Module Description, available in: EN

Autonomous mobile robot systems

General Information

Number of ECTS Credits

3

Module code

TSM_AutMobRoS

Valid for academic year

2022-23

Last modification

2021-12-01

Coordinator of the module

Björn Jensen (HSLU, bjoern.jensen@hslu.ch)

Explanations regarding the language definitions for each location:

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

	Lausanne			Lugano	Zurich		
Instruction					**X** E 100%		
Documentation					**X** E 100%		
Examination					**X** E 100%		

Module Category

TSM Technical scientific module

Lessons

2 lecture periods and 1 tutorial period per week

Entry level competences

Prerequisites, previous knowledge

- Linear algebra
- General affinity to mathematics
- Basic feedback control systems
- Basic programming skills

Brief course description of module objectives and content

Mobile robots are complex mechatronic systems often interacting autonomously with their environment.

In the first part, the course provides theoretical fundamentals of mobile robot sensor fusion, planning, localization and mapping with examples in ROS. Tests of these complex systems can be conducted in simulated environments to speed up development and minimize risk of damage. Data from live tests can be recorded for later reuse and analysis as a foundation for further development.

In the second part of the course, students learn how to develop robot software and put it into practice using a practical example on a training robot. This includes real-time control, path planning, odometry, observers, position estimation, path control, etc. In the development process, we use the same development environments and libraries as in our industrial research projects.

Aims, content, methods

Learning objectives and competencies to be acquired

This course aims at giving students a deep insight into and theoretical understanding of the inner workings of autonomous mobile systems reinforced by hands-on experience of mobile robots or simulations thereof. At the end of this course students will be able to build mobile robots with autonomous behaviour.

Module content with weighting of different components

* Mathematical foundations (short primer)
  + Coordinate transformations, quaternions
* Mobile robot platforms in different environments: air, land, sea
  + Wheeled robots, drones, submarines,
  + Kinematics
  + Typical sensors
  + Control
  + Real-time systems
* Localization
  + Odometry
  + GPS
  + Sensor fusion
* Mapping
  + SLAM & Loop-Closing
* Navigation
  + Planning
  + Obstacle avoidance
  + Trajectory follower
* Advanced Topics
  + Real-time systems & Robot operating system frameworks
  + Modelling & simplification (Simulation & Design)
  + Dynamics of mobile robot platforms.

Teaching and learning methods

Ex-cathedra teaching
Case studies
The theory learned in class is applied in exercises

Literature

Siegwart, R. et al. "Introduction to Autonomous Mobile Robots", 2011, 2nd edition, MIT Press.

ISBN 978-0262015356

Assessment

Certification requirements

Module does not use certification requirements

Basic principle for exams

As a rule, all standard final exams are conducted in written form. For resit exams, lecturers will communicate the exam format (written/oral) together with the exam schedule.

Standard final exam for a module and written resit exam

Kind of exam

Written exam

Duration of exam

120 minutes

Permissible aids

No aids permitted

Special case: Resit exam as oral exam

Kind of exam

Oral exam

Duration of exam

30 minutes

Permissible aids

No aids permitted