南方科技大学 SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

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**	**机器人与视觉感知：基本原理及算法** **Robotics and Visual Perception: Fundamentals and Algorithms**
2.	**授课院系** **Originating Department**	机械与能源工程系 Department of Mechanical and Energy Engineering
3.	**课程编号** **Course Code**	ME339
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**	英文 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）**	贾振中，机械与能源工程系 Zhenzhong Jia, Department of Mechanical and Energy Engineering Email（电子邮箱）: jiazz@sustech.edu.cn Cellphone（手机）: 86-15712835401
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
学时数 Credit Hours	48				48

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	MA107A 线性代数 Linear Algebra A、 MA212 概率论与数理统计 Probability and Statistics 有编程基础，熟悉 Matlab 的使用,建议先修 ME112 MATLAB 工程应用 Introduction to Matlab
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	现代机器人学（研究生） Modern Robotics (for Graduate Students)
14. 其它要求修读本课程的学系 Cross-listing Dept.	电子与电气工程、计算机科学与工程 Electrical and Electronics Engineering, Computer Science and Engineering

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程涵盖机器人、视觉和控制的基本概念和算法。它将理论、算法和示例结合在一起，分别阐述机器人技术和计算机视觉并对其进行综合。本课程首先对移动机器人、导航、定位、运动学、动力学和关节级控制等基础知识串讲学习，然后讲述相机模型、图像处理、特征提取和多视角几何，最后将所有内容综合到视觉伺服系统的广泛讨论中。在本课程中，通过使用 MATLAB Robotics 和 Vision 工具箱，我们将展示如何仅用几行简单的代码就可以分解和解决复杂的问题。本课程所涵盖的主题以实际问题为指导。

This course covers the fundamental disciplines and algorithms of robotics, vision and control. It weaves together theory, algorithms and examples in a narrative that covers robotics and computer vision separately and together. This course is a real walk through the fundamentals of mobile robots, navigation, localization, arm-robot kinematics, dynamics and joint level control, then camera models, image processing, feature extraction and multi-view geometry, and finally bringing it all together with an extensive discussion of visual servo systems. In this course, by using MATLAB Robotics and Vision Toolboxes, we will show how complex problems can be decomposed and solved using just a few simple lines of code. The topics covered are guided by real problems.

16. 预达学习成果 Learning Outcomes

本课程的预学习成果为：（1）记住机器人学中的基本概念，包括移动机器人、机械臂及运动规划等；（2）记住视觉感知中的基本概念；（3）了解机器人和视觉感知领域中的常用方法；（4）将上述基本概念和常用方法应用到多种机器人平台和问题中，包括移动机器人、机械臂、视觉伺服等。

The desired learning outcomes of this course are: (1) Remembering basic concepts in robotics (mobile robots, manipulator, and motion planning); (2) Remembering basic concepts in visual perception; (3) Understanding the most common techniques used in the field; (4) Applying them on a variety of robotic platforms, including mobile robots, manipulators, and visual servoing;

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.)

