MECH 573 Mechanics of Robotic Systems

Course Information – Winter 2005

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Prof. J. Angeles, Rm. 452 MD

Office Hours: W. 9:00–10:00; Th. 4:00–5:00

angeles@cim.mcgill.ca

Secretariat: Room 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 (spline) interpolating functions; 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.

4. Inverse kinematics of serial, six-axis robotic manipulators of general architecture: The solution of the nonlinear kinematic equations; calculation of all solutions; algebraic-geometric and semigraphical 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.

Marking Scheme:

Course work will consist of assignments, one mid-term exam, and one final exam, with the distribution below:

Assignments	20%
Midterm exam	30%
Final exam	50%

Note:
In order to protect the environment, students are encouraged to submit their assignments in either double-sided sheets or recycled paper.

Text:
Angeles, J., 2002, *Fundamentals of Robotic Mechanical Systems. Theory, Methods, and Algorithms*, Second Edition, Springer-Verlag, New York.

Note: 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

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