

# Magnetic Resonance Imaging Principles and Applications

## 核磁共振影像原理及應用

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Lecture Time: Thursday 09:00~12:00  
Classroom: BMES R501  
Office Hour: Tuesday 10:00~12:00 (appointment via E-mail)  
Course No.: 11210BMES546700

### 1. Prerequisites

General physics

### 2. Text books/Optional References

- (1) Lecture slides: eeclass
- (2) Robert W. Brown, Yu-Chung N. Cheng, Michael, R. Thompson, Ramesh, Venkatesan, Magnetic Resonance Imaging: Physical Principles and Sequence Design, 2<sup>nd</sup> edition, 2014, Wiley Blackwell.

### 3. Course Description

This course introduces the fundamental concepts and applications of magnetic resonance imaging. The concepts include spin behavior, NMR signals, hardware, pulse sequence and k space. The technical applications regarding fast scan, parallel imaging, artifacts will be covered in this course. We will also introduce some of clinical applications, e.g. fMRI, angiography, diffusion, and perfusion.

### 4. Course Objectives

- (1) Develop basic concepts and important applications of MRI
- (2) Develop problem-solving and critical thinking skills
- (3) Learn to integrate and apply various concepts to a single problem

### 5. Topic

- (1) NMR signal
- (2) Spatial encoding
- (3) Hardware
- (4) Image quality and contrast
- (5) MRI pulse sequence and k-space
- (6) Fast scan
- (7) Parallel imaging
- (8) MRI artifacts
- (9) fMRI
- (10) MR angiography
- (11) Phase contrast MRI
- (12) Diffusion imaging
- (13) Perfusion imaging

### 6. Evaluation

- (1) **Quiz: 70%**
  - Quiz1: 35%, Quiz2: 35%
  - You can bring a handwriting A4-size note (double-side)
- (2) **Final report: 25%**

- 1 persons/group
- Journal paper (1 major paper + 2 references)
  - targeting journal : Nature, Science, or their series (published year : after **2020**)
  - topic : new knowledge related to MRI
- Abstract (4%): Two-page A4
  - (1) Title, authorship, journal, volume, page, year
  - (2) Chinese/English, 12-size, single space
  - (3) Organized descriptions of the major paper
  - (4) Describe the relevance of this paper to our lecture ( $\leq$  600 words)
- Midterm report (6%)
  - Four-page A4 (Chinese/English, 12-size, single space, figures allowed)
  - Organized and detailed descriptions of 1 major paper + 2 references.
  - Figures and Tables are allowed.
- Final presentation (15%): hardcopy of slides, final report
  - 15 min presentation + 5 min Q&A
  - Final report: Six-page A4 (Chinese/English, 12-size, single space, figures allowed)
  - 15% (Presentation + Final report)

### **(3) Course Participation: 5%**

Website for paper survey: <http://www.nature.com/siteindex/index.html>;  
<http://www.sciencemag.org/>; <http://www.ncbi.nlm.nih.gov/sites/entrez>

### 7. 生成式人工智慧倫理聲明 「有條件開放，請註明如何使用生成式 AI 於作業或報告」

基於透明與負責任的原則，本課程並未禁止學生利用 AI 進行協作或互學，以提升本門課學習品質。根據本校公布之「大學教育場域 AI 協作、共學與素養培養指引」，本門課程採取有條件開放，請註明如何使用生成式 AI 於作業或報告，說明如下：

- 學生可於課堂作業或報告中的「引用文獻後」簡要說明如何使用生成式 AI 進行議題發想、文句潤飾或結構參考等使用方式。若經查核使用卻無在作業或報告中標明，教師有權重新針對作業或報告不予計分。
- 本門課授課教材或學習資料若有引用自生成式 AI，教師也將在投影片標註或口頭說明。
- 修讀本課程之學生於選課時視為同意以上倫理聲明。