

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	课程名称 Course Title	医学图像处理 Medical image processing
2.	授课院系 Originating Department	生物医学工程系 Department of Biomedical Engineering
3.	课程编号 Course Code	BMEB316
4.	课程学分 Credit Value	3
5.	课程类别 Course Type	专业选修课 Major Elective Courses
6.	授课学期 Semester	秋季 Fall
7.	授课语言 Teaching Language	中英 Chinese and English
8.	授课教师、所属学系、联系方式 (如属团队授课, 请列明其他授课教师) Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	李依明, 生物医学工程系 Yiming Li, Biomedical Engineering Liyim2019@sustech.edu.cn
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	待公布 To be announced
10.	选课人数限额(可不填) Maximum Enrolment (Optional)	

11. 授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
	32		32		64
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	无 None				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	无 None				
14. 其它要求修读本课程的学系 Cross-listing Dept.	无 None				

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

介绍数字图像基本概念和处理方法，介绍医学图像的特点及医学图像标准，以案例的形式介绍典型医学图像问题和处理方法

Introduce the fundamental concepts and basic processing methods. Introduce the features of medical

16. 预达学习成果 Learning Outcomes

熟悉数字图像基本概念，掌握基本处理方法。了解医学图像的特点和图像标准，并通过实验与课程项目体验医学图像处理具体处理过程。

Understand the fundamental concepts of digital images, master the basic processing methods.

Get known about the features of medical images and the standards.

Experience the typical processing of medical images via experiments and projects

17. 课程内容及教学日历（如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）

Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

Scheduled lecture topics:

Lecture 1. 概述/Introduction (2 学时)

医学成像系统；医学图像处理与分析；医学图像应用研究
Medical imaging system; Medical image processing and analysis; Medical image applications

Lecture 2. 图像基础/ Basics for Image Formation (3 学时)

人眼的成像基础；电子探测器；采样；量化；噪声；相关数学工具
Image formation by the human eyes; Electronic detectors; Sampling; Quantization; Noise; Related Mathematical tools

Lecture 3. 图像增强技术/Image Enhancement (3 学时)

灰度变换函数；灰度直方图；空间滤波器；卷积；平滑空间滤波器；锐化空间滤波器
Grey scale transformations; Histogram; Spatial filter; Convolution operator; Smoothing spatial filters, Sharpening spatial filters

Lecture 4. 频域变换/ Frequency domain transformation (3 学时)

2 维傅里叶变换和 2 维线性移不变系统；频域滤波基础；频域平滑滤波器；频域锐化滤波器
2D Fourier transform and 2D linear shift-invariant system; Basics of filtering in the Frequency Domain; Image smoothing using frequency Domain filters; Image sharpening using frequency domain filters

Lecture 5. 几何变换和图像配准 Geometric transformation and Image registration (4 学时)

刚体变换；放射变换；透视变换；非线性变换；图像卷绕；插值；图像配准方法
Rigid Body Transformation; Affine Transformation; Perspective Transformation; Nonlinear Transformation; Image Warping; Methods for image registration

Lecture 6. 图像复原/ Image restoration (2 学时)

噪声模型；空间滤波器复原；频域滤波器复原；维纳滤波
Noise model; Restoration using spatial filter; Restoration using frequency domain filter; Wiener filter

Lecture 7. 图像分割 1/ Image segmentation 1 (2 学时)

图像分割基础；边缘分割；阈值化
Fundamentals; Edge Detection; Thresholding

Lecture 8. 图像分割 2/ Image segmentation 2 (2 学时)

形态学图像处理，灰度形态学；分水岭分割
Morphological Image Processing; Gray-scale morphology; Watershed Segmentation

Lecture 9. 三维和彩色可视化/ 3D and color visualization (2 学时)

相机光学；最大光强投影；彩色模型；彩色变换；彩色图像处理
Camera Optics; Maximum Intensity Projection; Color Models; Color Transformations; Color Image Processing

Lecture 10. 图像压缩/Image Compression (2 学时)

编码冗余；保真度准则；图像格式；基本的图像压缩方法
Coding Redundancy; Fidelity Criteria; Image Compression Models; Image Formats; Basic Compression Methods;

Lecture 11. 显微图像复原/Microscopic image restoration (2 学时)

显微图像成像原理；点扩散函数；去卷积
Microscopic image formation; Point Spread Function; Deconvolution

Lecture 12. 深度学习/Deep Learning (3 学时)

人工神经网络；正向传播；梯度递减；代价函数；反向传播
Artificial Neural Network; Forward Propagation; Gradient Descent; Loss Function; Backward propagation

Lecture 13. 报告/Presentation (2 学时)

Experiments:

- Experiment 1. (Week 9) Basics for MATLAB Image Processing
- Experiment 2. (Week 10) Geometric transformation, intensity transformation and spatial filtering
- Experiment 3. (Week 11) Spatial domain and frequency domain processing
- Experiment 4. (Week 12) Image segmentation- Thresholding and edge detection
- Experiment 5. (Week 13) Morphological image processing and watershed segmentation
- Experiment 6. (Week 14) Brain MRI image registration
- Experiment 7. (Week 15) Microscopic image restoration
- Experiment 8. (Week 16) Deep Learning

18. 教材及其它参考资料 **Textbook and Supplementary Readings**

1. Rafael C. Gonzalez, Richard E. Woods . Digital Image Processing(third edition). 电子工业出版社.
2. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins. Digital Image processing using Matlab (second edition). 电子工业出版社.
3. Paul Suetens. Fundamentals of Medical Imaging(2nd Edition). Cambridge University Press. 2009

课程评估 **ASSESSMENT**

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		5		
课堂表现 Class Performance		5		
小测验 Quiz				
课程项目 Projects		40		
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam		30		
期末报告 Final Presentation		20		
其它(可根据需要 改写以上评估方 式) Others (The above may be modified as necessary)				

20. 记分方式 **GRADING SYSTEM**

A. 十三级等级制 **Letter Grading**

B. 二级记分制 (通过/不通过) **Pass/Fail Grading**

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority

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