课程内容	教学要求	学时分配
绪论 • 机器人与视觉感知的应用背景 • 本课程的性质、任务和主要内容 • 课程安排与考核标准 • 基础知识：位置和运动 • 所需前期知识的复习 Introduction • Application background of Robotics and visual perception • The objectives, outcomes and main topics of this course • Schedules and grading policies • Recap of prerequisite knowledge	了解机器人与视觉感知的发展和重要性 了解本课程在机器人培养方向的地位，了解其目标、任务、内容、课程安排和考核 Understand the history and importance of Robotics and Visual Perception Understand the importance of this course to robotics education program Understand the objectives, expected outcomes, main topics, schedules and grading policies of this course 【RVC，Chapter-1】	2
机器人基础知识 • 位置和运动 • 时间和运动 Foundations of Robotics • Position and Motion • Time and Motion	了解如何表示位置和姿态，了解机器人运动和时间的关系 Understand methods of representing position and orientation Understand robot motion versus time 【RVC，Chapter-2 and Chapter-3】	4
移动机器人 • 轮式移动机器人 • 多旋翼无人机 Mobile Robot Vehicles • Wheeled Mobile Robots • Flying Robots – Quadrotors	了解移动机器人平台，特别是不同形式的轮式移动机器人，以及多旋翼无人机 Understand mobile robot platform, especially different types of wheeled mobile robots, and flying robots such as quadrotors 【RVC，Chapter-4】	2
机器人导航 • 反应导航 • 基于地图的规划 Navigation and Localization • Reactive Navigation • Map-Based Planning	了解机器人导航的基本原理，了解反应导航，以及基于地图的导航（即运动规划） Understand the robot navigation problem Understand reactive navigation, and map-based navigation, i.e., motion planning 【RVC，Chapter-5】	2
机器人定位 • 航位推测 • 定位与建图 • 蒙特卡洛方法 Localization • Dead Reckoning • Localization and Mapping • Monte-Carlo Methods	了解机器人定位中的多种方法，包括航位推测、同时定位与建图、蒙特卡洛方法等 Understand multiple localization methods, including dead reckoning, SLAM, Monte-Carlo, and other methods 【RVC，Chapter-6】	4
关节型机器人及其运动学 • 正运动学 • 逆运动学 • 速度运动学—雅克比 Arm-Type Robots and Kinematics • Forward Kinematics • Inverse Kinematics • Velocity Kinematics – Jacobian	了解关节型机器人及其运动学基本知识，包括正运动学、逆运动学、雅克比 Understand arm-type robots and their kinematics, including forward / inverse kinematics, and velocity kinematics (Jacobian) 【RVC，Chapter-7 and Chapter-8】	4
机器人动力学与控制 • 独立关节控制 • 运动学方程 • 动力学补偿控制 Dynamics and Control • Independent Joint Control • Equations of Motion • Dynamics Compensation	了解机器人动力学与控制基本知识，包括独立关节控制、运动学方程、补偿控制等 Understand the basics of robot dynamics and control, including independent joint control, rigid-body equations of motion, and dynamics compensation 【RVC，Chapter-9】	4
期中考试-课程复习 Mid-Term Review Lecture	系统回顾上半学期内容（主要是机器人） Systematic review of materials covered in the first-half semester (mainly robotics)	2

期中考试 Mid-term Exam		0
计算机视觉 • 光和颜色 • 图像生产 Computer Vision • Seeing (Light and Color) • Image Formation	了解图像生成的基本原理 Understand the basic principle of image formation 【RVC，Chapter-10 and Chapter-11】	2
计算机视觉 • 图像直方图 • 图像处理 Computer Vision • Images Histograms • Image Processing	了解图像处理的基本知识和多种常用方法，学习多个实例和编程 Understand basics and multiple methods used for image processing Study multiple examples and programming 【RVC，Chapter-12】	6
计算机视觉 • 图像特征提取 • 多视角情况 Computer Vision • Image Feature Extraction • Multiple View Case	Understand the basics of image feature extraction and multi-view case Familiar with basic operations through programming examples 了解图像特征提取和多视角计算机视觉的基本知识，并通过编程熟悉其基本操作 【RVC，Chapter-13 and Chapter-14】	6
基于视觉的控制 • 基于位置的视觉伺服 • 基于图像的视觉伺服 Vision-Based Control • Position-Based Visual Servoing (PBVS) • Imaged-Based Visual Servoing (IBVS)	Understand the basic principles and applications of visual servoing Understand PBVS and IBVS 了解视觉伺服控制的基本原理及应用 了解 PBVS 和 IBVS 的原理及应用 【RVC，Chapter-15】	4
高等视觉伺服 • XY/Z 分割视觉伺服 • 使用极坐标的视觉伺服 • 使用球形相机的视觉伺服 物体识别及其应用 Advanced Visual Servoing • XY/Z-Partitioned IBVS • IBVS using Polar Coordinates • IBVS for a Spherical Camera Object Recognition and Its Applications	了解高等视觉伺服的典型实例，包括 XY/Z 分割视觉伺服、使用极坐标的视觉伺服、使用球形相机的视觉伺服、应用实例 介绍物体识别方法及其在机器人中的应用 Understand typical examples of advanced visual servoing, including XY/Z-partitioned IBVS, IBVS using polar coordinates, spherical camera based IBVS, and typical applications 【RVC，Chapter-16】 Introduce object recognition methods and its applications in robotics (supplement)	4
课程复习与未来展望 Course Review and Future Prospects		2
期末考试 Final Exam		0

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

Peter Corke, "Robotics, Vision and Control: Fundamental Algorithms In MATLAB", Second Edition

参考：Peter Corke 著，刘荣 等译. 《机器人学、机器人视觉与控制——MATLAB 算法基础》，电子工业出版社

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				

小测验 **Quiz**		5		
课程项目 **Projects**				
平时作业 **Assignments**		40		
期中考试 **Mid-Term Test**		25		
期末考试 **Final Exam**		25		
期末报告 **Final Presentation**				
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

机械与能源工程系教学委员会