



Mobile Robots

Course description sheet

Basic information

Field of study AGH UST International Courses Major All Organisational unit AGH University Database of Electives Study level University database of electives Form of study Full-time studies Profile General academic		Didactic cycle 2026/2027 Course code UBPOJOS.A200000.20182.26 Lecture languages English Mandatoriness Elective Block General Modules Course related to scientific research Yes USOS code 130-INT-xS-308
Course coordinator	Łukasz Ambroziński	
Lecturer	Łukasz Ambroziński, Joanna Koszyk	
Period Summer semester	Method of verification of the learning outcomes Exam Activities and hours Laboratory classes: 15 Project classes: 15	Number of ECTS credits 4

Goals

C1	Introduce students to the fundamental principles of mobile robotics, navigation and robot perception.
C2	Provide knowledge of local and global path planning methods, SLAM techniques and robot sensors.
C3	Develop practical skills in programming mobile robots and implementing navigation algorithms in simulation and on real robotic platforms.

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge - Student knows and understands:			
W1	fundamental concepts of mobile robots and application areas.		Project, Report, Test results, Presentation
W2	principles of robot sensing, localization, mapping and navigation.		Project, Report, Test results, Presentation
W3	methods of local and global path planning and SLAM algorithms.		Project, Report, Test results, Presentation
Skills - Student can:			
U1	U1 program mobile robots and use robotic software frameworks.		Project, Report, Test results, Presentation
U2	implement and evaluate local and global path planning algorithms in simulation environments.		Project, Report, Test results, Presentation
U3	configure and apply selected SLAM methods.		Project, Report, Test results, Presentation
U4	prepare an engineering project concerning autonomous navigation.		Project, Report, Test results, Presentation
Social competences - Student is ready to:			
K1	work in teams during engineering tasks involving robotics systems.		Project, Presentation
K2	critically evaluate developed solutions and justify design decisions.		Project, Presentation
K3	present, showcase, and defend the developed solution to a given problem		Project, Presentation

Program content ensuring the achievement of the learning outcomes prescribed to the module

The course provides practical knowledge and engineering skills in the field of mobile robotics. Students become familiar with robot programming, navigation algorithms, localization and mapping methods, and deployment of autonomous systems. The module combines laboratory exercises with project classes, where students design and implement a mobile robot navigation system in simulation and validate selected elements on real robotic platforms

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Laboratory classes	15
Project classes	15
Preparation of project, presentation, essay, report	60

Preparation for classes	30
Student workload	Hours 120
Workload involving teacher	Hours 30

* hour means 45 minutes

Program content

No.	Program content	Course's learning outcomes	Activities
1.	The laboratory classes combines short theoretical introductions, computer programming exercises, simulation tasks and selected experiments on real robotic platforms to provide both conceptual understanding and practical skills. Topics cover: 1. Mobile robots basic concepts 2. Robot programming and software tools 3. Robot sensors and perception 4. Local path planning methods 5. Global path planning methods 6. Simultaneous localization and mapping (SLAM) 7. Mission planning and validation on real robots	W1, W2, W3, U1, U2, U3, K1	Laboratory classes
2.	Students carry out projects focused on designing and evaluating a navigation system for a mobile robot using simulated environments. Projects may involve localization, mapping, local and global path planning. Each group defines the project objective and scope, selects methods and tools, and develops the solution under instructor supervision. The project workflow includes: Problem definition and requirements analysis. Simulation environment preparation. Implementation of selected navigation modules. Testing and parameter tuning. Evaluation of results. Preparation of technical report and final presentation.	W1, W2, W3, U1, U2, U3, U4, K1, K2, K3	Project classes

Extended information/Additional elements

Teaching methods and techniques :

Discussion, E-learning, Case study, Flipped classroom, Project Based Learning, Demonstration, Workshop

Activities	Methods of verification	Credit conditions
Lab. classes	Report, Test results	Positive grade from laboratory tasks
Project classes	Project, Report, Presentation	Positive grade from completed project (report + oral presentation)

Conditions and the manner of completing each form of classes, including the rules of making retakes, as well as the conditions for admission to the exam

by personal arrangement with course leader and lecturers

Method of determining the final grade

the weighted average of grades from project classes (35%), laboratory classes (35%), exam (30%) - exam must be passed to pass the course.

Manner and mode of making up for the backlog caused by a student justified absence from classes

by personal arrangement with course leader and lecturers

Literature

Obligatory

1. Thrun, S.; Burgard, W.; Fox, D. Probabilistic Robotics; Intelligent robotics and autonomous agents; MIT Press: Cambridge, Massachusetts London, 2006.
2. Siegwart, R. Introduction to Autonomous Mobile Robots, 2nd ed.; Intelligent robotics and autonomous agents series; MIT Press: Cambridge, Massachusetts, 2011
3. Barfoot, T. State Estimation for Robotics, Second edition.; Cambridge University Press: Cambridge, United Kingdom New York, NY, USA, 2024

Optional

1. Choset, H. M. Principles of Robot Motion: Theory, Algorithms, and Implementations; Intelligent Robotics and Autonomous Agents Ser; MIT Press: Cambridge, 2014

Scientific research and publications

Research

1. Autonomous navigation
2. Localization and mapping

Publications

1. Koszyk, J., Hyla, B., Pieczonka, L., Ambroziński, L., 2026. Multi-sensor robotic mapping with thermal and acoustic imaging for non-contact technical diagnostics. Eksploatacja i Niezawodność – Maintenance and Reliability. <https://doi.org/10.17531/ein/217575>
2. Pargieła, K., Jasińska, A., Malczewska, A., Grzelka, K., Koszyk, J., Ambroziński, Ł., 2025. Application of mobile laser scanner to augment stationary collected point clouds. Building Research & Information 53, 675–699. <https://doi.org/10.1080/09613218.2025.2451975>
3. Koszyk, J., Jasińska, A., Pargieła, K., Malczewska, A., Grzelka, K., Bieda, A., Ambroziński, Ł., 2024b. Semantic Segmentation-Driven Integration of Point Clouds from Mobile Scanning Platforms in Urban Environments. Remote

Sensing 16, 3434. <https://doi.org/10.3390/rs16183434>

4. Hyla, B., Koszyk, J., Ambroziński, Ł., Pieczonka, Ł., 2024. Zrobotyzowany system inspekcyjny do detekcji anomalii termicznych i akustycznych w obiektach technicznych. *Badania Nieniszczące i Diagnostyka* 10, 14–18. <https://doi.org/10.26357/BNiD.2024.006>