Course Specification

RARD 527: Medical Image Processing

Institution Name: Mahidol University

Campus/Faculty/Department: Faculty of Medicine Ramathibodi Hospital, Department of Diagnostic and Therapeutic Radiology

Section 1: General information

1. ***Course number and name***
   Course number: RARD 527
   Course name: Medical Image Processing

2. ***Credits: 2(1-1-3)***

3. ***Curriculum and type of course***

   3.1 Curriculum: Medical Image Processing

   3.2 Type of course: Core course

4. ***Instructors***
   4.1 Course Coordinator: Lect.Dr. Krisanat Chuamsaamarkkee
   4.2 Instructors
   Lect.Dr. Krisanat Chuamsaamarkkee
   Asst. Prof. Dr. Wiwat Owasirikul
   Asst. Prof. Dr. YudthaphonVichianin

5. ***Semester/Year:*** 1st Semester, Academic Year 2020, 1styear students
6. ***Pre-requisite:*** None
7. ***Co-requisite:*** None
8. ***Classroom:*** To be announced
9. ***Revision Date:*** Nov 2019 ***By:*** Committee

   Note: Revised course learning outcome, course description, and evaluation

Section 2: Purpose and objective

1. ***Course Learning Outcomes***
   - 1.1 Have a comprehensive knowledge of the basics of medical image processing.
   - 1.2 Demonstrate anunderstanding of the image quality, signal to noise ratio (SNR) and modelling image degradation
   - 1.3 Describe the role of basic image processing techniquesuch as image registration and image segmentation in high level image analysis
   - 1.4 Explainthe medical networking and information system, image format, DICOM and PACS
   - 1.5 Discuss the current and future roles of image analysis techniques in biomedical researches

Section 3: Course details

1. ***Course description***

   This course will cover the fundamental components of medical image analysis and visualization. It will start with an introduction to the underlying concepts and mathematics of biomedical image processing including data storage types and co-ordinate systems. This will be followed by the image processing techniques, Intensity Correction, Registration and Segmentation.The remainder of the course will focus on specific examples of high-level image processing and their application in medical imaging. The examples covered will be Non-linear registration, image fusion or cross modality data. In addition to this theoretical background, students will be expected to work through real data examples using common image analysis software.

   Hours per semester: Lecture 30 hours

2. ***Assignment feedback:*** Within 2 - 4 weeks

Section 4: Course Learning Outcomes

Course level learning outcomes	Program level learning outcomes	Methods	Assessment
1 Student have a knowledge of the basics of medical image processing	ELO 2	-Lecture -Assignment	- Paper/oral Examination - Report/Assignment
2 Student can understand the image quality, signal to noise ratio (SNR) and modelling image degradation	ELO 2	- Lecture - Assignment	- Paper/oral Examination - Report/Assignment
3 Student can understandthe role of basic image processing techniquesuch as image registration and image segmentation in high level image analysis	ELOs 2, 6	- Lecture - Assignment	- Paper/oral Examination - Report/Assignment
4 Student can explain the medical networking and information system, image format, DICOM and PACS	ELOs 2, 6	- Lecture - Assignment - Presentation	- Paper/oral Examination - Report/Assignment - Presentation Rubric Assessment
5 Student can Discuss the current and future roles of image analysis techniques in biomedical researches	ELOs 2, 5	- Lecture - Assignment - Presentation	- Paper/oral Examination - Report/Assignment - Presentation Rubric Assessment

Section 5: Lesson plan and assessment

1. Lesson plan

Time (h)	Topics	Instructors	Method	Assessment
2	Introduction to Medical Image Processing and the Human Visual Perception	Lect. Dr. Krisanat	Lecture	Paper/Oral examination/Assignment
2	Medical Image Formation Datatypes & co-ordinate systems in medical imaging.	Lect. Dr. Krisanat	Lecture	Paper/Oral examination/Assignment
3	Image Quality, SNR and Modelling Image Degradation	Lect. Dr. Krisanat	Lecture	Paper/Oral examination/Assignment
3	Image Reconstruction and Filtering	Lect. Dr. Krisanat	Lecture	Paper/Oral examination/Assignment
6	Image Transformation, Linear and non-linear medical image registration	Asst. Prof. Dr. Wiwat	Lecture	Paper/Oral examination/Assignment
3	Sources of intensity variation and geometric distortion in Biomedical Images. BO correction, geometric distortion correction, EPI distortion correction.	Asst. Prof. Dr. Wiwat	Lecture	Paper/Oral examination/Assignment
6	Biomedical image segmentation Multi-spectral segmentation, spatial priors, Guassian Mixture modelling,kmean, Expectation Maximisation (EM). Atlas creation and applications,model based segmentation	Asst. Prof. Dr. Wiwat	Lecture	Paper/Oral examination/Assignment
5	Medical networking and information system, image format, DICOM and PACS	Asst. Prof. Dr. Yudthaphon	Lecture	Paper/Oral examination/Assignment

Measurement and Evaluation of Student Achievement

2.1	Theory (short/Long answer questions)	60%
2.2	Assignment	25%
2.3	Journal presentation	10%
2.4	Class discussion	5%

Section 6: Assessment and improvement of the course operation

1. Strategies to assess the effectiveness of the courses by the students
    - Assessment of instructor's teaching by student

2. Strategy to assess the instruction
    - Assessment of students' learning records
    - Assessment of instructor's teaching by student

3. Improvement of Instruction
    - Consider the students' learning records
    - Consider the students' assessment of instructor's teaching
    - Consider the program committee's comment

4. Verification of student achievement in the subject
    - By program committee and faculty-level academic committee

5. Review and action plan to improve the effectiveness of the course
    - Using the results from 1 - 4 as inputs to the instruction improvement

Learning Resources

1. Birkfellner, W., 2015. *Applied medical image processing: a basic course*. CRC Press.
2. Bushberg, J.T. ed., 2002. *The essential physics of medical imaging*. Lippincott

Williams & Wilkins.