Course Information
Fall 2016 ENME 444: Assistive Robotics

Course Description: Two and a half hours of lecture per week. Prerequisite: ENME 351 (Electronics II).

The course presents students with fundamentals on behind assistive robots used to in a wide variety of ways to help humans with disabilities. The following three application areas will be covered: (1) Rehabilitation robotics to recover motor function from neurologic injuries such as stroke, (2) Prosthetics to enable mobility function in amputees, and (3) Social robotics for cognitive impairment and developmental disorders such as autism. For each of these topic areas the course will begin with the discussion of the disability and its consequences, including some guest lectures by experts in these fields. Higher emphasis will be on Rehabilitation Robotics. The course will then present robotics solutions that exist and new technologies that are being developed to address these disabilities. The course will introduce the theory behind different control systems employed by assistive robotics, as well as the mechanical design, sensors & actuators, and user interfaces behind representative robots in the respective areas. The course will also present general guidelines for designing assistive robots. The course will discuss ethical and regulatory considerations in the design of assistive robots. At appropriate times during the course, the instructor and/or guest lecturers will bring one or more robots into the classroom for viewing and/or demonstration/s. The course will also offer opportunities to all interested students, one or more visits to the instructor’s own state-of-art rehabilitation robotics laboratory on the University of Maryland, Baltimore School of Medicine campus, to “see and feel” rehabilitation robots and better relate to the theoretical control concepts taught in the classroom used for research and clinical studies.

Course Classification: This is an elective course for ENME majors.

Textbook: There is no textbook for this course. Teaching materials include instructor’s own lecture slides and notes, and selected journal and scientific conference proceeding articles.

Meeting Times: Tue, Thu 9:30 am - 10:45 am (EGR 2116)
Instructor: Dr. Anindo Roy aroy1975@umd.edu EGR 2146 Phone: (410) 200-0894
Office Hours: TBD and by appointment.

General Course Logistics:

CANVAS: ENME 444 will be using the Canvas course environment this semester. Students can login to their course(s) by going to http://elms.umd.edu/page/student-support. A University online identity and password are required to access Canvas. Information on your University password is available at http://www.it.umd.edu/password/. Canvas offers many choices for notification about course activities. It is each student’s responsibility to set their communication preferences for their Canvas accounts. Information posted on Canvas will govern course operation. All lecture slides, reading materials, videos, announcements, etc. will be posted on Canvas.
Course Objectives
This course provides the students with a fundamental understanding of assistive robotics, a rapidly emerging field in robotics. It provides the theoretical knowledge of automatic control systems deployed in assistive robots and insight into selection of appropriate control systems based on different robots targeting different disability conditions. The course provides information about the design and development processes underlying different assistive robots taking into account clinical considerations and biomechanical needs of the targeted disabilities. It introduces students to experimental techniques used in human movement science to enable understanding of how bioinstrumentation is used to evaluate human performance, a key aspect of characterizing the efficacy of assistive robots. Through journal and conference articles, both research and commercial assistive robots are introduced to provide students with a thorough knowledge of the literature on the state-of-the-art. For each application area, the course will take students through a “virtual” design and development process of example robots to study the engineering principles of robot subsystems (sensors, actuators, motors, and controller) to understand how the design decisions are made to achieve the subsystem and overall robot performance toward alleviating specific disabilities. This will include conceiving possible changes to the hardware design and/or controller to either improve human performance or motivate the next-generation of the device/s. The course will introduce students to ethical and regulatory guidelines in the field of assistive robots.

Relationship of course to Mechanical Engineering program outcomes (H: high; M: Medium; L: Low):
This course helps to satisfy the following learning outcomes of the ME program:
1. The ability to design a system, component, or process to meet desired customer or population needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (H).
2. The ability to apply mathematics, science, and engineering knowledge to identify, formulate, and solve mechanical engineering problems (H).
3. The ability to design and conduct experiments, as well as to analyze and interpret data (H).
4. A knowledge of state-of-the-art engineering bioinstrumentation as tools to analyze performance and solve engineering problems (M).
5. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context (M).
6. The recognition that engineers must maintain ethical and regulatory standards and an appreciation of these standards especially in instances of human-robot interaction such as robot-aided rehabilitation (M).
7. An ability to work professionally in the field of assistive robotics (H).

Major course Topics
• Introduction to robotics, assistive robotics terminology
• Robotic control systems
• Rehabilitative robotics to recover motor function from neurologic injuries
• Prosthetics to enable mobility function in upper and lower limb amputees
• Social robotics for cognitive impairments and developmental disorders
• Sensors and actuators for assistive robots
• Guidelines for designing assistive robots
• Ethical considerations in the design of assistive robots
• Regulatory considerations in the design of assistive robots
Grading Policy:
• 4 assignments (10% each, total 40%)
• Mid-term exam (25%)
• Final exam (35%)

Late Assignments: Assignments that are submitted between 1 minute and 24 hours late will receive 75% of the credit. Assignments that are more than 24 hours late will receive 0% of the credit. Exceptions will be made in accordance with University policy regarding these major grading events.

Attendance Policy:
Regular attendance at lectures is expected. Students are responsible for inquiring about and obtaining course material delivered in their absence (from course colleagues). University policy excuses the absences of students for illness (self or dependent), religious observances (http://www.president.umd.edu/policies/iii510a.html), participation in University activities at the request of University authorities, and compelling circumstances beyond the student's control. Students must submit the request in writing and supply appropriate documentation, e.g. medical documentation. Students with written, excused absences are entitled to a makeup exam (or assignments if applicable) at a time mutually convenient for the instructor and student. For more information, see UMD's policy on medically necessitated absences from class.

University wide Honor Code:
The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating on exams, cheating on clicker quizzes in lecture, fabrication, facilitation, and plagiarism. Copying work done by another is considered an act of academic dishonesty and will be reported according to University policy. Please review the Code of Academic Integrity and the University’s policy on academic dishonesty at http://www.jpo.umd.edu/ and http://www.shc.umd.edu. Note that no form of plagiarism will be tolerated. All work presented to the instructor is assumed to be the original work of the course participant(s). Words, diagrams, figures, or original contributions of anyone other than a student must be referenced when included in a student’s work. The course instructor may use plagiarism checking software and/or request evidence of references for any submitted work. A useful website on avoiding plagiarism is found at the Purdue Online Writing Lab (http://owl.english.purdue.edu/owl/). To further exhibit your commitment to academic integrity, remember to sign the Honor Pledge on all examinations and assignments: "I pledge on my honor that I have not given or received any unauthorized assistance on this examination (assignment)." Questions about the pledge can be found online at http://www.shc.umd.edu/SHC/HonorPledgeUse.aspx.

Online Course Evaluation
Students can go directly to the website (www.courseevalum.umd.edu) to complete their evaluations. They will be alerted via their official University e-mail account about the dates of the evaluation period and provided more information closer to that time. Students who complete evaluations for all of their courses in the previous semester (excluding summer), can access the posted results via Testudo’s CourseEvalUM Reporting link for any course on campus that has at least a 70% response rate.