VM 467 Introduction to Robotics Syllabus

UM-SJTU Joint Institute, Summer 2017

Course Description:

This course provides a systematic study of robotics, consisting primarily of two parts: 1) modeling and actuation and 2) sensing and reasoning. The first part provides students with a mathematical tool to model the motion of a robot, analyze its kinematics and dynamics, and design control strategies. The second part introduces robot perception through vision, popular localization and mapping techniques, and fundamental motion planning algorithms. A brief introduction is also given to the key components of a robotic system including actuators and sensors. Students are required to accomplish course projects involving both hardware and software in order to gain hands-on experience.

Prerequisites: Vm240 and Vm360

Instructor: Prof. Yu Zheng
Email: yuuzheng@umich.edu
Office room: Room 217, N Law School Building
Office hours: Tuesday, 14:00-16:00 or by appointment
Classroom: 东中院 E1-103
Class times: Tuesday & Thursday, 8:00-9:40
Teaching assistant: Lei Tang
Email: 20090430414@sjtu.edu.cn
Office: Room B304, ME Building
Office hours: TBD

Textbook:

1. R. M. Murray, Z. X. Li, S. S. Sastry, A Mathematical Introduction to Robotic Manipulation, CRC Press, 1994. (available online)
2. R. Siegwart, I. R. Nourbakhsh, D. Scaramuzza, Introduction to Autonomous Mobile Robots – 2nd edition, The MIT Press, 2011. (1st edition available online)

Grading Policy:

Homework	25%
Quizzes	10%
Midterm exam	20%
Final exam	20%
Projects	25%

The instructor reserves the right to change the percentages of the above grading system.

Attendance Policy:

- A student is expected to attend every class. The instructor makes the final decision to excuse or not to excuse an absence.
- The instructor is entitled to give a failing grade for excessive absences.

- No food is allowed in class.

Homework Policy:

- Homework may consist of writing and/or coding parts.
- Students are required to accomplish homework independently. However, it is acceptable for students to collaborate in discussing and helping each other solve the problems.
- Homework is due in one week at the beginning of class, unless otherwise indicated. No late homework will be accepted after the due date.

Project Policy:

- Students will be divided into groups to conduct the projects.
- At the end of each project, every student need finish an experimental report with a clear statement of what he/she has contributed to the project.
- While students in a group collaborate on the project, every student must finish his/her own report.
- Reports are due at 23:59, August 6. Half credit for any late turn-in.

Quiz and Exam Policy:

- Quizzes and exams are closed book. One-page notes are allowed for midterm and final exams.
- Any use of cell phones, pads, tablets, or other electronic devices is prohibited.
- No make-ups will be given unless documented emergency.

Academic Integrity Policy:

Each student has the responsibility to understand, accept, and comply with the honor code as set forth by the UM-SJTU Joint Institute (http://umji.sjtu.edu.cn/academics/academic-integrity/honor-code/). Violations of the honor code will be reported to the honor council. At the instructor's discretion, the penalty may be a grade of zero on the assignment up to and including a grade of failure on the course. It is the sole responsibility of the student to understand and follow the honor code.

Tentative Schedule:

Date	Activity and Content	HW
Week 1	Course introduction, robotic system overview, mathematical basis	
Week 2	Rigid body motion, homogeneous representation	HW1 assigned
Week 3	Forward and inverse kinematics, Jacobian	HW2 assigned
Week 4	Lagrange's equations, holonomic constraints	HW3 assigned
Week 5	Position and trajectory tracking control, force control	
Week 6	**Midterm**, introduction to sensors and actuators	Project Proposal due
Week 7	Computer vision: cameras, image information, stereo vision	HW4 assigned
Week 8	Image processing: filtering, edge detection	HW5 assigned
Week 9	Feature extraction: feature detectors, recognition	HW6 assigned
Week 10	Kalman filter, Kalman filter localization, Markov localization	HW7 assigned
Week 11	Simultaneous localization and mapping (SLAM)	HW8 assigned
Week 12	Motion planning, obstacle avoidance	Project Report due on August 6
Week 13	Summary, **Final Exam**	