

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	移动机器人导航与控制 Mobile Robot Navigation and Control
2.	授课院系 Originating Department	电子与电气工程系 Electronic and Electrical Engineering
3.	课程编号 Course Code	EE346
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 Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	张宏、电子系、h Zhang@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 / 已确定的实验员/助教联系方式 Please list all Tutor/TA(s). TBA 需要 TA
10.	选课人数限额(可不填) Maximum Enrolment (Optional)	20

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	32		32	64
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	MA212 概率论与数理统计; EE205 信号和系统 MA212 Probability and Statistics; EE205 Signals and Systems				
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.					

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

通过本课程，学生将从一套零部件开始，并以自动驾驶的小型模型自动驾驶机器人车辆完成。在此过程中，学生将使用传统或最先进的方法，最新的软件工具和真实的硬件来建立和实验，从而获得动手学习的经验。该课程是车辆自动驾驶的实用介绍。它探索了针对自动化理论挑战的现实解决方案，包括它们在算法中的实现，在仿真以及硬件中的部署。使用 Python，机器人操作系统（ROS）和 Docker 构建的现代软件架构，学生将尝试到经典架构和基于现代机器学习的方法的互补优势。本入门课程将一部移动机器人从零到无人驾驶在汽车在模型版道路上安全行驶。

With this course, the students will start from a package of robot parts and finish with a scaled self-driving robot vehicle that drives autonomously. In the process, the student will use established as well as experiment with state-of-the art approaches, the latest software tools and real hardware in an engaging hands-on learning experience. The course is a practical introduction to vehicle autonomy. It explores real-world solutions to the theoretical challenges of automation, including their implementation in algorithms and their deployment in simulation as well as on hardware, using modern robotics software development tools such as Python, ROS, and Docker.

16. 预达学习成果 Learning Outcomes

- 了解移动机器人基本零部件
 - 掌握基本机器人编程工具，如 Python, ROS, OpenCV
 - 学习相关计算机视觉算法，如滤波，线特征检测，物体检测，物体姿态估计
 - 尝试 PID 类基本系统控制方法
 - 培养团队工作能力
 - 阅读机器人导航相关文章
- Learn the basic components of a mobile robot
 - Acquire knowledge about the programming environment of a robot (Python, ROS, OpenCV)
 - Establish an understanding of the basic algorithms in computer vision such as filtering, line detection, object detection, perspective-n-point

- Practice with the PID control algorithm of a dynamic system (mobile robot)
- Experience working within a group and preparing lab reports and presentations
- Read scientific papers on the subject of autonomous robotics and self-driving vehicles

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.)

Part 1: (8 学时)

Autonomous vehicles and Robotic systems System and autonomy architectures
Representations
Robot operating system (ROS)

Part 2: (8 学时)

Kinematics: modeling, calibration and system processing
PID control

Part 3: (22 学时)

Computer vision basics
Feature extraction
Line Detection
Place recognition
RANSAC
Camera calibration

Part 4: (10 学时)

Bayes filter
Particle filter
Kalman filter
Simultaneous localization and mapping (SLAM)

Part 5: (16 学时)

Robot path planning
AIDO: AI Driving Olympics
Learn-based autonomous navigation

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

1. ROS Robot Programming: From the Basic Concept to Practical Programming and Robot Application, by YoonSeok Pyo, HanCheol Cho, RyuWoon Jung and TaeHoon Lim.
免费下载, 中文版/英文版, <https://community.robotsource.org/t/download-the-ros-robot-programming-book-for-free/51>
2. Computer Vision: Algorithms and Applications, by Richard Szeliski,
免费下载, https://szeliski.org/Book/drafts/SzeliskiBook_20100903_draft.pdf

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		10%		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects		60%		项目部分包括单位任务的完成和期末机器人比赛成绩, 各占 30%左右
平时作业 Assignments				
期中考试 Mid-Term Test		20%		
期末考试 Final Exam				
期末报告 Final Presentation		10%		
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

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

电子与电气工程系课程设置与培养方案委员会