COURSE DESCRIPTION CARD - SYLLABUS

Course name
Modern sensors in robotics [N2AiR1-RiSA>NSwR]

Course

Field of study
Automatic Control and Robotics

Year/Semester
1/2

Area of study (specialization)
Autonomous Robots and Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
20

Laboratory classes
20

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Students should have a basic knowledge of the Linux-like systems (e.g. Ubuntu) with basic knowledge of computer architecture. Students are expected to have the skills required to obtain information from provided sources and to solve basic technical issues with access to the Internet. It is also expected that students should be willing to cooperate in groups.

Course objective

The goal is to teach students about the current state-of-the-art regarding sensors used in mobile robotics. During lectures, the students will learn about theoretical aspects of sensor measurements, resulting in properties of the sensors, and possible applications of these sensors. The laboratory will cover the material concerning the practical aspects of sensor usage, data recording with these sensors and basic data processing.

Course-related learning outcomes

Knowledge
1. has detailed knowledge in the field of building and employing advanced sensor systems (K2_W6 [P7S_WG])

2. has knowledge related to running a business, managing engineering projects, and quality management (K2_W15 [P7S_WK])
Skills
1. Is able to select and integrate elements of a specialized measuring and control system, including a control unit, an execution system, a measuring system as well as periferal and communication modules (K2_U13 [P7S_UW])
2. Is able to employ advanced methods of processing and analyzing signals, including visual signals, and extract information from analyzed signals (K2_U11 [P7S_UW])
3. Is able to assess usefulness and possibility of employing new developments in the field of automatics and robotics (methods and tools) (K2_U16 [P7S_UW])
4. Is able to develop an algorithm for solving a complex engineering task and a simple research problem and to implement, test and run it in a chosen programming environment for selected operating systems; (K2_U25 [P7S_UW])
Social competences
1. Understands the need to continue self-education and knows the possibilities of further education - raising professional, personal and social competences, is able to inspire and organize self-education of others (K2_K1 [P7S_KK])

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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The knowledge from the lecture will be tested on the last meeting with a written test consisting of multi-choice questions. The test will cover the topic concerning the basic information about the working of the sensors, sensor features, and their application. The passing threshold is 50% of correct answers.
Additionally, the students are expected to fill short, 10-question tests after each lecture on the e-learning platform. The slides of the lectures will be made available to students in the PDF form.
The knowledge from the laboratories will be tested on the last meeting to verify the practical skills concerning the sensors usage and basic analysis of recorded data.

Programme content

Lectures:
1. Introduction, general about sensors, applications
2. RGB cameras, stereovision, thermal cameras
3. Laser scanners 2D/3D, radars
4. RGB-D sensors
5. Measuring orientation with AHRS
6. Different orientation representation
7. Odometry and tactile sensing
8. RFID/Beacony/UWB/WiFi
9. GPS/DGPS
10. Invited company presentation, e.g. SICK
11. External sensors calibration
12. External sensors calibration, part 2
13. Kalman filter
14. Graph optimization
15. Test
Laboratories:
Classes are divided into sections concerning different sensors. During laboratories, the students are expected to run, handle and register data from different classes of sensors (cameras, laser scanners, AHRS units, and GPS) within the ROS environment. The classes focus on aspects concerning proper data acquisition, external sensors calibration, and verification to the external ground truth measurements.

Course topics

none

Teaching methods

1. Lecture: presentation in the PDF with additional examples presented on the whiteboard.
2. Laboratories: each class has its instruction that is performed with the help and supervision of the teaching assistants. During laboratories, the students will use the sensors that are available in the Institute of Robotics and Machine Intelligence.

Bibliography

Basic
1. P. Skrzypczyński, Metody analizy i redukcji niepewności percepcji w systemie nawigacji robota mobilnego, Wyd.PP, Poznań, 2007
2. H. R. Everett, Sensors for Mobile Robots. Theory and Applications. Taylor & Francis, 1995
3. Dokumentacja techniczna robotów i sensorow będących na wyposażeniu laboratorium
Additional
1. Lentin Joseph, "ROS robotics projects", 2017 (Rozdziały 9 i 10)
2. Anil Mahtani, Luis Sanchez, Enrique Fernandez, Aaron Martinez, "Effective Robotics Programming with ROS", 2017 (Rodziały 8, 9 i 10)
3. Peter Corke, "Robotics, Vision and Control", 2017 (Rozdziały 2, 3, 4, 6, 10 i 11)
4. A. Borkowski, R. Chojecki, M. Gnatowski, W. Mokrzycki, B. Siemiatkowska, J. Szklarski, Reprezentacja otoczenia robota mobilnego, EXIT, Warszawa, 2011.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	40	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	60	2,50