GHENT UNIVERSITY

Course Specifications

From the academic year 2024-2025 up to and including the academic year

Servo Systems and Industrial Robots (E008420)

Course size *(nominal values; actual values may depend on programme)*

Credits 3.0 **Study time 90 h**

Course offerings and teaching methods in academic year 2024-2025

A (semester 1)	English	Gent	lecture
			practical

Lecturers in academic year 2024-2025

Ostyn, Frederik	TW08	lecturer-in-charge
Lefebvre, Tom	TW08	co-lecturer

Offered in the following programmes in 2024-2025	crdts	offering
Bridging Programme Master of Science in Electromechanical Engineering(main subject Control Engineering and Automation)	3	A
Master of Science in Electromechanical Engineering(main subject Control Engineering and Automation)	3	A
Master of Science in Electromechanical Engineering(main subject Electrical Power Engineering)	3	A
Master of Science in Industrial Engineering and Operations Research(main subject Manufacturing and Supply Chain Engineering)	3	A
Master of Science in Electromechanical Engineering(main subject Maritime Engineering)	3	A
Master of Science in Electromechanical Engineering(main subject Mechanical Construction)	3	A
Master of Science in Electromechanical Engineering(main subject Mechanical Energy Engineering)	3	A
Master of Science in Industrial Engineering and Operations Research(main subject Transport and Mobility Engineering)	3	A
Master of Science in Materials Engineering	3	A
Master of Science in Sustainable Materials Engineering	3	A

Teaching languages

English

Keywords

robotics, servo systems, robot kinematics, robot dynamics, robot planning, robot control

Position of the course

This course deals with hardware and information processing aspects of robot and servo systems. Industrial robots can be found amongst others in pick-and-place applications, assembly, and the manipulation of objects. Furthermore, with the increase in industrial automation, servo drive systems have become increasingly popular. Servo systems and robotics have become the fundamental technology for accomplishing automatic tasks and will be ubiquitous in the factory of the future, exploration robotics, medical robotics, etc. This course provides fundamentals on robotics consisting of:

(1) Hardware aspects reviewing key actuators and sensors
(2) Robot kinemactis: Modeling and information processing of robot manipulators
(3) Robot dynamics: dynamic representations of motion and robot control strategies
(4) Robot planning and control to plan a motion and tracking a robot's movement.

Contents

- Introduction: history of robotics and applications
- Robot kinematics: rigid body motion, forward manipulator kinematics, Denavit-Hartenberg, differential kinematics, manipulator Jacobian, inverse manipulator kinematics
- Actuators and sensors: electric servo actuators, stepper motors, hydraulic servo actuators, distance sensors, encoders, resolvers
- Robot dynamics: robot control, rigid body dynamics, forward and inverse dynamic models, recursive Newton-Euler algorithm
- Robot planning and control: tracking, feedback linearization, computed torque control, planning algorithms for robots

Initial competences

Mathematical analysis (differential equations, linear algebra), physics, mechanics, electric drives, control theory, basic informatics, programming languages

Final competences

1 Understand how basic components of robot and servo systems work, specifically aspects related to the hardware and information processing
2 Discriminate between manipulator and joint space configuration
3 Know the basic concepts in servo and robot systems to represent pose and motion.
4 Apply forward robot kinematics on a robot system
5 Apply robot dynamics on a robot system
6 Calculate inverse kinematics on a robot system
7 Design and implement computer-based robot motion control strategies
8 Propose, analyze, select and implement hard- and software solutions for robot and servo systems.
9 Know the typical aspects of drives, sensors and controllers used in robot and servo control

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture, Practical, Independent work

Study material

Type: Syllabus

Name: Syllabus
Indicative price: Free or paid by faculty
Optional: no

References

- R. Murray, Z. Li, S. Sastry, A mathematical introduction to robotic manipulation, CRC Press, 1994.
- P. Abbeel, Advanced Robotics, EECS, UC Berkeley, 2009.
- P. Corke, Robotics, vision and control, Springer 2011.

Course content-related study coaching

Assessment moments

end-of-term assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment

Examination methods in case of periodic assessment during the second examination period

Written assessment

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

During examination period: written closed-book exam
During semester: project work and reports; second chance not possible.

Calculation of the examination mark