

NEW COURSE (Spring 2011)

ME392-02: Special Topics:

ADVANCED TOPICS IN ROBOTICS AND MECHANISM SYNTHESIS

Instructor: N. Simaan

Prerequisites: Linear algebra, Introduction to robotics; Recommended: Mechanics of Machines; Or based on instructor's permission: If you have some of these courses from your undergraduate study you qualify for the course registration. Please see Professor Nabil Simaan for any questions)

Description:

This course is for graduate students interested in theoretical kinematics and robot design and optimization. The course will cover preparatory topics for graduate research in robotics. We cover topics on parallel robots, serial robots, multi-fingered hands, robots with kinematic and actuation redundancies.

Topics to be covered (time permitting)

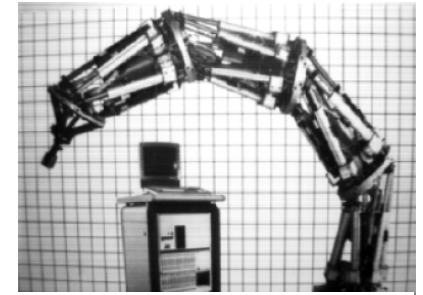
1. Special methods in kinematics: quaternions, dual numbers, rotation vectors, and dual numbers for kinematics.
2. Quaternions on hyper-spheres, path planning and pose interpolation.
3. Instantaneous kinematics of open and closed kinematic chains and their screw-based modeling and analysis
4. Introduction to line geometry and applications in robotics
5. Introduction to screw theory and its applications in robotics.
6. Introduction to redundant manipulators: inverse kinematics, resolved rate control, performance measures, priority-based task optimization for obstacle avoidance and dexterity optimization.
7. Introduction to numerical and symbolic methods for the solution of polynomial systems arising in kinematics: use of resultants, eigenvalue methods and introduction to numerical continuation methods for solving direct kinematics problems of parallel robots.

Course Requirements

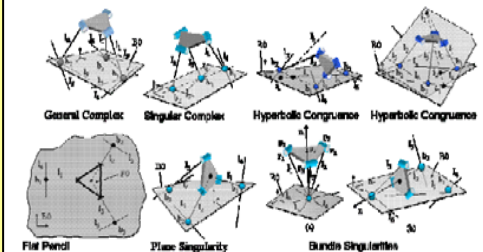
The course will have no final exam. The grading will be based on **bi-weekly assignments**, class participation, **1 term project** and a **project presentation**. We will also assign several recent research papers for group and individual research study.

Who should take this course

MECE/CS graduate students interested in strengthening their theoretical background in robotics.



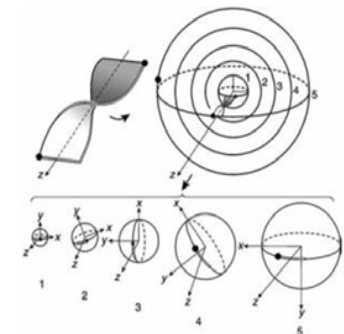
Hybrid redundant robot



Singularity Analysis using line geometry



Robotic Hands for



Quaternion representation