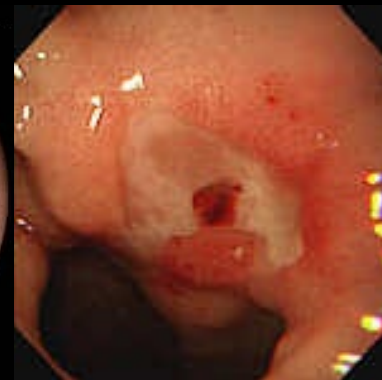


Fluorescence microscopy

醫學影像技術：顯微鏡、內視鏡

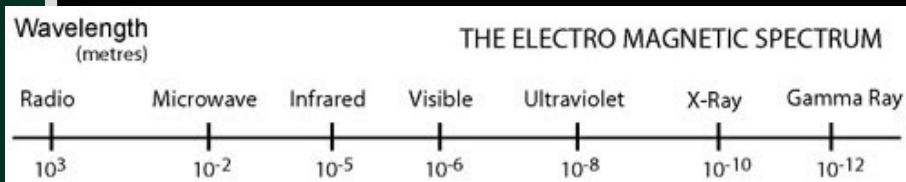


病理切片

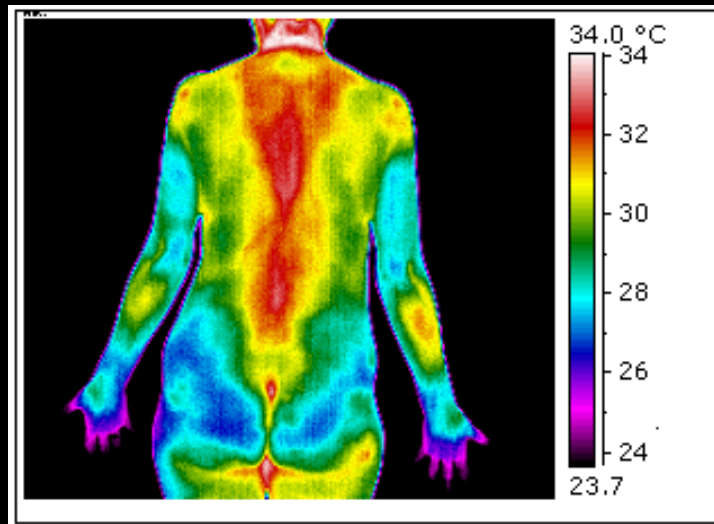


Endoscopy

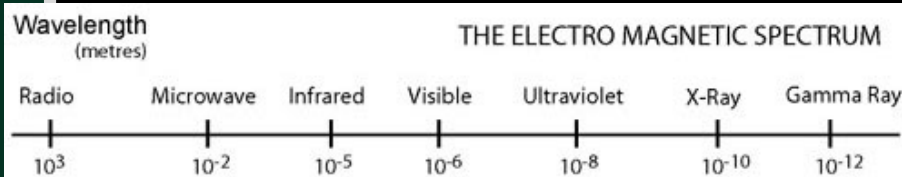
Courtesy: 馬偕醫院



