NEW COURSE (Spring 2012)

ME392-02: Special Topics: Advanced Topics In Robotics And Mechanism Synthesis

Course web page: http://arma.vuse.vanderbilt.edu (see education section)

Instructor: Dr. Nabil Simaan. **Time and Location:** Tuesdays & Thursdays 2:35-3:50 PM, Olin 134

Who should take this class: Mechanical engineering and computer science (EE/CS) students interested in a solid theoretical foundation for robotics research.

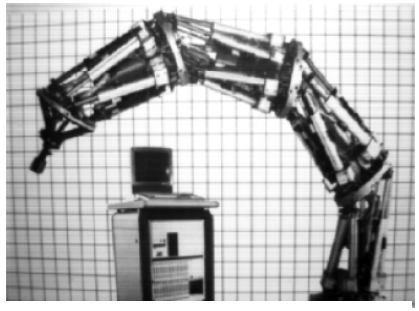
Description:
This course is for graduate students interested in theoretical kinematics and robot design and optimization. The course will cover preparatory topics for graduate research in robotics. We cover topics on parallel robots, serial robots, multi-fingered hands, robots with kinematic and actuation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

Prerequisites: Introduction to robotics or based on instructor permission (please see or email Professor Nabil Simaan for any questions nabil.simaan@vanderbilt.edu)

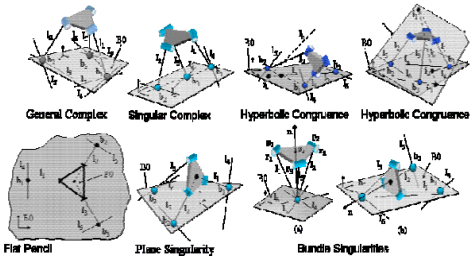
Topics to be covered

1. Special modeling methods in kinematics: quaternions, dual numbers, rotation vectors, and dual numbers/dual quaternions for kinematics and vision.
2. Quaternions on hyper-spheres, path planning and pose interpolation.
3. Applications of quaternions for eye-in hand calibration (hand-eye calibration).
4. Introduction to screw theory
5. Screw theory for modeling of Instantaneous kinematics of open and closed kinematic chains
6. Introduction to line geometry and applications in robotics
7. Performance measures for serial and parallel robots
8. Introduction to redundant manipulators: inverse kinematics, resolved rate control, priority-based task optimization for obstacle avoidance and dexterity optimization.
9. Kinematic modeling and analysis of parallel robots.
10. Introduction to stability of grasp in robotic hands.
11. 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.

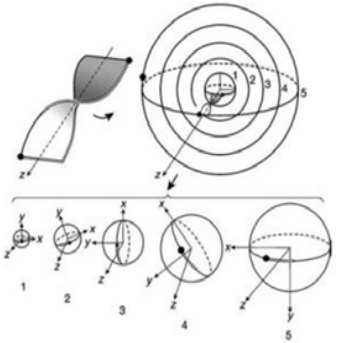


Hybrid redundant robot



Singularity Analysis using line geometry

Robotic Hands for



Quaternion representation