ECE4753/6753 Intro to Robotics

Department of Electrical and Computer Engineering
Bagley College of Engineering
Mississippi State University

Syllabus

Fall 2023

Description of Course:

ECE4753/6753 Intro to Robotics (3-credit course) is concerned with the theory and applications associated with the development of mobile robots and autonomous systems that possess sensors and intelligence sufficient to operate independently and collaboratively in constrained environments. This class covers a range of fundamental topics to provide students with a strong foundation in robotics principles and practices. Topics include but not limited to some sub-areas of perception, localization, mapping, cognition, path planning, navigation, motion control, and multiple robots, etc. It will cover the following components: Concept of robotics including brief history and evolution of robotics, importance and applications of robotics in various fields. Robot components, robot anatomy including sensors, actuators, manipulators, end effectors, etc. Sensors and perception, types of sensors: proximity, vision, touch, force, etc. Robot actuators and control including types of actuators such as motors, servos, hydraulic, etc. motor control such as PWM, PID, feedback control. Robot control paradigms including teleoperation, autonomous, semi-autonomous, and robot simulation environments. Robot behavior and planning, robot behavior modeling, path planning and obstacle avoidance, trajectory generation and interpolation.

This course covers mathematical foundations (kinematics and dynamics), manipulation, modeling, motion planning, robot control, and hardware implementations of actuators and sensors for modern robots. Some important topics that benefit robotics algorithms are selected to be taught, simulated, demonstrated, and implemented deeply. The main focus is on teaching students to perform robotics algorithms to meet the required specifications while applying computational intelligence, biologically inspired intelligence, swarm intelligence, and machine learning for robotics.

Course Instructor:

Dr. Chaomin Luo, Ph.D., Associate Professor, Department of Electrical and Computer Engineering, Mississippi State University
Email Address: chaomin.luo@ece.msstate.edu,
Course Web page: **Canvas**

Prerequisites by Topics:
- Engineering programming (MATLAB, C/C++, or Python), calculus and differential equations, probability, linear algebra/matrix algebra.

Office Hours:
Posted office hours, or by appointment (through WebEx) (Simrall Electrical Engineering Building, ECE Department, Room 312).

Lecture:
Tuesday, Thursday, 2:00-3:15pm, Simrall 106

Textbooks:
- "Introduction to Autonomous Mobile Robots", Roland Siegwart, Illah Reza Nourbakhsh and Davide Scaramuzza, Second Edition, MIT Press.
- "Robotics, Vision and Control: Fundamental Algorithms in MATLAB®", Peter I. Corke, Springer 2017, ISBN: 978-3-319-54412-0.

Reference Books:
- "Computational Principles of Mobile Robotics", Gregory Dudek and Michael Jenkin, Cambridge Press, 2nd edition, 2010. ISBN-13: 978-0521692120. ISBN-10: 0521692121.
- "Probabilistic Robotics", Sebastian Thrun, The MIT Press, 2005. ISBN-10: 0262201623, ISBN-13: 978-0262201629.
- Other reference material including research literature will be identified as the course evolves.

Course Learning Outcomes/Linkage to Program Outcomes:

This class aims to provide students with a balanced understanding of the theoretical foundations and practical applications of robotics, encouraging critical thinking, problem-solving skills, and creativity in the field. This course will allow students to explore the simulation, implementation and evaluation of robotics algorithms in computational intelligence, biologically inspired intelligence, and machine learning for robotics (such as fuzzy logic, neural networks, Voronoi diagram, Delaunay Triangulation, wavefront, cell decomposition, distance transform, optimization, and road map, etc.) involving robotics topics in mapping, localization, navigation, path planning, and motion control. It is intended to allow students to explore current methods and literature associated with robotics by computational intelligence, swarm intelligence, biologically inspired intelligence, and machine learning algorithms.

Class Schedule:
Two 75-minute class sessions per week (for distance learning students, videos posted).