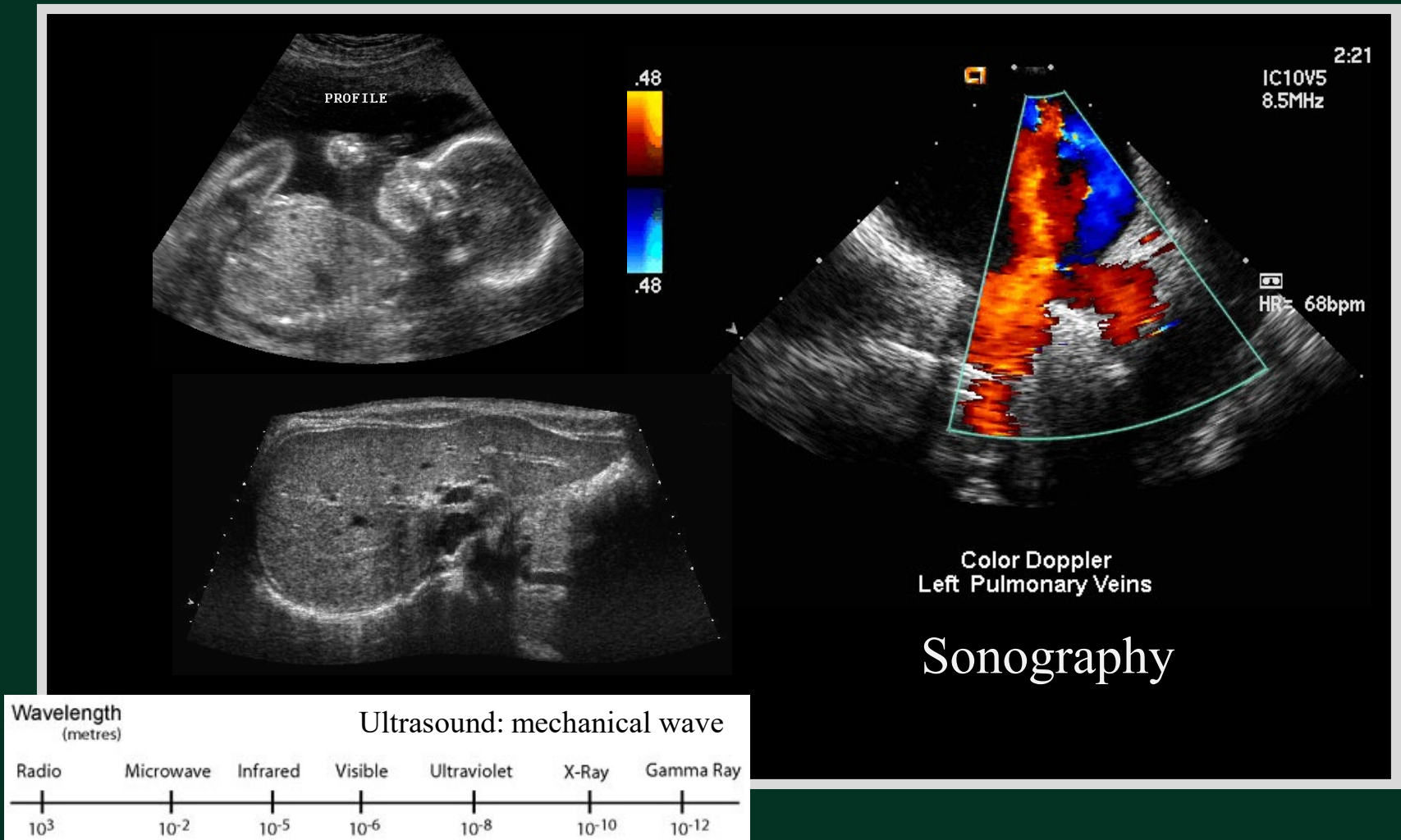
醫學影像技術：熱輻射影像



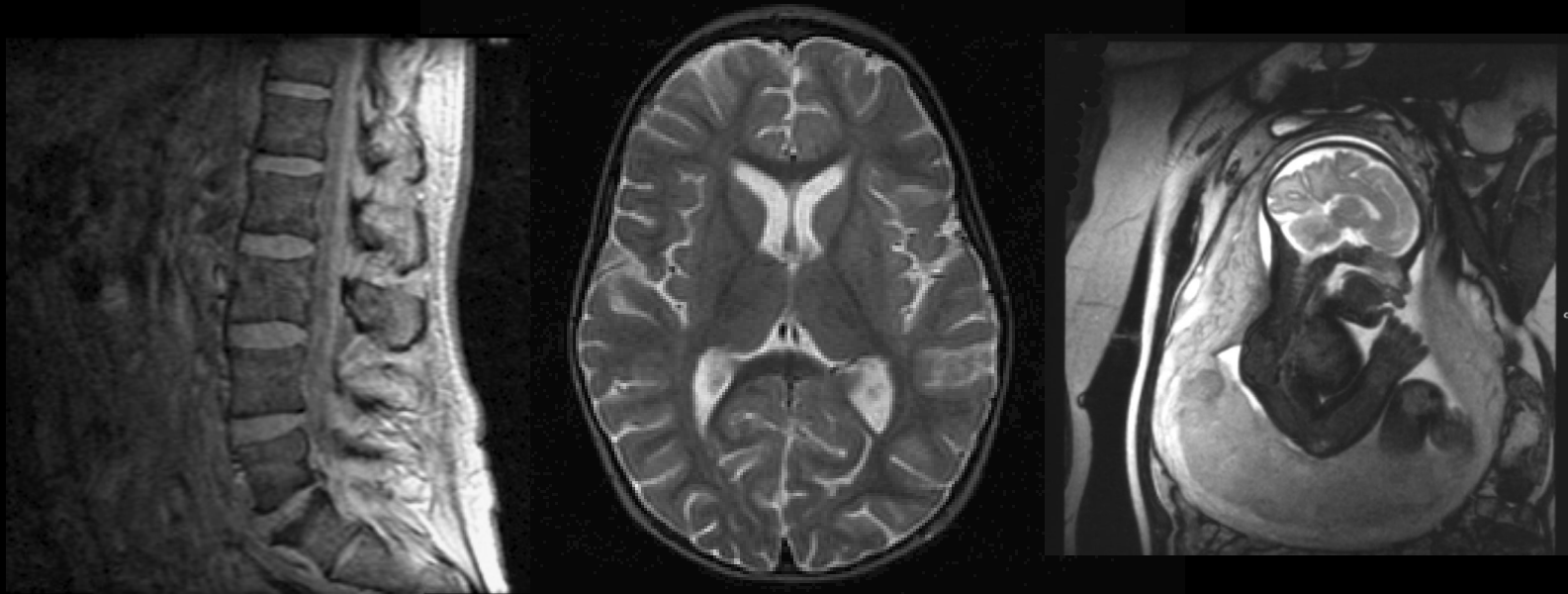
Infrared thermometer



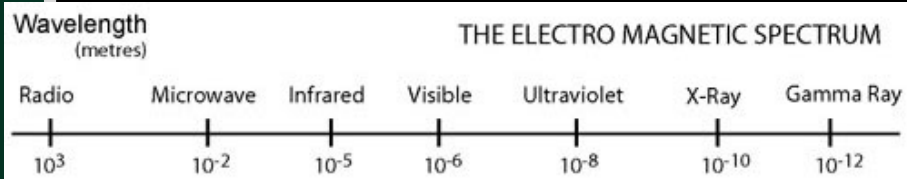
醫學影像技術：醫用超音波



醫學影像技術：磁共振影像



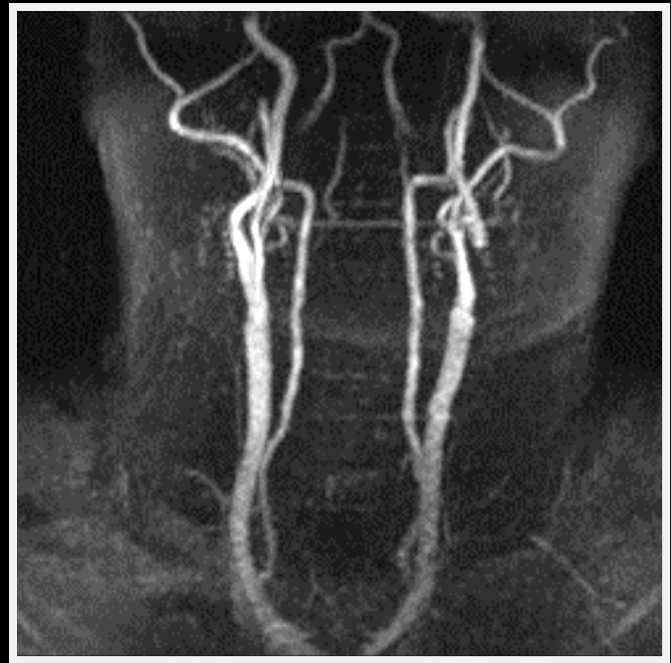
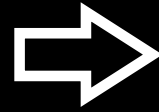
