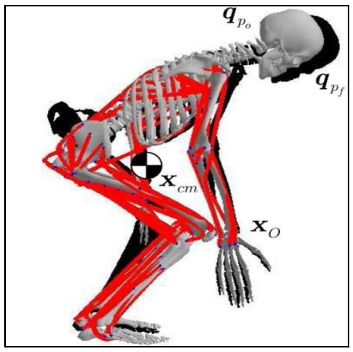
Advanced Robotics Manipulation

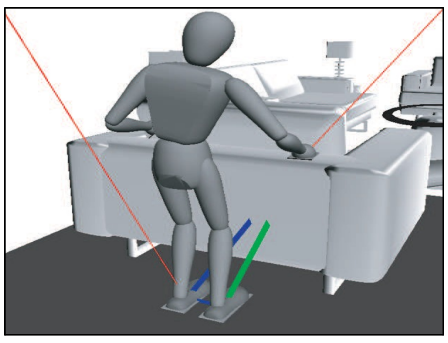
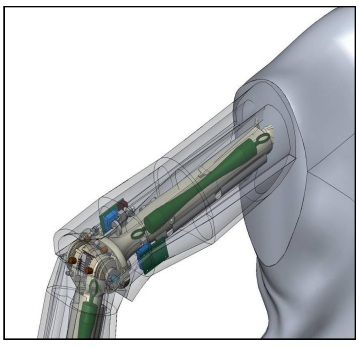
CS327A - Spring 2010/2011

Outline

This course focuses on advanced control methodologies and novel design techniques for complex human-like robotic systems. It provides an extensive coverage of the task-oriented operational space formulation, and discusses its application to the challenges of interactive whole-body control of humanoid robots. The presentation of the material starts with the basic models and control structure of a simple robot arm and culminates with the most recent developments on the control of humanoid robots. The framework addresses various challenging problems which include: (i) the motion coordination of the large number of degrees of humanoid robots; (ii) the effective control of their contacts and interactions with the environment; (iii) the maintenance of their internal and external constraints; (iv) and the strategies for dealing with their underactuation and balance. The above issues are all treated in a unified fashion within a general control structure that addresses the whole body dynamics for specifications involving multiple distributed tasks and postures in consistency with the requirements of multiple distributed contacts and constraints. Other fundamental issues in human centered robotics will be also examined in this course. These include: (i) the synthesis of human movements to produce human-like robot behaviors; (ii) the critical issue of robot safety and the design requirements for human-friendly robots that conceived to operate in human environments (iii) the elastic planning methodology for real-time modifications of existing motion plans; (iv) and various other efficient algorithms that address the computational challenges associated with human-like robotic structures.

In addition to the lectures, this course includes reviews of papers on wide range of topics relevant to advanced robotics. These reviews which are done by groups of students will be presented at a mini-symposium held at the end of the quarter.

Schedule

March 28	Course introduction
March 30	Kinematics
April 4	Jacobian
April 6	Inverse Kinematics
April 11	Dynamics
April 13	Operational Space
April 18	Redundancy
April 20	Inertial properties
April 25	Cooperative
April 27	Unified Motion/Force Control
May 2	Tactile Perception
May 4	Haptics
May 9	Mobile Manipulation
May 11	Elastic Planning
May 16	Robot Design
May 18	Humanoids
May 23	Unified Whole Body
May 25	Human-Motion Analysis
May 27	Mini-Symposium
May 30	Holiday
June 3	Take-Home Final (June 1)

Staff

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Course Format and Grading

Lectures (75%), Paper Reviews (25%)
Homework (30%), Review (20%), Final (50%)