FALL 2007 MECE4602 Introduction to Robotics

This is an undergraduate/graduate level course intended to introduce students to Robotics. The course focuses on fundamental aspects of robotics including: rigid body transformations (rotation matrices, screw representations), kinematics modeling of serial and parallel robots, inverse and direct kinematics, motion planning in joint and task space, robot dynamic modeling using Lagrange and Newton Euler recursive method, fundamentals of simulation and control for robotic systems.
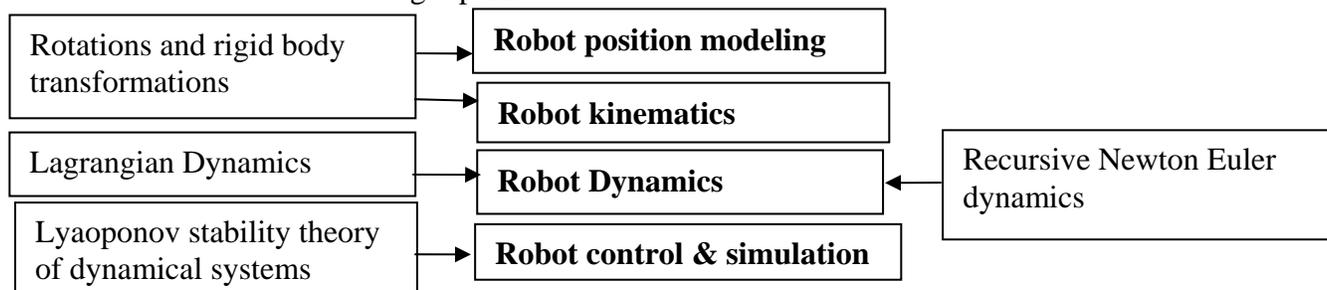
Course Administration

This course is intended for graduate and undergraduate students interested in robotics. Advanced junior and senior level students and graduate students are encouraged to register for this class. The course requirements include 5 bi-weekly homework assignments, mid-term exam, and a term project designed to showcase the students' skills. More details on the breakdown of percentages will be provided through the official course syllabus.

Prerequisites

The prerequisites for this course include rigid-body physics and mathematics as a sophomore/junior level. Basic kinematics as covered in Theory of Machines course is advantageous, but not necessary. There will be an extensive use of methods from linear algebra and calculus. These topics will be reviewed and covered in class, but previous exposure to these topics is helpful. The course will also make extensive use of Matlab (Mathematica or Maple are acceptable too) for simulations and for homework sets. An introduction of the necessary Matlab tools will be given by the course instructors based on the relevance to each homework set.

Robotic car assembly plant of Ford Motor Company at Michigan as an industry example (Top), NASA Robonaut dual-arm humanoid torso for space applications as a research example (Bottom).

Subjects covered in class

The course will cover the following topics.

Rotations and rigid body transformations	→	**Robot position modeling**
Lagrangian Dynamics	→	**Robot kinematics**
Lyaoponov stability theory of dynamical systems	→	**Robot Dynamics** ← Recursive Newton Euler dynamics
	→	**Robot control & simulation**

For information contact professor Nabil Simaan ns2236@columbia.edu