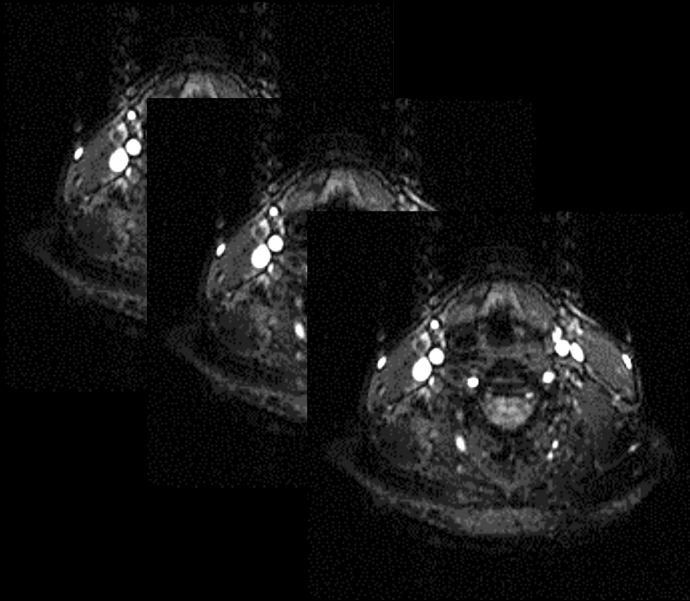
Magnetic Resonance Imaging



醫學影像處理

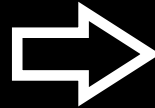
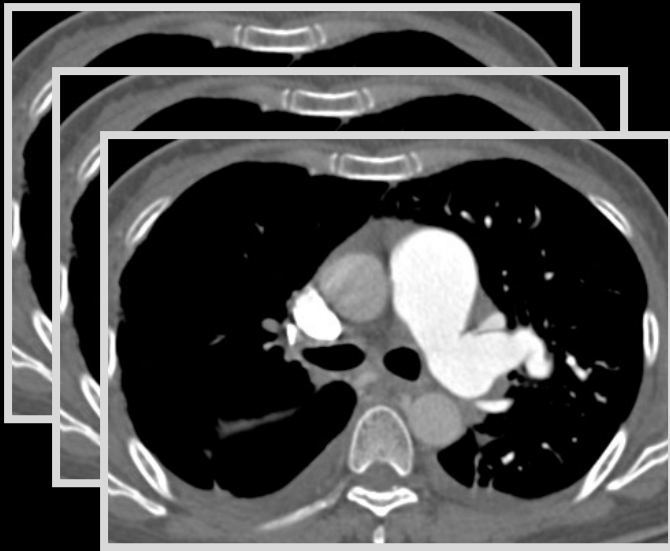
- 哪種醫學影像需要影像處理？
 - X光？電腦斷層掃描？
 - 螢光顯微攝影？內視鏡？
 - 超音波？磁共振造影？
- 全部都需要！
- 來幾個例子吧...

