ENGR 4421: Robotics II (CRN33091)
Spring, 2025

Class / Lab

Time: Tuesday & Thursday, 10:50 AM–1:30 PM
Location: Lewis Science Center Annex (LSCA) 105
Course Materials: https://linzhanguca.github.io/robotics2-2025

Instructor

Name: Lin Zhang
Office: LSCA 105 *Look for me in LSC 110 or LSC 013 if not in lab.*
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Overview

Course Description

Robotics II is an advanced engineering course that builds on the principles introduced in Robotics I, designed for students of the junior and senior levels. This course explores advanced theories and technologies in robotics, with a focus on autonomous navigation using a differential drive mobile robot. Students will gain hands-on experience integrating a variety of sensors—including encoders, LiDAR, cameras, and IMUs—to enable perception, localization, and decision-making in real-world environments.

The Robot Operating System (ROS) will serve as the central framework for managing these complex systems, allowing students to develop and control sophisticated robotic behaviors. Through a combination of individual and team-based projects, students will design, build, and program an autonomous mobile robot capable of navigating dynamic environments. By the end of the course, students will have mastered key concepts in robotics, gained practical experience with industry-standard tools, and developed the skills necessary to tackle real-world engineering challenges.

Prerequisites

Minimum grade of C in **ENGR 3421: Robotics I** is required.

Textbooks

We will rely on ROS2's official online documents:https://docs.ros.org/en/jazzy/index.html.

Supplies

This course will provide most supplies for free, including laptop computers, robot assembly parts, microcontrollers, sensors, crafting tools, measuring tools, programming software, etc. Students are welcome to ask the instructor to purchase reasonable supplies if necessary.

Students can take their robots and computers out of the classroom. Tools, computer peripherals (e.g. monitors, keyboards, and mice) can be taken out only if asked the instructor for permission.

Attendance Policy

- The instructor and the students are expected to appear in the classroom/lab in every class.
- If a student cannot show up on time, he/she needs to contact the instructor in advance.
- The instructor will notify the students with any changes of a class in advance.

Safety Requirement

- **Wear safety goggles in the classroom/lab all the time!**
- **Disconnect batteries before heading out!**
- No food nor drinks are allowed on the workbench. A snack table will be provided near the entrance.

Grading

A's are 90-100%, B's are 80-89%, C's are 65-79%, D's are 64-50%, F's are 0-49%. The final grade will be determined by following criteria.

Component	Percentage	Note
Attendance/Perfection*	1%	Attend every class on time, need a bit good luck.
Assignments	30%	Follow the rubrics.
Projects	60%	Follow the rubrics.
Presentation/Demonstration	9%	Peers and faculty members will assess it.
Total	100%	

* No excuse will be accepted unless traveling with UCA athletic teams.

Other Policies

The policies and procedures detailed in the UCA 2024-2025 Student handbook are also part of this syllabus. Please refer to the relevant policies as your guidance.
https://uca.edu/student/files/2024/08/The-UCA-Student-Handbook-2024-2025.pdf

Title IX

UCA has long been committed to providing a fair and consistent process for students, faculty, and staff to report incidents of sexual harassment and sexual misconduct, and will continue to do so under these new Title IX rules. The new rules became effective on August 14, 2020. As always, members of the campus community who have experienced Title IX Sexual Harassment (including sexual harassment, sexual assault, dating violence, domestic violence, stalking, and the unauthorized distribution of sexual images or recordings) are encouraged to report these incidents to the Title IX Coordinator. For further information, please visit: https://uca.edu/titleix/.

The University encourages individuals to report alleged sexual crimes promptly to campus officials and the University of Central Arkansas Police Department. Individuals are strongly encouraged to submit reports promptly in order to

preserve evidence for a potential legal or disciplinary proceeding. All complaints or reports of Title IX Sexual Harassment should be submitted to the Title IX Coordinator:

Jennifer Craun
Associate General Counsel and Compliance Officer
Wingo Hall, Suite 207
201 Donaghy Avenue Conway, Arkansas 72035
501-450-3247
Email: jcraun@uca.edu

Academic Integrity

The University of Central Arkansas affirms its commitment to academic integrity and expects all members of the university community to accept shared responsibility for maintaining academic integrity. Students in this course are subject to the provisions of the university's Academic Integrity Policy, approved by the Board of Trustees as Board Policy No. 709 on February 10, 2010, and published in the Student Handbook. Penalties for academic misconduct in this course may include a failing grade on an assignment, a failing grade in the course, or any other course-related sanction the instructor determines to be appropriate. Continued enrollment in this course affirms a student's acceptance of this university policy.

