MECH 573 Mechanics of Robotic Systems

Course Information – Winter 2010

www.cim.mcgill.ca/~rmsl/courses

Prof. J. Angeles, MD452　　　　　　　　　　　　　　Office Hours: W. 4:00–5:00; Th. 10:00–11:00
angeles@cim.mcgill.ca

Secretariat: I. Cartier <irene.cartier@mcgill.ca> MD461, Local 6313

Course Outline

Objective:

　　To learn the kinematics, statics, dynamics and trajectory-planning of robotic mechanical systems at large: serial manipulators of general architecture; parallel manipulators; grasping devices; walking machines; and rolling robots. Applications to the optimum design and the kinematic control of these systems are emphasized.

Contents:

1. Manipulator performance evaluation and optimization: dexterity and manipulability; condition number and isotropy; the characteristic length and the characteristic point of manipulators; manipulator design under isotropy criteria; functional requirements of manipulator design.

2. Trajectory planning for pick-and-place operations: polynomial and piecewise-polynomial interpolating functions (splines); cycloidal motion. Consideration on motor specifications of maximum speed and maximum torque.

3. Special topics in rigid-body kinematics: twist and twist-rate determination from body-point measurements of position, velocity, and acceleration.

Class Test & submission of PR one week after completion of these three topics

4. Inverse kinematics of serial, six-axis robotic manipulators of general architecture: the solution of the nonlinear kinematic equations; calculation of all solutions; polynomial and contour-intersection methods.

5. Kinematics of other types of robotic mechanical systems: planar, spherical and spatial parallel manipulators; direct and inverse kinematics of these devices; grasping devices; walking machines; rolling robots.

6. Continuous-path operations: curve geometry; parametric path representation; parametric splines; continuous path-tracking.

7. Dynamics of robotic mechanical systems: classification of robotic mechanical systems with regard to dynamics; the structure of the dynamics models of holonomic and nonholonomic systems; dynamics of parallel manipulators; dynamics of rolling robots.

Class Test & submission of FR on the last day of lectures

Marking Scheme:

Course work will consist of: assignments, but these will not be marked; two class tests; and one term project. Mark distribution:

Class Test 1	10%
Class Test 2	10%
Project Progress Report (PR)	30%
Project Final Report (FR)	50%

Text:
Angeles, J., 2007, *Fundamentals of Robotic Mechanical Systems. Theory, Methods, and Algorithms*, Third Edition, Springer, New York.

Notes:

1. In order to protect the environment, students are required to submit their reports in double-sided sheets. When the hardware available does not allow for double-sided printouts, use recycled paper and a **note to this effect**.

2. McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offenses under the code of student conduct and disciplinary procedures. For more information see

   `www.mcgill.ca/integrity`

3. If you have any disability please contact the instructor to arrange a time to discuss your situation. It will help if you contact the Officer for Students with Disabilities at 398-6009 before you do this.

4. Every student has the right to write term papers, examinations and theses in English or in French, except in courses where knowledge of a language is one of the objectives of the course.

5. Lecture attendance is mandatory. Students missing one lecture are responsible for obtaining course information from their fellow students.