血管攝影



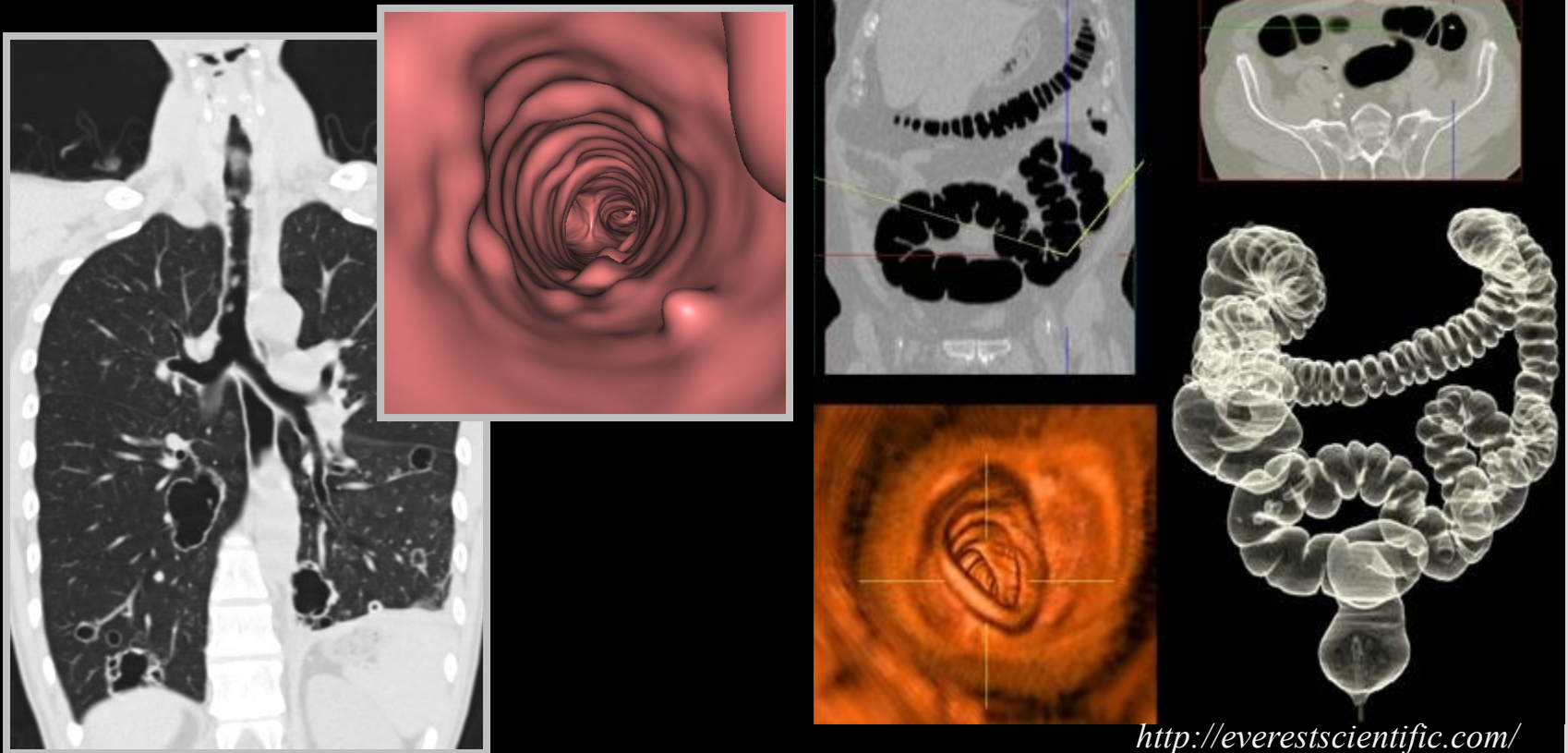
Maximum intensity projection

三維重建



3D rendering of cardiovascular system

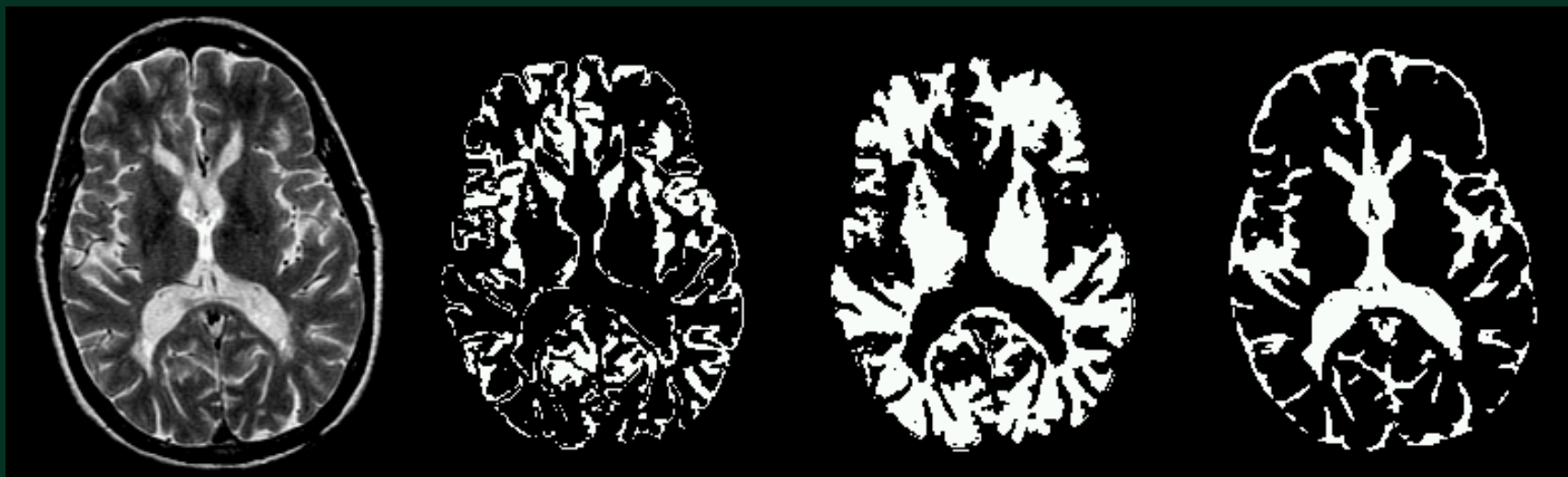
虛擬內視鏡



