Université d'Ottawa
Faculté de génie

Département de
génie mécanique

uOttawa

University of Ottawa
Faculty of Engineering

Department of
Mechanical Engineering

MCG 4134: Robot Design and Control

Winter 2013

Instructor: Dr. Davide Spinello
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phone: 613.562.5800 ext. 2460
office hours: Take an appointment by email

Lecture: TBT 0021
Tuesday 13:00 - 14:30
Thursday 11:30 - 13:00

Tutorial: STE 2060, Wednesday 14:30 - 16:00

Textbook: Spong M. W., Hutchinson S., Vidyasagar M. *Robot Modeling and Control*. Wiley, 2006

Web page: http://by.genie.uottawa.ca/~spinello/webpage/teaching.html

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Course Outline

Classification of robot manipulators. Review of rigid motions. Forward and Inverse Kinematics. Independent joint control. Point-to-point control. Path planning and trajectory control. Computed torque technique. Compliance and force control. Sensory components for robot control.

Description and objectives

This course presents the concepts of robot manipulators kinematics and dynamics, and teaches methods for designing classical linear controllers to achieve desired motions of robot manipulators, with a brief introduction on sensory components for feedback control of robotic systems. Students will develop the capability of analyzing the motion of robot manipulators and of designing simple controllers to regulate their behaviour.

Exams: policy and dates

The final exam will be open book - open notes.

Illegible work and loose sheets will not be graded. If a student cannot attend a test/exam due to a medical condition, certified by a doctor, he/she must notify the instructor in advance. Unexcused absence from an exam will result in a grade of 0 for that exam.

Mid-term exam Take home, due on Monday, Feb 25.

Final exam TBD

Computer oriented assignments

Three computer oriented problems will be assigned during the term. Assignments will be individual.

Marks

Marks from computer oriented assignments and mid-term exam determine the semester mark S, computed as follows:

Mid-term exam	60%
Computer oriented assignments	40%
Total of semester (S)	100%

This mark will be combined with the final exam mark F in the following way:

$$0.6F + 0.4S$$

If $F < 55\%$, regardless of the mark of the semester S the overall course grade will be F.

Regulations on Academic Fraud

The following link provides information regarding academic fraud, including the Regulation on Academic Fraud which provides information on the definition of fraud, the disciplinary process and the consequences of dishonest behaviour: `http://web5.uottawa.ca/mcs-smc/academicintegrity/regulation.php`

Suggested problems

Chapter 2: 2-1; 2-2; 2-15; 2-20; 2-22; 2-24; 2-37; 2-38; 2-39; 2-41

Chapter 3: 3-2; 3-3; 3-4; 3-5; 3-6; 3-7; 3-8; 3-9; 3-11; 3-12; 3-13; 3-14; 3-15; 3-16; 3-18; 3-21

Chapter 4: 4-1; 4-2; 4-6; 4-7; 4-13; 4-14; 4-15; 4-16; 4-17; 4-18; 4-20; 4-21

Tentative lecture schedule

Lecture	Reading	Topic
1: Tu Jan 8	1.2; 1.3; 2.1 - 2.2	Robotic manipulators and their classification; Review of rigid bodies kinematics
2: Th Jan 10	2.3 - 2.5	Review of rigid bodies kinematics
3: Tu Jan 15	2.6; 2.7	Review of rigid bodies kinematics
4: Th Jan 17	3.1; 3.2	Kinematic chains; The Denavit-Hartenberg convention
5: Tu Jan 22	3.3	Inverse kinematics
6: Th Jan 24	3.3	Inverse kinematics
7: Tu Jan 29	4.1; 4.2	Angular velocity: the fixed axis case; Skew symmetric matrices
8: Th Jan 31	4.3; 4.4	Angular velocity: the general case; Addition of angular velocities
9: Tu Feb 5	4.6	Derivation of the Jacobian
10: Th Feb 7	4.7; 4.8	The tool velocity; The analytical Jacobian
11: Tu Feb 12	4.9	Singularities
12: Th Feb 14	4.10	Static force/torque relationships
13: Tu Feb 26	4.11	Inverse velocity and acceleration
14: Th Feb 28	4.12	Manipulability
15: Tu Mar 5	5.1	The configuration space
16: Th Mar 7	5.2	Path planning using potential fields
17: Tu Mar 12	5.5	Trajectory planning
18: Th Mar 14	6.1	Actuator dynamics
19: Tu Mar 19	6.2	Independent joint model
20: Th Mar 21	6.3	Set-point tracking
21: Tu Mar 26	6.4	Feedforward control
22: Th Mar 28	9.1	Coordinate frames and constraints
23: Tu Apr 2	9.2	Network models and impedance
24: Th Apr 4	9.3	Task Dynamics and Control 25: Tu Apr 9