Grades
- A straight grading scale will be used for the final assignment of letter grades at the course's end. The scale used is as follows:
  90.0 – 100 A
  80.0 – 89.9 B
  70.0 – 79.9 C
  60.0 – 69.9 D
  0 – 59.9 F

Individual graded elements may be curved to account for difficulty (exams or design assignments for example).

Tentative Percentage Structure:
- Homework: 30%
- Progress exams: 30%
- One final examination worth approx. 40%
- **NO late submissions will be accepted** (unless you have an advance notice email for urgent reasons). **10% penalty per day is applied to late assignments**.

There will be NO makeup exams.

Homework Assignments

- The homework assignments will be announced and assigned.
- The homework assignments must be turned in by the due date through Canvas online, and hard copy must be submitted in the classroom.
- It is advised that each student make a sincere attempt to understand and solve the homework assignments on his/her own.
- All work must be neatly presented taking advantage of the computer aided schematic software and word processing software available at MSU.
- The homework assignments should be submitted by electronic copy online and hard copy. Homework assignments without electronic submission will not be graded.
- **NO late submissions will be accepted**. After due date, the **online submission is closed**.
- All homework assignments submission deadlines are 11:59pm (Central Time).

Attendance is expected and required. Multiple in-class assignments will provide opportunities to practice and solidify your understanding.

Honorlock is required for online exams and/or quizzes just in case of online exams. Honorlock software has been successfully implemented at MSU for three semesters. It is a provable tool to undergo online quizzes effectively. Many questions and concerns have been officially answered by reviewing our student website: https://online.msstate.edu/honorlock/ This site addresses the privacy questions as well as where videos are stored as well.

Email Policy:

Email to your instructor and fellow students should be sent from your official MSU email account. In the **subject line** of your email, it should include **ECE4753/6753** (such as ECE4753/6753 HW1 submission concerns. ECE4753/6753 Exam questions). Any emails without subject line of **ECE4753/6753**, will **NOT be replied**!

Academic Conduct:

Academic misconduct is any activity which may compromise the academic integrity of the University. Academic misconduct includes, but is not limited to, deceptive acts such as the following:

- Using unauthorized materials (crib notes, books, etc.) as an aid during an examination.
- Looking at or using information from another person's examination, report, or assignment.
- Providing assistance to, or receiving assistance from, another person in any manner prohibited by the instructor.
- Possessing or providing an examination or assignment, or any part thereof, at any time or in any manner not authorized by the instructor.
- Taking a quiz, examination, or similar evaluated assignment for another person; or utilizing another person to take a quiz, examination, or similar assignment in place of oneself.
- Submitting any course materials or activities not the student's own, allowing such a submission to be made for oneself, or making such a submission for another.
- Using the ideas, organization, or words of another from a book, article, paper, computer file, or other source in any assignment without giving proper credit following accepted citation rules (plagiarism).
- Altering, stealing, and/or falsifying research data used in research reports, theses, or dissertations.
- Disregarding policies governing use of human subjects or animals in research.

More info: http://www.msstate.edu/dept/audit/1207A.html

University Safety Statement During the Global Pandemic

STATEMENT 1
To safeguard the health of all members of the MSU campus during this global pandemic, the university has reconfigured classroom spaces and adjusted room capacities to assure adequate physical distance between all individuals in each room. In addition, the university has published requirements for the use of face coverings for everyone on campus, including specific requirements for their use in all classrooms, labs, and shared office spaces regardless of physical distancing. In order to mutually protect the students' freedom to learn and the instructor's ability to teach in a safe classroom environment, everyone in this classroom is required to wear a face covering in the classroom in accordance with MSU policy
(https://www.msstate.edu/sites/www.msstate.edu/files/SafeReturnBooklet.pdf).
If a student cannot wear a face covering due to a medical condition, they should request an accommodation via the Office of Disability Support Services. If a student simply doesn't want to wear a face covering, they will not be permitted to remain in the classroom or lab.