Generative AI

Use of Generative AI Tools in Engineering

The usage of generative AI (such as ChatGPT, Gemini, Claude, etc.) is highly encouraged in this course. You can use it for any assignments and projects, but you have to cite it properly.

- **Technical Reports and Projects**: When using AI-generated text or design suggestions in your reports or presentations, cite the tool used, e.g.,:
  OpenAI, "ChatGPT Response to How do I cite chatgpt's response following IEEE's standards?," ChatGPT, [Online]. Available: https://chatgpt.com/share/007f83e5-4426-41ae-88c6-c53343228e44. Accessed on: Aug. 19, 2024.
- **Code and Algorithms**: If AI contributed to a code snippet or algorithm in your work, include a comment noting its origin and a citation if required by the assignment/project guidelines.
- **Acknowledgment in Design or Research**: When AI plays a role in idea generation or refining your designs, include an acknowledgment in your report or project documentation explaining how it was used.

Ethical Use of Generative AI in Engineering

You can access generative AI anytime and anywhere. When using such tools in an engineering context, follow these ethical guidelines:

- **Transparency in AI Assistance**: Clearly disclose when and how AI contributed to your projects, reports, or problem-solving processes. Whether generating design ideas, writing code, or clarifying concepts, it's important to attribute AI's role honestly.
- **Academic Integrity and Learning**: Ensure your work reflects your understanding and effort. AI can assist with problem-solving, but it's crucial that you develop and demonstrate the core engineering skills you're learning in this course.
- **Safety and Accuracy in Technical Work**: AI-generated outputs are not always reliable, especially when it comes to technical calculations, design parameters, or safety-critical applications. Verify all AI-generated content against trusted engineering sources or industry standards.
- **Bias and Ethical Engineering Design**: AI models can introduce biases into design or problem-solving suggestions. It's important to critically evaluate these outputs, particularly in engineering applications that impact diverse populations or involve ethical considerations.
- **Respecting University and Industry Standards**: Adhere to both academic guidelines and professional engineering standards when using AI. Unauthorized or unacknowledged use of AI in technical reports, design projects, or exams can result in academic penalties.

Building Emergency Plan

An Emergency Procedures Summary (EPS) for the building in which this class is held will be discussed during the first week of this course. EPS and Building Emergency Plan (BEP) documents for most buildings on campus are available at https://uca.edu/go/bep-library. Every student should be familiar with emergency procedures for any campus building in which he/she spends time for classes or other purposes.

Disabilities

The University of Central Arkansas adheres to the requirements of the Americans with Disabilities Act. If you need an accommodation under this Act due to a disability, please contact the Office of Accessibility Resources and Services (OARS), (501)450-3613.

Course Evaluation

The Student Course Experience Survey is a crucial element in helping faculty achieve excellence in the classroom and the institution in demonstrating that students are gaining knowledge. Students may complete surveys for the courses they are taking starting on **Monday, April 21st, through Sunday, May 4th** after finals week by logging in to myUCA and clicking on the Course Evaluations task.

Course Contents

Please refer to the following for a tentative course plan. The actual contents will be subject to changes due to the progress of the course. **Note: all assignments and projects due at 2:30 pm on Thursdays.**

Module 1 - Prepare the Robot

Continue the setup from Robotics 1, the students are expected to equip their robots with more advanced sensors and control algorithms.

- **Assignment 1 (Individual):** LiDAR scan. **Due date:** Thursday, 01/16/2025.
- **Assignment 2 (Individual):** Fine motor control. **Due date:** Thursday, 01/23/2025.
- **Assignment 3 (Individual):** Robot velocity control. **Due date:** Thursday, 01/30/2025.

Module 2 - Manage the Robot

Students will get started to utilize the Robot Operating System (ROS) to manage their robots.

- **Assignment 4 (Individual):** Create a ROS package. **Due date:** Thursday, 02/06/2025.
- **Assignment 5 (Individual):** Velocity command listener. **Due date:** Thursday, 02/13/2025.
- **Project 1 (Team):** Remote control using ROS. **Due date:** Thursday, 02/27/2025.

Module 3 - Model the Robot

Students will learn how to describe a robot using URDF files and how to simulate the robot with Gazebo.

- **Assignment 6 (Individual):** Model a robot. **Due date:** Thursday, 03/06/2025.
- **Project 2 (Team):** Simulated prototype. **Due date:** Thursday, 03/20/2025.

Module 4 - Navigate the Robot

Students will be introduced to *Nav2* and *slam_toolbox* packages to build maps and navigate the robot autonomously.

- **Final Project (Team):** Autonomous Navigation. **Due date:** Thursday, 05/01/2025.