MARYLAND
ROBOTICS CENTER

STUDENT PREPARATION TO ADVANCE ROBOTICS IN COLLEGE (SPARC) CERTIFICATE PROGRAM

TRACK: AUTONOMOUS GROUND VEHICLES (AGVS)

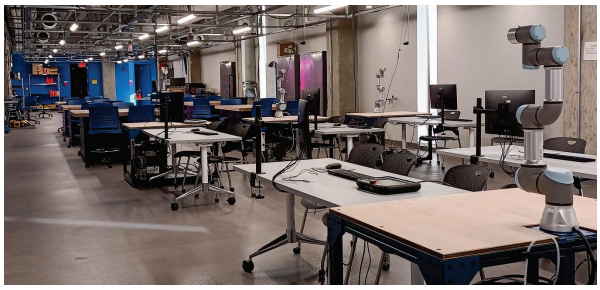
Program Syllabus

Summer 2026

PROGRAM INFORMATION

The "Autonomous Ground Vehicle (AGV)" Track of the *Student Preparation to Advance Robotics in College (SPARC) Certificate Program* introduces high school students to the fundamentals of **mobile robotics** and **autonomous navigation** through a highly hands-on, build-and-program experience. Students will learn how ground robots sense the world, make decisions, and move purposefully through real environments—connecting core concepts in mechanical design, electronics, programming, and artificial intelligence.

Through a combination of short lectures, guided build sessions, demonstrations, and structured lab activities, participants will get hands-on experience assembling a ground robot, integrating key hardware components (such as motors, motor drivers, and onboard sensors), and learning how to program the robot's behavior. Students will develop and test algorithms for autonomy, including perception (interpreting sensor data), planning (choosing actions), and control (executing smooth, accurate motion). As the track progresses, students will imbue their robot with artificial intelligence to help it perform autonomous tasks—such as navigating cluttered environments, avoiding obstacles, and making decisions in uncertain conditions. The track culminates in a final demonstration in which each student team's AGV must autonomously navigate a maze, using its sensors and onboard intelligence to reach the goal without human intervention.



The Maryland Robotics Center (MRC) Robotics and Autonomy Lab supports robotics prototyping and manufacturing, and mobile robotics research.

PROGRAM FORMAT

The program will run for three weeks, with instructional hours scheduled Monday through Friday from 9:00 AM to 3:30 PM. Participants must be signed in and signed out of the program each day by an authorized adult; however, students with signed waivers from their legal guardians may be permitted to sign themselves in and out. For the final day of the program, participants may invite guests to attend the final project presentations and demonstrations, which will be followed by the SPARC Certificate Conferment Ceremony.

Daily Schedule

9:00 – 9:15 AM	Student Drop-Off
9:15 AM – 12 PM	Morning Activities
12:00 – 1:00 PM	Lunch
1:00 – 3:15 PM	Afternoon Activities
3:15 – 3:30 PM	Student Pick-Up

PROGRAM INSTRUCTOR

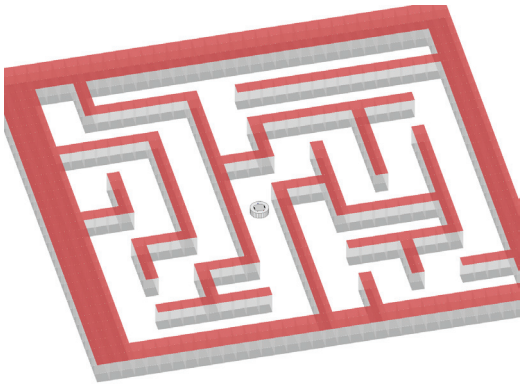
Prof. Yancy Diaz-Mercado, Associate Professor of Mechanical Engineering
Affiliate Faculty, Maryland Robotics Center

Course Schedule (Subject to Changes)

		Morning Topics & Activities	Afternoon Topics & Activities
Week 1 Robot Assembly	**M**	• Program Overview & Team Formation • Facilities/MRC Labs Tours	• Introduction to mobile robots; robot build plans discussion; Team concept development
	T	• 3D printing modeling and print queue	• Robot body assembly
	W	• Electronics and wiring diagram overview	• Electronics and motor mounting; wiring and testing
	Th	• Motor controller and microelectronics overview	• Sensor and power mounting; wiring and testing
	F	• Hardware testing; design verification and validation	• Motor and sensor calibration
Week 2 Control and Perception	**M**	• Programming and codebase overview	• Robot motion and motor primitives
	T	• Open-loop vs. feedback control	• Control tuning and testing
	W	• Sensor processing and pose estimation	• Wall detection and line following
	Th	• Low-level behavior integration: wall following, centering, collision avoidance	• Mini-challenge overview
	F	• Maze mini-challenge; adjustments and redesigns	• Technical presentation skills; team project presentation preparation
Week 3 Autonomy	**M**	• Environment representations; states and configurations; robot planners	• Robot simulation; planner development
	T	• Localization; artificial intelligence tools	• Robot integration and testing
	W	• Autonomy testing	• Preparing Final Project Presentations
	Th	• Tuning and performance improvements	• Finalizing Final Project Presentations
	F	• Final Project Presentations & Demonstrations • SPARC Certificate Conferment Ceremony	

AUTONOMOUS GROUND VEHICLE TEAM DESIGN CHALLENGE:
THE GREAT MAZE ESCAPE

Through this SPARC Certificate Program project, participants will gain skills in electronics, programming, and motion planning. This final project will help participants build experiential learning experience with a tangible project. Students will leave with a refined ability to debug complex systems under pressure—a skill that translates directly to any field in STEM. More importantly, they will depart with a new mindset: seeing challenges not as roadblocks, but as problems waiting to be solved.



Simulation of a mobile robot navigating a maze.

Working in teams, participants will design, assemble, and program your robot to help it find its way through a maze fully autonomously and without any human assistance. Teams will race against the clock to test their robot's ability to sense, plan, and move their way to freedom!

1. **Engineering a Robot Construct:**
   - Teams will learn about motors, sensors, and the electronics needed to help a robot move within and sense its environment.

2. **Ability to Process Information:**
   - Teams will learn how sensor information is used to reason about the environment and let a robot determine its own position, state, and actions.

3. **Embodied Intelligence:**
   - Teams will learn how to model robot motion, and how use these models to help a robot plan and control its motion through the environment.

Students will use iterative engineering development to design and tune their robot's performance. For each design, teams will have their robots navigate a previously unseen maze in three experimental runs. The team achieving the strongest final performance, based on number of collisions and times of completion, will be recognized during the SPARC Certificate Conferment Ceremony on the final day of the program.