Neuromechanics

BME 6938 (100% online)
Class Periods: Tuesday Period 4 (10:40 AM - 11:30 AM), Thursday Periods 4 - 5 (10:40 AM - 12:35 PM)
Location: online via Zoom and Canvas
Academic Term: Spring 2021

Instructor:
Prof. Daniel Ferris
dferris@bme.ufl.edu

Office Hours: 2:00 – 3:00 pm Wednesdays, 2:00 - 3:00 pm Thursdays

Course Description
This course focuses on interaction of the nervous and musculoskeletal systems during human and animal movement with a focus on both biological and engineering principles. Specific topics will include neural control of locomotion, reaching and grasping, musculoskeletal biomechanics, neurorehabilitation, biorobotics, and computer simulations of neuromechanical systems (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. A secondary aim is to prepare students for handling complex real-world problems. Students will become self-directed learners that possess excellent inquiry and problem-solving skills. This will require effective communication strategies and the ability to function in team environments.

Specific Learning Objectives: By the end of this course, students will be able to
1. Describe the basic physiology of muscular actuators, biological movement sensors, and neural circuits for controlling animal movement
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 animal movement
5. Discuss neural limitations to animal movement
6. Outline the mechanical characteristics of vertebrate muscle
7. Explain the process of neuronal action potentials
8. Describe how simple models can be used to simulate legged locomotion
9. Explain principles dictating motor adaptation and learning
10. Describe common practices for neurological rehabilitation
11. Describe different methods for controlling robotic devices for neurological rehabilitation
12. Discuss current limitations to robotic exoskeleton and bionic prosthesis designs
13. Give reasons for creating computer simulations of neuromechanical systems
14. Create a computer simulation of a simple neuromechanical system to test an hypothesis about system control
15. Critically evaluate research literature in the area of neuromechanics

Materials and Supply Fees
None

Required Textbooks
None

There is a BME6938 Neuromechanics Sp2021 workspace on Slack for asking questions about the course (neuromechanics.slack.com). All questions about course material should be posted on the Slack workspace as it will benefit all students enrolled in the course.

Recommended Materials
None

Course Topics and Schedule*

Week 1	Introduction to neuromechanics
Week 2	Neurons
Week 3	Nervous system
Week 4	Muscle
Week 5	More muscle
Week 6	Central nervous system planning of movement
Week 7	Neural oscillators
Week 8	Locomotion
Week 9	Models and simulations
Week 10	Motor learning
Week 11	Neurological rehabilitation
Week 12	Rehabilitation robotics
Week 13	Robotic exoskeletons and bionic prostheses
Week 14	Biomimetic robotics

*The number of topics covered during the semester will be dependent on the progress of students, the spread and subsequent ramifications of the COVID-19 pandemic, and the discretion of the instructor.

Online Course Recording
Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Attendance Policy, Class Expectations, and Make-Up Policy
Lectures will occur on Tuesdays, and will be conducted via Zoom during the scheduled class time. Attendance during the lecture on Tuesday is not required. All Tuesday lectures will be recorded and posted to the Canvas course site. It would benefit the quality of instruction to have some students online for the lectures to ask questions and provide feedback in real time, but it is not required.

Thursdays will be devoted to computer simulation experiments, discussion of research literature, and other activities. Attendance on Thursdays is required during class time via Zoom. There will be weekly homeworks or quizzes for students to complete. Excused absences must be in compliance with university policies in the Graduate Catalog (http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance) and require appropriate documentation.

Evaluation of Grades

Assignment	Percentage of Final Grade
Weekly Homeworks or Quizzes	75%
Final Exam 04/29/2021 10:40 AM - 12:35 PM	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:
http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades

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/.

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/policies/student-honor-code-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 broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

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 Program Coordinator
• Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
• Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.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: http://www.counseling.ufl.edu/cwc, 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://lss.at.ufl.edu/help.shtml.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. https://www.crc.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://care.dso.ufl.edu.

On-Line Students Complaints*:* http://www.distance.ufl.edu/student-complaint-process.