Virtual Endoscope

<http://everestscientific.com/>

人腦灰白質切割



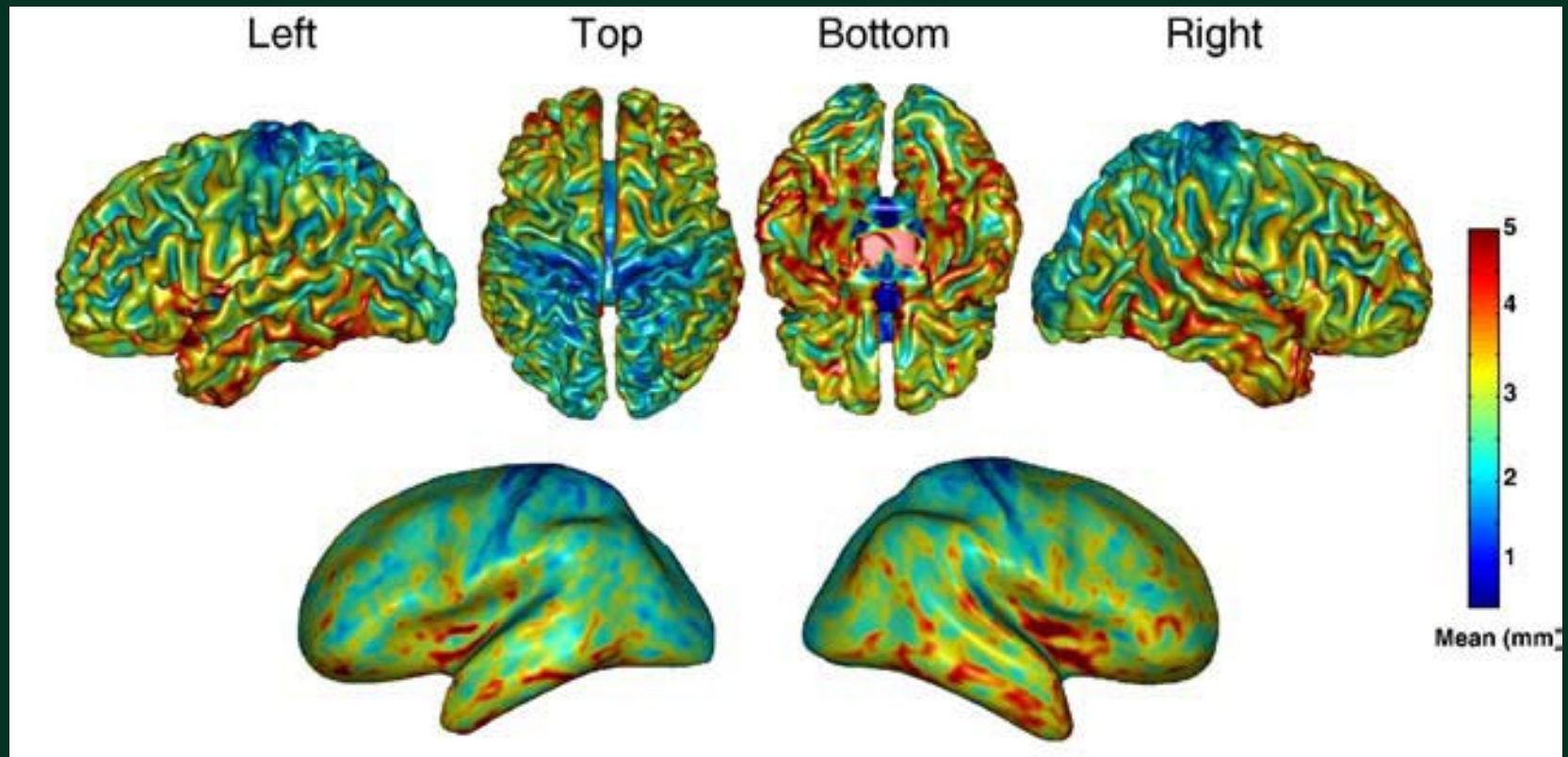
Brain

GM

WM

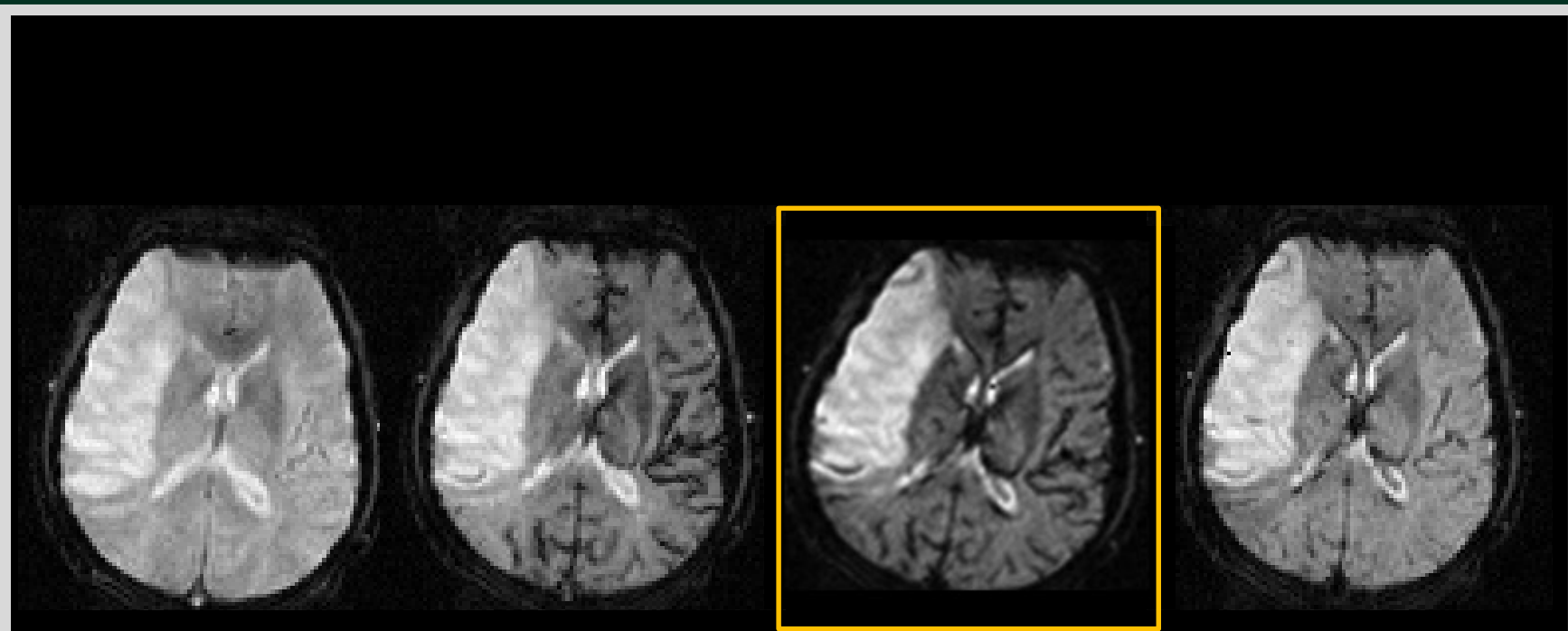
CSF

大腦皮質厚度量測



