

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	计算机视觉与应用 Computer Vision and Applications
2.	授课院系 Originating Department	系统设计与智能制造学院 School of System Design and Intelligent Manufacturing
3.	课程编号 Course Code	SDM378
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	春季 Spring
7.	授课语言 Teaching Language	中英双语 English & Chinese
8.	授课教师、所属学系、联系方式 Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	王振坤, 助理教授 系统设计与智能制造学院 (设计智造学院) WANG Zhenkun, Assistant Professor School of System Design and Intelligent Manufacturing (SDIM) Email: wangzk3@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)	待公布 To be announced

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
学时数 Credit Hours					
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	计算机程序设计基础 A (CS102A)、高等数学(下) A (MA102B)、线性代数 A (MA107A)				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	无 NIL				
14. 其它要求修读本课程的学系 Cross-listing Dept.	无 NIL				

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程首先介绍计算机视觉，包括视觉技术发展历程，视觉的几何模型以及学习模型，传统视觉特征提取以及学习方法，随后介绍当前计算机视觉中的热点技术，深度学习算法和模型及其在目标检测和追踪，图像分类以及分割，以及图像风格迁移以及图像压缩感知等实际应用任务。本课程的重点是在理解和掌握基础方法和理论模型的基础上，通过实际应用项目的实践，进一步促进学生对计算机视觉理论方法的全面掌握。

This course provides an introduction to computer vision including history of vision techniques, vision geometry models, vision learning models and traditional visual feature detection and learning methods. Besides, we will also discuss the cutting-edge techniques employed in computer vision- deep learning models and their applications in objective detection and tracking, image classification and segmentation, image style transfer and image compressed sensing. The focus of the course is to not only help students to understand the fundamental methods and theoretic models, but also to promote their comprehensive grasp of computer vision theories through a series of real-world case studies.

16. 预达学习成果 Learning Outcomes

完成该课程，学生能够做到：

- 1 了解视觉计算的理论和实践。
- 2 能够掌握传统视觉特征以及深度学习特征的区别。
- 3 熟悉深度学习模型及其在计算机视觉低层次和高层次任务中的应用。
- 4 能够使用代码实现经典的算法模型。

5 构建计算机视觉应用。

1. Recognize and describe both the theoretical and practical aspects of computing with images.
2. Identify the differences between the traditional visual features and deep learning based features.
3. Become familiar with the major deep learning models involved in low-level and high-level computer vision tasks.
4. Implement the classic algorithms and models
5. Build computer vision applications.

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.)

第一周：导论

- 课程介绍
- 计算机视觉发展历程
- 计算机视觉技术基本概念

[实验]：搭建与配置环境，包括 anaconda, python 和 pytorch 等

Week 1: Introduction

- Curriculum introduction
- Vision technique background
- Basic vision concepts

[Lab]: Build programing platforms, including anaconda, python and pytorch etc.

第二周：视觉几何模型

- 变换模型
- 摄像系统
- 应用

[实验]：配置 IDE(Pycharm) 和 jupyter，进行远程编程与调试

Week 2: Geometry models

- Transformation model
- Camera system and model
- Applications

[Lab]: Config IDE(Pycharm) and jupyter to remotely program and debug

第三周：视觉学习模型

- 判别模型
- 生成模型
- 应用

[实验]：图像及视频文件读取和显示

Week 3: Machine learning models in vision

- Discriminative models
- Generative models
- Applications

[Lab]: read and show the image and video files

第四周：图像预处理与特征提取

- 预处理
- 描述子
- 特征降维

[实验]：项目一：图像滤波和特征可视化

Week 3: Image pre-processing and feature extraction

- Image pre-processing
- Descriptor
- Feature dimension reduction

[Lab]: Project 1: Image filtering and feature visualization

第五周: 特征匹配

- 点与局部图像块
- 边缘检测
- 线检测

[实验]: 项目一: 图像过滤和特征可视化

Week 5: Feature matching

- Points and patches
- Edges
- Lines

[Lab]: Project 1: Image filtering and feature visualization

第六周: 深度神经网络 (一):

- 基础模型介绍
- 损失函数
- 应用

[实验]: 项目二: 基于深度学习的图像增强

Week 6: Deep learning

- Basic models
- Basic losses
- Applications

[Lab]: Project 2: Image enhancement based on deep learning

第七周: 深度神经网络 (二)

- 前沿模型介绍
- 优化基础
- 应用

[实验]: 项目二: 基于深度学习的图像增强

- Introduction to the state-of-the-art models
- Fundamentals of optimization

- Applications

[Lab]: Project 2: Image enhancement based on deep learning

第八周: 目标检测

- HOG 特征和线性模型
- 瀑布模型与滑动窗机制
- 基于深度学习的目标检测

[实验]: 项目三: 目标检测

Week 8: Object detection

- HOG features and linear classification
- Cascade models and sliding windows
- Deep learning-based models for object detection

[Lab]: Project 3: Objective detection

第九周: 图像分类

- 字典学习
- 特征学习
- 深度学习

[实验]: 项目三: 目标检测

Week 9: Image classification

- Dictionary learning
- Feature learning
- Deep learning

[Lab]: Project 3: Objective detection

第十周: 图像语义分割

- 块分类
- 编码器/解码器结构
- 全卷积方法

[实验]: 项目四: 基于深度学习的图像分类

Week 10: Semantic segmentation

- Patch classification
- Auto-Encoder
- FCN: Fully Convolutional Networks

[Lab]: Project 4: Deep learning based image classification

第十一周: 传统跟踪方法

- 光流法
- 卡尔曼滤波
- 粒子滤波

[实验]: 项目四: 基于深度学习的图像分割 Week 11: Classical tracking methods

- Optical flow
- Kalman filter
- Particle filter

[Lab]: Project 4: Image segmentation based on deep learning

第十二周: 高级跟踪算法

- 基于检测的跟踪
- 基于深度学习的跟踪算法

[实验]: 项目四: 基于深度学习的图像分割 Week 12: Advances in object tracking

- Tracking by detection
- Tracking using deep learning

[Lab]: Project 4: Image segmentation based on deep learning

第十三周: 图像风格迁移

- 图像重建
- 风格重建
- 风格迁移算法

[实验]: 项目五: 目标跟踪 Week 13: Image Style Transfer

- Image reconstruction
- Style reconstruction
- Style transfer

[Lab]: Project 5: Object tracking

第十四周: 生成对抗模型与应用

- 生成器
- 判别网络

[实验]: 项目五: 目标跟踪

Week 14: Generative adversarial networks

- Generator
- Discriminator

[Lab]: Project 5: Object tracking

第十五周 图像压缩感知

- 测量矩阵
- 稀疏表示与学习
- 迭代重构算法
- 评价指标

[实验]: 项目五: 基于 GAN 的 logo 自动生成

Week 15: Image compressed Sensing

- Sensing matrix
- Sparse representation
- Iterative algorithms
- Metrics

[Lab]: Project 5: 基于 GAN 的自动 logo 合成

第十六周: 深度学习图像压缩感知

- 卷积网络
- 生成对抗网络
- 残差重构网络

[实验]: 项目六 (可选): 基于深度学习的图像感知重构

Week 16 (Optional):

- Convolutional neural network
- GAN
- Residual reconstruction network

[Lab]: Project 6(Optional): Deep learning based Image Compressed sensing

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

Textbook : "Computer Vision: Algorithms and Applications" Website: <http://szeliski.org/Book/>

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	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects		60%	NIL	评估学生项目 To assess students' project
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告 Final Presentation		40%	NIL	评估学生项目 To assess students' project
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