Special Topics in Biomedical Engineering: Neuromechanics
BME 6938 Section NM02

Class Periods: Tuesday Periods 5-6 (11:45 AM - 1:40 PM), Thursday Periods 6 (12:50 PM - 1:40 PM)
Location: Communicore CG-067
Academic Term: Fall 2024

Instructor:
Prof. Daniel Ferris
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352-294-1281

Office Hours: 9:45 am – 10:45 am Mondays; 1:45 pm - 2:45 pm Wednesdays; by zoom

Course Description
This course focuses on interaction of the nervous and musculoskeletal systems during human and animal movement with a focus on biological and engineering principles. The course is taught via a mix of lectures, computer simulation activities, and Problem-Based Learning (PBL) methods. Specific topics will include neural control of locomotion, reaching and grasping, motor adaptation and learning, neurorehabilitation, and biorobotics (3 Credits).

Course Pre-Requisites / Co-Requisites
Undergraduate or graduate course in biomechanics or engineering dynamics; undergraduate or graduate course in physiology; or permission of the instructor.

Aims: The primary aim for this course is to increase students' understanding of how the nervous system and musculoskeletal system interact to produce coordinated movement in humans and animals. Secondary aims are to prepare students for handling complex real-world problems and learn how to create simple models of movement systems.

Specific Learning Objectives: By the end of this course, students will be able to
1. Describe key components in movement control for humans and other animals
2. Compare and contrast feedback and feedforward control in neuromechanical systems
3. Outline supraspinal, spinal, and peripheral contributions to movement control
4. Discuss biomechanical limitations to human and animal movement
5. Discuss neural limitations to human and animal movement
6. Explain the process of neuronal action potentials
7. Describe how simple models can be used to simulate human movement
8. Explain principles dictating motor adaptation and learning
9. Describe common practices for neurological rehabilitation
10. Describe different methods for controlling robotic devices for neurological rehabilitation
11. Discuss current limitations to robotic exoskeleton and bionic prosthesis designs
12. Give reasons for creating models/simulations of neuromechanical systems
13. Create a computer simulation of a simple neuromechanical system to test an hypothesis about system control
14. Critically evaluate research literature in the area of neuromechanics

Materials and Supply Fees
None

Required Textbooks
None. There is a Canvas website for the course that will have some materials for students.

Required Computer
Students will be required to bring a laptop of their own to Thursday classes. UF student computing requirement: *https://news.it.ufl.edu/education/student-computing-requirements-for-uf/*

Course Topics and Schedule

Week 1	Introduction to course
Week 2	Neurons
Week 3	Nervous system
Week 4	Central nervous system planning of movement
Week 5	Neural oscillators
Week 6	Locomotion
Week 7	Models and simulations
Week 8	Motor adaptation and learning
Week 9	Neurological rehabilitation
Week 10	Rehabilitation robotics
Week 11	Electrical stimulation
Week 12	Biomimetic robotics
Week 13	Project presentations
Week 14	Project presentations

Problem Based Learning - Students will build skills and increase their knowledge in the area of neuromechanics by participating in teams of 4-5 students to tackle problems during the semester. At the end of each problem cycle, the team will come to a problem resolution. The resolution will be detailed in a report analyzing the problem and assessing the proposed solutions. Problem-based learning is an instructional method that challenges students to "learn to learn," working cooperatively in groups to seek solutions to real world problems. These problems are used to engage students' curiosity and initiate learning the subject matter. Problem-based learning prepares students to think critically and analytically, and to find and use appropriate learning resources. It sometimes evokes frustration and resentment from students that have been spoon-fed information by lecturers throughout their education. However, a large number of medical, health sciences, and engineering programs currently use Problem-based learning very successfully because it promotes high-level critical thinking skills. Implicit in the design of the course are the following assumptions:
1) All students enrolled in the course are truly interested in knowing more about neuromechanics
2) All students can learn to work together in teams to solve real world problems
3) The instructor does not know the 'correct answer' to any of the problems

Attendance Policy, Class Expectations, and Make-Up Policy
Students are required to attend class. Absences for legitimate reasons (e.g. health, student organization travel, medical or graduate school interviews, etc.) need to be approved by the instructor prior to the start of the class to be missed. Absences will result in a reduction of the final course grade by 3% for each absence.
Excused absences must be consistent with university policies in the Graduate Catalog (https://catalog.ufl.edu/graduate/regulations) and require appropriate documentation. Additional information can be found here: https://gradcatalog.ufl.edu/graduate/regulations/

Evaluation of Grades

Assignment	Percentage of Final Grade
Quizzes	25%
In class exercises	25%
Project #1	25%
Project #2	25%

Grading Policy

Percent	Grade	Grade Points
92.50-100%	A	4.00
90.00-92.49%	A-	3.67
87.50-89.99%	B+	3.33
82.50-87.49%	B	3.00
80.00-82.49%	B-	2.67
77.50-79.99%	C+	2.33
72.50-77.49%	C	2.00
70.00-72.49%	C-	1.67
67.50-69.99%	D+	1.33
62.50-67.49%	D	1.00
60.00-62.49%	D-	0.67
below 60.00%	E	0.00

More information on UF grading policy may be found at:
UF Graduate Catalog
Grades and Grading Policies

Students Requiring Accommodations
Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation
Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

In-Class Recording
Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons),

including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing

staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: https://counseling.ufl.edu, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical suppor*t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://elearning.ufl.edu/.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; https://career.ufl.edu.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall*,* 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.

Student Complaints Campus*:* https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/;https://care.dso.ufl.edu.

On-Line Students Complaints*: https://distance.ufl.edu/getting-help/; https://distance.ufl.edu/state-authorization-status/#student-complaint.*