STATEMENT 2
In the event that face-to-face classes are suspended due to the pandemic or its effects, the instructor will continue instruction in a manner that best supports the course content and student engagement. In this event, all instructors will notify all students of the change via their university email address (the official vehicle for communication with students). At that time, they will provide details about how instruction and communication will continue, how academic integrity will be ensured, and what students may expect during the time that face-to-face classes are suspended. If a student becomes unable to continue class participation, the student should contact their instructor and advisor for guidance.

Continuity of Instruction
In the event that face-to-face classes are suspended due to extenuating circumstances, such as weather, the instructor will continue instruction in a manner that best supports the course content and student engagement. In this event, all instructors will notify students of the change via their university email address (the official vehicle for communication with students). At that time, they will provide details about how instruction and communication will continue, how academic integrity will be ensured, and what students may expect during the time that face-to-face classes are suspended. If a student becomes unable to continue class participation due to extenuating circumstances, (e.g., health and safety, loss of power, etc.) the student should contact their instructor and advisor for guidance. For additional guidance, please refer to Academic Operating Policy 12.09.

Attendance Policy for Face-to-Face Instruction
This section is a face-to-face instructional class. Please refer to Academic Operating Policy 12.09, regarding attendance expectations and accommodations.

Disability Resource Center
Mississippi State University is committed to providing equitable access to learning opportunities for all students. The Disability Resource Center (01 Montgomery Hall) collaborates with students who have disabilities to arrange reasonable accommodations. If you have, or think you may have, a disability, please contact drc@saffairs.msstate.edu or 662-325-3335 to arrange a confidential discussion regarding equitable access and reasonable accommodations. Disabilities may include, but are not limited to, conditions related to mental health, chronic health, attention, learning, autism, brain injury, vision, hearing, mobility, speech, or intellectual disabilities. In the case of short-term disabilities (e.g., broken arm), students and instructors can often work to minimize barriers. If additional assistance is needed, please contact the Disability Resource Center.

REQUIRED BY AOP 13.03 (http://www.policies.msstate.edu/policypdfs/1303.pdf)

Student Honor Code: Mississippi State has an approved Honor Code that applies to all students. The code is as follows: "As a Mississippi State University student, I will conduct myself with horror and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do." Upon accepting admission to Mississippi State University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning, and to follow the philosophy and rules of the Honor Code. Student will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the MSU community from the requirements or the processes of the Honor Code. For additional information, please visit: http://honorcode.msstate.edu/policy

REQUIRED BY MSU GENERAL COUNSEL'S OFFICE (as of January, 2015):

Title IX: MSU is committed to complying with Title IX, a federal law that prohibits discrimination, including violence and harassment, based on sex. This means that MSU's educational programs and activities must be free from sex discrimination, sexual harassment, and other forms of sexual misconduct. If you or someone you know has experienced sex discrimination, sexual violence and/or harassment by any member of the University community, you are encouraged to report the conduct to MSU's Direction of Title IX/EEO Programs at 325-8124 or by email to titleix@msstate.edu. Additional resources are available

at http://www.msstate.edu/web/security/title9-12.pdf,
or at http://students.msstate.edu/sexualmisconduct/.

Support Services: Students who need academic accommodations based on a disability should visit the Office of Student Support Services, 01 Montgomery Hall, call 662-325-3335, or visit the website at www.sss.msstate.edu.

DUO Enrollment for Students

Students must sign up for DUO in the first part of the Spring semester in order to continue using many of MSU's online resources. ITS has provided instructions to make the process easy for the students. The instructions can be found at:
https://servicedesk.msstate.edu/TDClient/KB/ArticleDet?ID=24

University Safety Statement

Mississippi State University values the safety of all campus community members. Students are encouraged to register for Maroon Alert texts and to download the Everbridge App. Visit the Personal Information section in Banner on your mystate portal to register. To report suspicious activity or to request a courtesy escort via Safe Walk, call University Police at 662-325-2121, or in case of emergency, call 911. For more information regarding safety and to view available training resources, including helpful videos, visit ready.msstate.edu.