ECE 555: Course Syllabus (Spring 2018)
TR 3:30-4:45 pm, ENGR B103

Instructor: Dr. Anthony Maciejewski
Office: B104B (Main Electrical Engineering Office)
Office Hours: By appointment - confirmed via email
Email: aam@engr.colostate.edu

TA: Megan Emmons
Office: C21
Office Hours: By appointment (aka. send me an email)
Email: mremmons@rams.colostate.edu

Textbook: Required readings will be provided on the course website

Optional Text - DO NOT BUY: *Advanced Robotics: Redundancy and Optimization*, Yoshihiko Nakamura, Addison-Wesley Publishing, 1991, ISBN 0-201-15198-7

Course Description: ECE 555, Advanced Robotics: Redundancy and Optimization, will focus on the advanced analysis, design, and control of kinematically redundant articulated objects, including both robotic and biologic systems. Upon successful completion of the course, students shall be able to:

1. Control robots near and/or through kinematically singular configurations
2. Optimize the use of redundancy for desirable secondary criteria
3. Design repeatable inverse kinematic inverses that are closest to desired non-repeatable inverses
4. Analyze, design, and control failure tolerant robots.

Lecture material will be driven by provided articles and student-generated questions. Weekly homework assignments, possible quizzes, one computer project, and a final exam will be used to evaluate each student's understanding of key material.

Required Readings: All required articles will be uploaded to Canvas. You are expected to read the associated material prior to class and come to lecture with questions regarding the material.

Assignments: Unlike many traditional courses, homework problems will be primarily student-generated. Every week, each student will prepare a single problem to test an important topic from the assigned reading. The problem should take approximately 30 minutes to solve. The generated problem and its solution should be submitted as a PDF attachment via Canvas.

Each student will then receive three problems developed by his or her classmates to work through and evaluate. Solutions to each of the three problems, as well as evaluations for each problem, should be uploaded to Canvas the following week and the best problems will be covered in lecture. All questions will be posted to Canvass to provide additional practice for interested students.

Grading Policy: Course work will be divided into three separate categories with percentages as follows:

- Homeworks/Quizzes: 50%
- Software Project: 25%

- Final: 25%

Grades will be assigned in the standard +/- manner.

Academic Integrity: To quote the National Society of Professional Engineers Code of Ethics, "Engineering has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity...Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct." As future engineers, you are held to the same code of conduct.

Homeworks, quizzes, the computer projects, and final exam will be used to evaluate your performance throughout the course. Homework assignments are intended as tools to help you put lecture material into practice and reasonable collaboration is allowed; however, the work you submit must represent your effort and understanding. Similarly, concepts behind the computer project can be discussed with classmates but all code implemented must be yours alone. Quizzes will be conducted during class time and are not group activities - nor is the final exam.

This course will adhere to the CSU Academic Integrity Policy as found in the General Catalog, Section 1.6, as well as the Student Conduct Code. If it is discovered you have submitted work that you do not fully understand or which represents the work of another student, that is justification for failing the assignment, failing the course, and/or facing disciplinary action by the university. At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct Services.

Special Accommodations: There are no make-ups for quizzes or final exam. A penalty of 10% per day is accrued for a late homework assignment. If you are experiencing difficult situations that are affecting, or could potentially affect, your academic success, please contact **Student Case Management** as soon as possible (www.studentcasemanagement.colostate.edu, E203 Newsom Hall, 970-491-8051). Difficult situations can include issues such as medical, mental health, personal or family crisis, illness, or injury. If students request extensions or considerations due to difficult situations, I typically require documentation from SCM. In addition, I urge students to contact me in advance of deadlines about such issues.

Honest Disclaimer: All information about the course (including but not limited to grading policy, assignment due dates, office hours, and course schedule) may be superseded by information given in class at any time. Regular attendance and active participation in the class is expected. A lot of work has gone in to preparing material for this course and providing you with the tools to succeed but it is ultimately up to you to take advantage of the resources so roll up those sleeves and let's have a great semester!

Inclusivity Statement: I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

Anticipated Weekly Schedule

1. Review of ECE455: Robotic Simulation material
2. Singular Value Decomposition
3. Damped Least Squares
4. Local Optimization of Redundancy
5. Obstacle Avoidance
6. Global Optimization of Redundancy
7. Repeatability
8. Measures of Fault Tolerance
9. Fault Tolerant control
10. Free-Swinging Failures
11. Fault Tolerant Teleoperation
12. Fault Tolerant Path Planning
13. Fault Tolerant Workspaces
14. Optimally Fault Tolerant Kinematic Design (Planar and Spatial Reasoning)
15. Optimally Fault tolerant Kinematic Design in 6D
16. Course Project