



WHEELED MOBILE ROBOTS

PROF. ASOKAN THONDIYATH

Department of Engineering Design
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INTENDED AUDIENCE : Undergraduate/graduate students interested in mobile robotics

COURSE OUTLINE : Upon completion of the course, the students should be able to:

- Learn algorithmic approaches, mathematical models and computational and motion control methods applicable to mobile robotic systems
- Learn basic sensor systems related to state measurements, navigation and localization.
- Learn different motion planning and navigation schemes related to mobile robots
- Recognize and analyze the basic mechanical and electrical systems concerning robots' locomotion and manipulation
- Analyze and design the basic mobile robotic systems

ABOUT INSTRUCTOR :

Prof. T. Asokan is a Professor in the Department of Engineering Design, and currently the Head of the Department, at IIT Madras. He completed his B.Tech. and M.Tech. in mechanical engineering and received his Ph.D. in Mechanical Engineering from the Indian Institute of Technology Madras. Prior to joining IIT Madras, he was with the Robotics Research Center, Nanyang Technological University, Singapore working in the area of robotic system development. He was awarded the Stanford-India biodesign fellowship by the Stanford University, USA in 2009 and has completed a post doctoral fellowship in medical device development at the Stanford University. He is currently the national secretary of The Robotics Society. He has more than 25 years of professional experience in research and teaching in the broad areas of Robotics, Product design, and Engineering System design. Dr. Asokan has published more than 100 papers in International Journals and conferences and has filed 18 patents in India, USA, and Singapore. More details can be found at <https://ed.iitm.ac.in/~asokan/>

Prof. Santhakumar Mohan is an Associate professor in the department of Mechanical Engineering, Indian Institute of Technology Palakkad. He has more than 10 years of professional experience in teaching and research. He has been teaching the course on Wheeled mobile robots (shortly mobile robotics) for the last 7 years for both undergraduate and postgraduate students. He is active in the design and development of mobile robots for field applications and has 4 patents filed in India. For more details please visit the webpage (<https://iitpkd.ac.in/people/santhakumar>).

COURSE PLAN :

- Week 1:** Introduction to mobile robots and mobile manipulators. Principle of locomotion and types of locomotion. Types of mobile robots: ground robots (wheeled and legged robots), aerial robots, underwater robots and water surface robots.
- Week 2:** Kinematics of wheeled mobile robot, degree of freedom and maneuverability, generalized wheel model, different wheel configurations, holonomic and non-holonomic robots.
- Week 3:** Dynamics of mobile robot: Lagrange-Euler and Newton-Euler methods. Computer based dynamic (numerical) simulation of different wheeled mobile robots.
- Week 4:** Sensors for mobile robot navigation: magnetic and optical position sensor, gyroscope, accelerometer, magnetic compass, inclinometer, tactile and proximity sensors, ultrasound rangefinder, laser scanner, infrared rangefinder, visual and motion sensing systems.
- Week 5:** Robot navigation: Localization, Error propagation model, Probabilistic map based localization, Autonomous map building, Simultaneous localization and mapping (SLAM).
- Week 6:** Motion and path planning: collision free path planning and sensor-based obstacle avoidance.
- Week 7:** Motion control of mobile robots: Motion controlling methods, kinematic control, dynamic control and cascaded control.
- Week 8:** Introduction to modern mobile robots: Swarm robots, cooperative and collaborative robots, mobile manipulators, autonomous mobile robots.