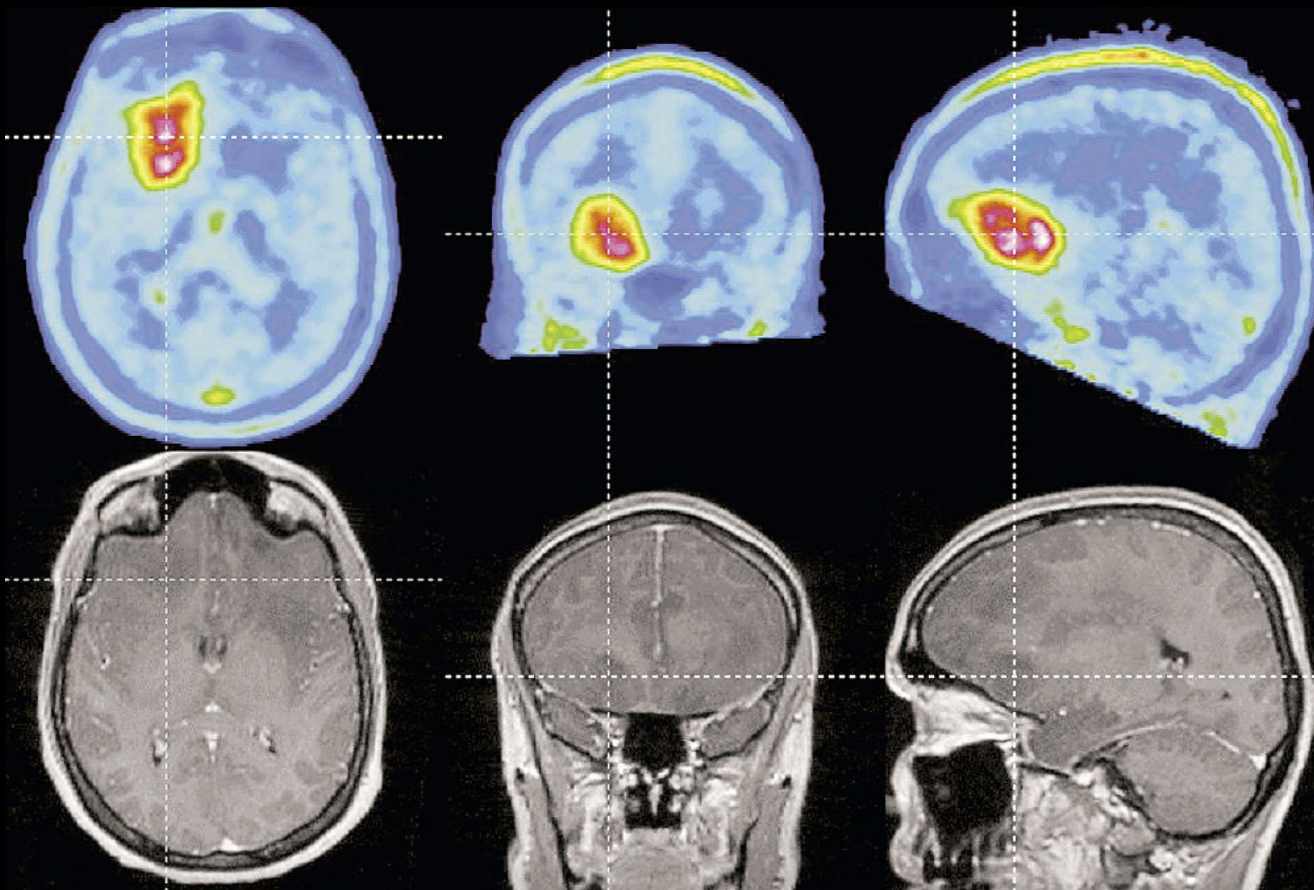
Hutton C, De Vita E, Ashburner J, Deichmann R, Turner R. "Voxel-based cortical thickness measurements in MRI." *Neuroimage*. 2008 May 1;40(4):1701-10.

