Viterbi

AME 547: Foundations for Manufacturing Automation
Units: 4
Fall 2024: 3:30PM to 7:00PM Thursday
Location: KAP 144
Instructor: Satyandra K. Gupta
Office: Center for Advanced Manufacturing
Office Hours: Wednesday from 1 to 3 PM
Contact Info: Email: **guptask@usc.edu;**
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Course Description

This course covers fundamentals underlying the contemporary manufacturing automation. It covers the underlying building blocks of the automation system and also discusses mechanics-based models for designing automation system. It covers physical as well as decision making aspects of automation. The course will be taught using a project-based learning approach. This course will cover the following topics:

1. Forward and Inverse Kinematics of Robotic Manipulators
2. Jacobian and Velocity Kinematics for Robotic Manipulators
3. Dynamics of Robotic Manipulators
4. Robotic Manipulator Control
5. Motion Planning and Trajectory Generation for Robots
6. Automated Material Handling Systems
7. Computer Vision for Automation
8. Automated Part Feeding Systems
9. Design for Automation

This course is intended for would be manufacturing system designers and technical managers who intend to lead product development teams and play strategic roles in selection and deployment of advanced manufacturing automation technologies. This course will provide students with the basic and the specialized training in using and deploying modern automation systems. Through lectures, hands-on learning experience in the Center for Advanced Manufacturing, and demonstrations students are expected to gain the knowledge and skills in modern manufacturing that are necessary for seeking rewarding employment opportunities.

Learning Objectives

After completing this course students should be able to:

1. Design and program automated work cells consisting of industrial robots

2. Model, analyze, and select the following manufacturing automation technologies

- Industrial Robots
- Automated Material Handling Systems
- Automated Part Feeding Systems
- Computer Vision Based Inspection Systems

Prerequisite(s): Undergraduate Courses in Mechanics, Control, and Product Design
Co-Requisite (s): NONE
Concurrent Enrollment: NONE
Recommended Preparation: NONE

Course Grading: Regular Letter Based Grading

Technological Proficiency and Hardware/Software Required

The course will be taught in a traditional classroom. Students will have access to the required hardware/software in the Center for Advanced Manufacturing

Textbook

- M.W. Spong, S. Hutchinson, and M. Vidyasagar, *Robot Modeling and Control*, Wiley, 2020

Suggested Readings

- Richard M. Murray, Zexiang Li, and S. Shankar Sastry, *A Mathematical Introduction to Robotic Manipulation*, CRC Press, 1994
- Matthew T. Mason, *Mechanics of Robotic Manipulation*, MIT Press, 2001

Supplementary Materials

- M.P. Groover. *Automation, Production Systems, and Computer Integrated Manufacturing*, Pearson, 2014
- Geoffrey Boothroyd, *Assembly Automation and Product Design*, CRC Press, 2005
- Daniel E. Whitney, *Mechanical Assemblies: Their Design, Manufacture, and Role in Product Development*, Oxford University Press, 2004

Description and Assessment of Assignments

- 8 Homework (25%)
- Class Participation (5%)
- Course Project (35%)
- Final Exam (35%)

Assignment Submission Policy

Assignment will be submitted on Blackboard

Additional Policies

Penalty will be applied to late assignments. The full allocated points will be reduced by 10 percentage points for the day after the deadline for the submission of coursework. Score will be reduced by a further 40 percentage points each day if coursework is submitted during the following two days.

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu or to the *Department of Public Safety* http://adminopsnet.usc.edu/department/department-public-safety. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* *http://emergency.usc.edu* will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.