ME 115(a,b): Introduction to Kinematics and Robotics

(Winter/Spring 2013-14)

Lecturer: Prof. Joel Burdick, Thomas 319/Keck 205, x4139, jwb@robotics.caltech.edu

T.A.: TBD
T.A. office hours: TBD

Admin.: Mrs. Maria Koeper, Thomas 321/Keck 207, x3385, maria@robotics.caltech.edu

Class Meeting Time & Location

The schedule class time is officially scheduled for Tu/Th 10:30 a.m. - 11:55 a.m. in Thomas 306. However, since many students have a conflict with the scheduled time, we will try to find a new meeting time that accomodates as many students as possible. Likely, the class location may also be changed in response to the new schedule. Please see the course web site for updates on class schedule and location.

Scope and Content of ME 115

Theoretical Kinematics is the study of motion (without regard to the forces that generate the motion), while *Applied Kinematics* is the analysis and synthesis of mechanisms which implement given motions. This course presents basic material in theoretical kinematics, while the applied portions of the course focus on robotic mechanisms. The heuristic goals of this course are to:

- Introduce some of the basic problems and methodology of theoretical kinematics and kinematic analysis.
- Give an introduction to those areas of robotics which rely heavily upon kinematics.
- Introduce sufficient kinematic terminology so that interested students can read and understand the kinematics and robots research literature after completing this course.
- Introduce students to the kinematics of the main classes of robotic mechanisms (serial and parallel), as well as the kinematics of multi-fingered robotic grasping and quasi-static robotic locomotion.
- Introduce some recently active topics in the practice of kinematic mechanisms (such as compliant mechanisms and parallel mechanisms).

The first quarter of the course largely reviews the fundamentals of kinematics at a measured pace. The second quarter is largefly devoted to applications of the theory, with a particular emphasis on multi-fingered robotic grasping.

Course Prerequisites

The course assumes basic knowledge in linear algebra (such as eigenvalues and eigenvectors). Most other mathematical concepts will be reviewed or introduced as needed. Students who have completed Math 2 or the equivalent should have adequate preparation.

Course Mechanics and Grading

The course-work will consist entirely of homework and a take-home final exam. A final project, whose content is approved by the course instructor, can be substituted for the final exam. The second quarter format will be similar. Many students opt to extend their first quarter final project to a second quarter final project.

The course grade will be computed as follows:

Homework (approximately 6 sets)	70%
Final Exam (or project)	30%

The homework is not intended to be difficult, but rather to reinforcethe topics presented in the lectures and the book.

Course Web Site: The web site for this course can be found at:

http://robotics.caltech.edu/∼jwb/courses/ME115/ME115.html

This site will contain copies of homework assignments, homework solutions, and most class handouts. Important information about the class, such as changes in due dates, homework errata, etc. can be found in the "Bulletins" section. You should visit this site if you miss class, as there will be no excuses for being uninformed.

References: The main text for this course is:

- R.M. Murray, Z. Li, and S.S. Sastry, A Mathematical Introduction to Robotics, CRC Press, 1994.
- Web Site: *http://www.cds.caltech.edu/∼murray/mlswiki/index.php/Main_Page*

The acronym "MLS" will often be used to refer to this text. This book is *freely* available on-line at the link given above. This web link is also included in the course web site. Some of you may wish to buy the book (e.g. it's available from Amazon). If you wish to buy a used version of the text, note that there is a second edition with some of the errata from the first edition corrected. Either edition is fine for the course.

Most of the other course reading material not found in this book will be distributed in class, and copies posted on the course website. A very few handouts will not be available electronically–copies will be kept in the office of Mrs. Maria Koeper.