# 课程大纲
# COURSE SYLLABUS

| | | |
|---|---|---|
| **1.** | **课程代码/名称**<br>**Course Code/Title** | **移动机器人自主导航 Autonomous Robot Navigation** |
| **2.** | **课程性质**<br>**Compulsory/Elective** | Elective |
| **3.** | **课程学分/学时**<br>**Course Credit/Hours** | 3 |
| **4.** | **授课语言**<br>**Teaching Language** | English |
| **5.** | **授课教师**<br>**Instructor(s)** | ZHANG Hong |
| **6.** | **是否面向本科生开放**<br>**Open to undergraduates or not** | No |
| **7.** | **先修要求**<br>**Pre-requisites** | Calculus, Probability Theory or Statistics, Linear Algebra, Computer Programming (C++ or Python) |

**8.** **教学目标**
**Course Objectives**

本课程涉及自主机器人导航的主题。 学生将熟悉相关的移动机器人技术，及经典和现代算法。 本课程将重点讲授移动机器人如何利用其传感器（例如激光测距仪和摄像头）收集的传感信息，同时构建地图并在该地图中进行机器人定位（所谓的 SLAM 问题）。介绍各类 SLAM 算法，通过阅读文献并利用其软件实现，学生将对这些算法有深入的了解。 课堂授课和家庭作业将依靠开源 SLAM 算法以及公开数据集，实现对 SLAM 算法的理解。

This course is concerned with the subject of autonomous robot navigation. The students will become familiar with related mobile robotics research and study a number of classical and modern algorithms. Specifically, the course will focus on how a mobile robot builds a map and localizes itself in that map at the same time (the so-called SLAM problem), by making use of the information collected by its sensors such as laser range finders and cameras. The lectures will introduce both basic and advanced SLAM algorithms, and the students will gain an in-depth understanding of these algorithms by both reading research papers and examining their software implementations. Class lectures and homework assignments will rely on existing SLAM algorithms to control robots in simulated environments and study SLAM algorithms on benchmark datasets.

**9.** **教学方法**
**Teaching Methods**

The teaching of the course will consist of classroom lectures. Students will be evaluated based on a combination of homework assignments and exam(s). There is a course project at the end of the semester or a final exam.

**10.** **教学内容**
**Course Contents**
（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）

| | |
|---|---|
| **Section 1** | Introduction to robotics |
| **Section 2** | Coordinate frames, transformations, and robot kinematics |
| **Section 3** | Sensors: LiDARs, cameras, RGB-D, and IMU |
| **Section 4** | Odometry: wheel, visual and LiDAR odometry |

| | | |
|---|---|---|
| | **Section 5** | Filter-based SLAM algorithms |
| | **Section 6** | Optimization-based SLAM algorithms |
| | **Section 7** | Computer vision basics |
| | **Section 8** | Visual SLAM |
| | **Section 9** | Place recognition and loop closure detection |
| | **Section 10** | Advanced Topics |
| | | |

**11. 课程考核**
**Course Assessment**

1. Form of examination: written exam
2. Grading policy: (a) attendance 10% (b) assignments 35% (c) midterm exam: 20% (d) final exam/project: 35%

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


1. http://ais.informatik.uni-freiburg.de/teaching/ss20/robotics/
2. Grisetti, G., Kummerle, R., Stachniss, C., and Burgard, W. “A tutorial on graph-based SLAM.” IEEE Intelligent Transportation Systems Magazine, 2(4):31–43, 2010.
3. Lowry, Stephanie, et al. “Visual place recognition: A survey.” IEEE Transactions on Robotics 32.1 (2016): 1-19.
4. Cadena, Cesar, et al. “Past, present, and future of simultaneous localization and mapping: Towards the robust-perception age.” IEEE Transactions on Robotics 32.6 (2016): 1309-1332.