MICRO-452

Basics of mobile robotics

Mondada Francesco

Cursus	Sem.	Type
Computer science	MA1, MA3	Opt.
Cybersecurity	MA1, MA3	Opt.
Data Science	MA1, MA3	Opt.
Mechanical engineering	MA1, MA3	Opt.
Microtechnics	MA1, MA3	Opt.
Robotics, Control and Intelligent Systems		Opt.
Robotics	MA1, MA3	Obl.
SC master EPFL	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly
Number of positions	

Summary

The course teaches the basics of autonomous mobile robots. Both hardware (energy, locomotion, sensors) and software (signal processing, control, localization, trajectory planning, high-level control) will be tackled. The students will apply the knowledge to program and control a real mobile robot.

Content

- Applications, products and market
- Sensors
- Perception, feature extraction
- Modeling
- Markov localization: Bayesian filter, Monte Carlo localization, extended Kalman filter
- Navigation: path planning, obstacle avoidance
- Control architectures and robotic frameworks
- Current challenges in mobile robotics
- Locomotion principles and control
- Embedded electronics

Keywords

mobile robots, sensing, perception, localisation, navigation, locomotion.

Learning Prerequisites

Required courses

Introduction to automatic control (catching up possible with extra effort)
Introduction to signal processing

Recommended courses

Microinformatique (SMT)

Important concepts to start the course

Embedded system programming

Basics of automatic control
Basics of signal processing

Learning Outcomes

By the end of the course, the student must be able to:

- Choose the right methods to design and control a mobile robot for a particular task.
- Integrate approriate methods for sensing, cognition and actuation
- Justify design choices for a robotic system
- Implement perception, localisation/navigation and control methods on a mobile robot
- Choose the right methods to design and control a mobile robot for a particular task.

Transversal skills

- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Set objectives and design an action plan to reach those objectives.
- Use a work methodology appropriate to the task.
- Assess progress against the plan, and adapt the plan as appropriate.
- Chair a meeting to achieve a particular agenda, maximising participation.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Negotiate effectively within the group.
- Resolve conflicts in ways that are productive for the task and the people concerned.

Teaching methods

Ex cathedra, exercises, work on mobile robots

Expected student activities

- weekly lectures
- studying provided additional materials
- lab exercises with practical components

Assessment methods

Project during the semester (60% of the grade). The project takes place during the semester and the report and presentation are done before the end of the semester, following the specific planning given by the teacher at the beginning of the semester.
Written exam (40% of the grade)

Supervision

Office hours	No
Assistants	Yes
Forum	Yes

Resources

Bibliography

Introduction to Autonomous Mobile Robots R. Siegwart, and I. Nourbakhsh, MIT Press, 2004
Autonomous Robots: From Biological Inspiration to Implementation and Control G.A. Bekey, MIT Press, 2005

Probabilistic Robotics S. Thrun, W. Burgard and D. Fox, MIT Press, 2005
Handbook of Robotics (chapter 35) B. Sicilian, and O. Khatib (Eds.), Springer, 2008
Elements of Robotics M. ben-Ari and F. Mondada, Spinger, 2017.
additional literature provided on Moodle

Ressources en bibliothèque

- Handbook of Robotics / Sicilian
- Elements of Robotics / Ben-Ari
- Autonomous Robots / Bekey
- Introduction to Autonomous Mobile Robots / Siegwart
- Probabilistic Robotics / Thrun

Notes/Handbook

Lecture slides are continously provided on Moodle during the course.
Introduction to Autonomous Mobile Robots R. Siegwart, and I. Nourbakhsh, MIT Press, 2004
Probabilistic Robotics S. Thrun, W. Burgard and D. Fox, MIT Press, 2005

Moodle Link

- https://go.epfl.ch/MICRO-452