COURSE DESCRIPTION
FIELD AND SERVICE ROBOTICS

SSD: AUTOMATICA (ING-INF/04)

DEGREE PROGRAMME: INGEGNERIA DELL'AUTOMAZIONE E ROBOTICA (P38)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

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GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: U2329 - ADVANCED ROBOTICS
MODULE: U2331 - FIELD AND SERVICE ROBOTICS
CHANNEL: FG A-Z
YEAR OF THE DEGREE PROGRAMME: II
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER II
CFU: 6

REQUIRED PRELIMINARY COURSES
Foundations of Robotics
Nonlinear Dynamics and Control

PREREQUISITES
Knowledge on the foundations of robotics

LEARNING GOALS
The course aims to provide students with the tools for modeling, planning and control of self-driving mobile robots (with wheels, drones, legged, underwater).

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)
Knowledge and understanding
The course path aims to provide students with the essential methodological tools for modeling, planning and control of autonomous mobile robot systems. The fundamental problems concerning robots with locomotion mechanisms in open spaces, structured and not, are dealt with. The

analytical methods acquired by the students are then used to understand the peculiarities in the design of planning techniques and control laws for such robots.

Applying knowledge and understanding

The student must demonstrate that (s)he is able to apply the methodologies acquired to model, plan and control autonomous-drive robots with different locomotion mechanisms, such as land rovers, drones (in particular quadcopters), underwater robots, quadrupedal and bipedal robots.

Field and service robotics

Wheeled robots

·   Kinematics and dynamics

·   Planning

·   Motion control

·   Odometric localization

·   Motion planning

·   Probabilistic planning

·   Planning through the method of artificial potentials

Aerial robotics

·   Drone kinematics

·   Dynamics of a quadcopter

·   Hierarchical control and geometric control

·   Passive control with external disturbance estimator

Underwater robotics

·   Kinematics and dynamics

·   Mixed controller

Legged robots

·   Kinematics of the floating base

·   Dynamics and centroidal dynamics

·   Stability and criteria

·   Whole-body control

·   Planner

·   Momentum-based estimator

READINGS/BIBLIOGRAPHY

·   B. Siciliano, L. Sciavicco, L. Villani, G. Oriolo, Robotics –Modeling, Planning and Control, Springer, London, 2009, ISBN 978-1-84628-641-4

·   A. Ollero, B. Siciliano (Eds.), Aerial Robotic Manipulation, Springer, Berlin, 2019, ISBN 978-3-030-12945-3

·   G. Antonelli, Underwater Robots, 3rd Ed., Springer, Berlin, ISBN 978-3-319-02877-4

- Lecture notes available at https://prisma.dieti.unina.it/index.php/education/education-courses/18-education/education-courses/722-field-and-service-robotics

TEACHING METHODS OF THE COURSE (OR MODULE)

The teacher will use: a) lectures for about 70% of the total hours, b) seminars for about 20% of the total hours; c) classroom examples through the use of analysis and simulation tools in Matlab / Simulink® for about 10% of the total hours.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [ ] Written
- [x] Oral
- [x] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [ ] Open answers
- [ ] Numerical exercises

b) Evaluation pattern

Both modules include the oral exam. The interview consists in ascertaining the acquisition of the concepts and contents introduced during the lessons. The oral interview of the Field and Service Robotics module also includes the discussion of a design project assigned by the teacher during the first month of the course.

The final grade will be weighted on the credits of each module and therefore composed as follows:

- Module: Robot Interaction Control, 6 CFU, 50%
- Module: Field and Service Robotics, 6 CFU, 50%