Instructor: Brian Umberger, Ph.D.
Associate Professor
Department of Kinesiology
Office: 106 Totman Building
Email: umberger@kin.umass.edu
Phone: 545-1436
Office Hours: Tu/Th 10:00 - 11:00 am; also by appointment

Course Description
Development and use of physics-based computer simulation models with applications to biomechanics of human movement.

Prerequisites
KIN 430 or equivalent (i.e., undergraduate biomechanics). Ideally, students will also have some graduate level coursework in biomechanics (e.g., KIN 530) and facility with computers/programming.

Goal
The goal of this course is to help students develop an understanding of how computer models of the musculoskeletal system are developed and used to study normal and pathological human movement. Learning will be achieved through a series of lectures, discussions, readings, article critiques, and modeling assignments. Students will be introduced to several software tools that are used in musculoskeletal modeling and human movement simulation. This course also provides the foundation for students who plan to use musculoskeletal modeling techniques in their research.

Objectives
By the end of the course, students should be able to:
1. Identify the major elements typically included in a computer model of the musculoskeletal system, and describe alternative approaches for developing such models.
2. Describe the challenges involved in developing accurate and valid models of the musculoskeletal system, and explain the strengths and weaknesses of using such models to evaluate human movement.
3. Describe analysis techniques used in conjunction with musculoskeletal models, such as numerical optimization, induced acceleration, and segmental power analyses.
4. Critically evaluate research articles that make use of modeling and simulation techniques.
5. Develop basic models of the musculoskeletal system, and use these models to simulate specific human movements.

Brief Topical Outline:
1. Introduction to computer modeling and simulation
2. Inverse and forward dynamics
3. Components of a musculoskeletal model
4. Simulation and control of movement
5. Advanced analysis techniques

Readings
There is no single textbook that would be adequate for this course. Instead, readings will be taken from the scientific literature, and will be augmented with specific textbook chapters. All readings will be made available in the form of PDF files which may be accessed from the course web site.
Web Site
Some materials will only be made available on the course web site (e.g., modeling assignments, readings, lecture notes). Students are responsible for checking the course web site on a regular basis, so that they may obtain these materials at the appropriate time. The URL for the course web site will be announced in class.

Attendance Policy
Attendance will not be taken in class, and is not a formal part of the final course grade. However, students are personally responsible for all information disseminated in class. If a student misses a class, they are responsible for obtaining all information that was presented during that class period. If a student misses the final exam, due to a documented medical emergency or other extenuating circumstance, they will be given an alternate exam as a make up. Otherwise, the student will receive a grade of zero on the missed exam.

Modeling Assignments:
Modeling assignments will involve developing small Matlab programs that are focused on some specific aspect of modeling and simulating human movement. Students are encouraged to work together and help each other, but copying of assignments is not allowed; the final product must represent the work of each individual student. All modeling assignments must be submitted electronically (via email as an attachment) by the indicated due date, and must include the program code and all requested output. Students should put all of the files related to a particular assignment in a single “zip” file, and name the file with the student’s last name, a dash, and the assignment number (e.g., “umberger-assignment1.zip”). Submissions that do not conform exactly to this naming convention will not be accepted.

Late assignments: In the event that a student turns in a modeling assignment late for an excused reason (e.g., documented illness or accident, religious holiday), the assignment will be graded on the same basis as if it had been turned in on time. Otherwise, a late penalty of 10% per day will be enforced (i.e., an assignment that is two days late will be worth at most 80% of the full point value).

Evaluation:
Modeling Assignments: 50%
Final Exam: 30%
Article Critiques: 20%

Grading:

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Scores will be rounded to the nearest whole number: i.e., 89.4 = 89%, 89.5 = 90%

Academic Honesty
Students are expected to adhere to the guidelines developed by the Dean of Students regarding academic honesty (http://www.umass.edu/dean_students/code_conduct/acad_honest.htm).

Accommodations for Disabilities
Students with a documented physical, psychological, or learning disability on record with Disability Services may be eligible for reasonable academic accommodations to help them succeed in this course. Students requiring an accommodation should notify their instructor within the first two weeks of the semester to make appropriate arrangements.