影像對位：連續取像



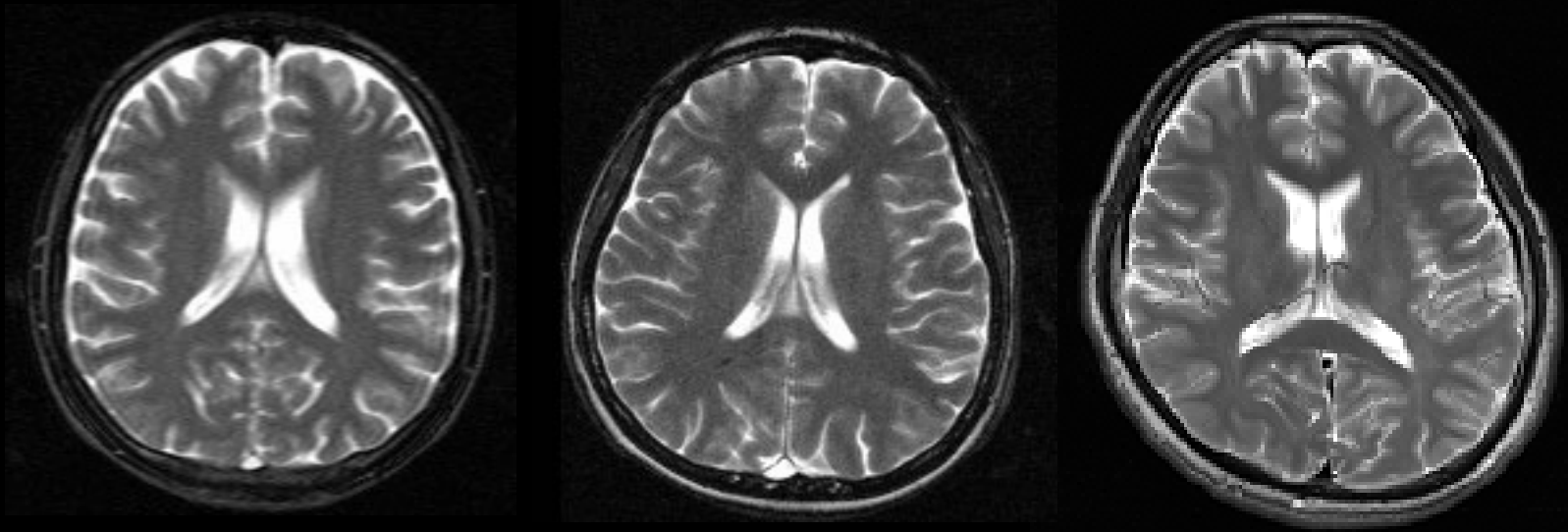
動態顯影劑的注射追蹤

影像對位：不同影像來源



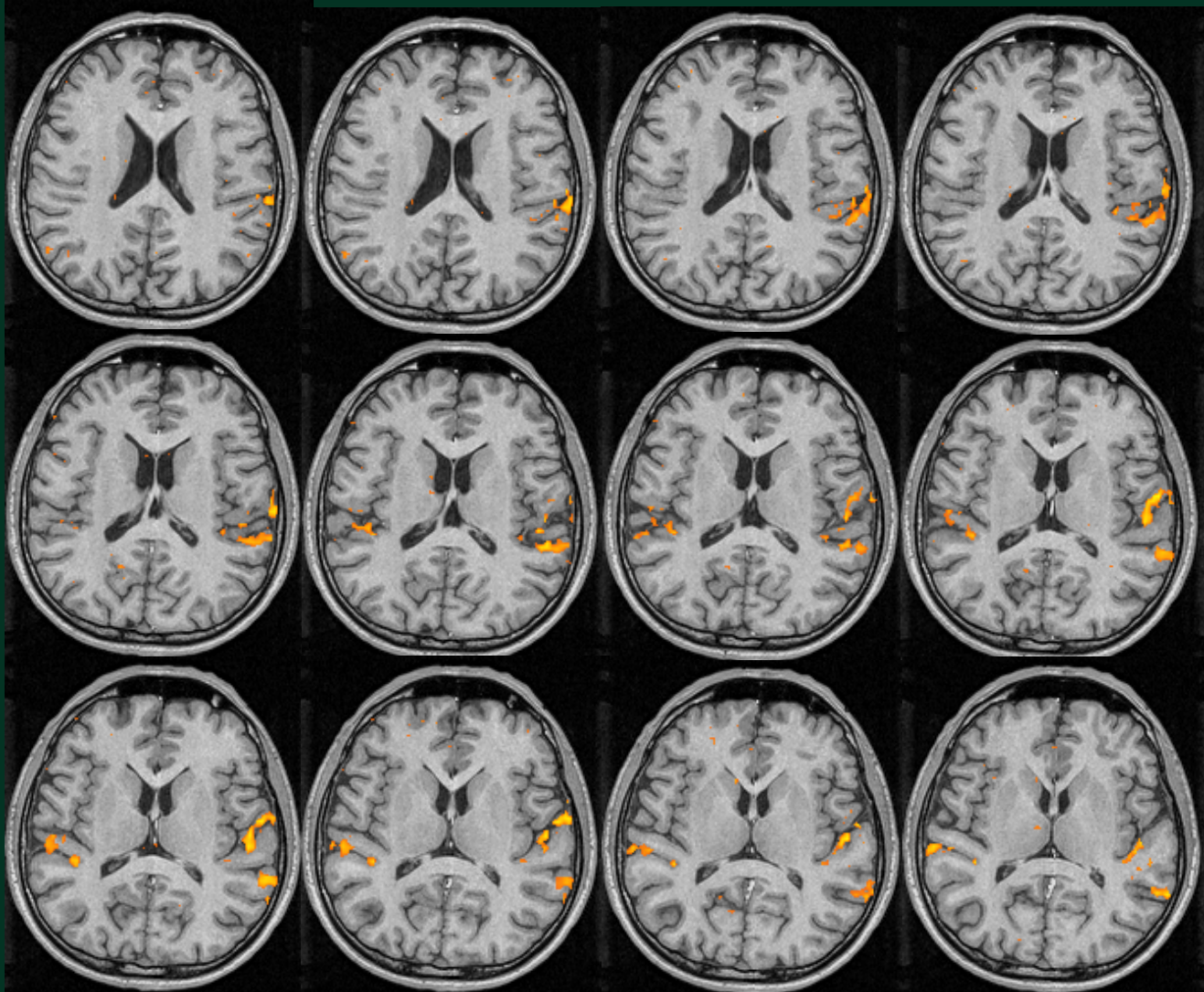
上：代謝物影像(PET) 下：結構影像(MRI)

影像對位：不同受試者

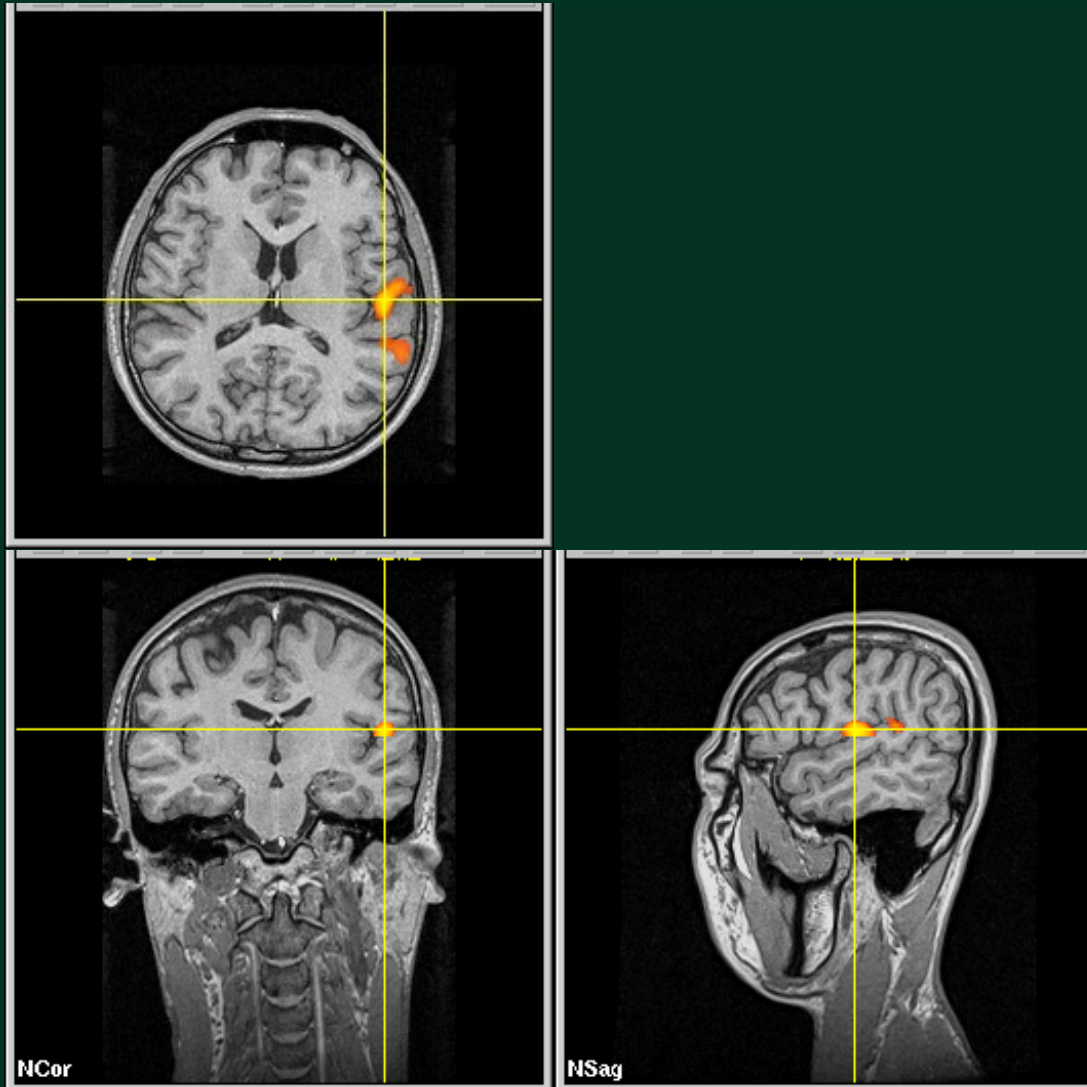


Group analysis 硬是需要不同頭形對位

誇張一些：功能性磁共振造影



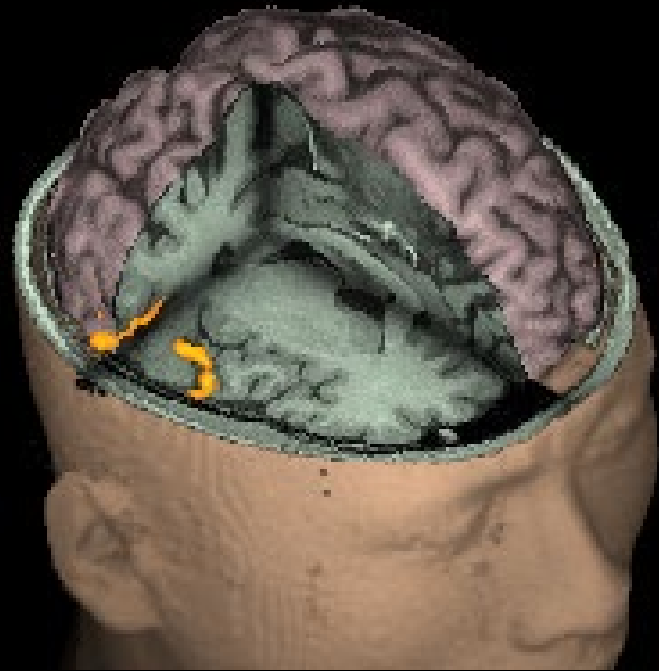
當然可以重組出任何切面



3D定位/顯示



腦部軟膜表面



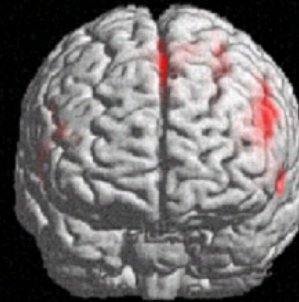
頭部表面切割

各種角度都可以看

Posterior



Anterior



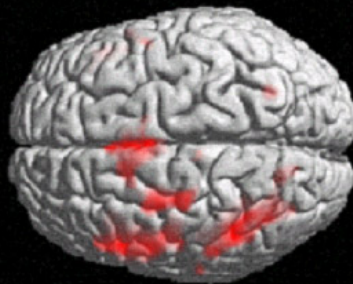
Right



Left



Up



Down



總結

- 醫學影像處理的目的：
正確地擷取重要，但並非顯而易見的生理資訊
- 良好的醫學影像品質、適當的影像處理技術缺一不可



生醫影像研究方法