

SYLLABUS

Spacecraft Guidance, Navigation and Control 7.5 credits R7030R

Styrning, navigering och reglering av rymdfarkoster

Course syllabus admitted: Autumn 2023 Sp 1 - Present

**DECISION DATE
2022-02-11**

Spacecraft Guidance, Navigation and Control 7.5 credits R7030R

Styrning, navigering och reglering av rymdfarkoster

Second cycle, R7030R

Education level	Grade scale	Subject	Subject group (SCB)
Second cycle	G U 3 4 5	Rymdteknik	Space Technology

Main field of study

Space Technology

Entry requirements

Basic knowledge of control systems and modeling corresponding to the course R0005E Measurement and control. The students should also have a good background in Orbit and attitude dynamics (R7025R Orbit and Attitude Dynamics) and basic knowledge of spacecraft control, corresponding to the course R7026E Spacecraft Control.

Good knowledge English, equivalent to English 6.

Selection

The selection is based on 30-285 credits

Course Aim

The aim of the course is that the student shall learn the concepts of guidance, navigation and control (GNC) for space systems, including satellites, rockets, rovers, aerial vehicles, manipulators and planes.

After the course, the student shall be able to:

- Identify and select sensorial systems for GNC
- Generate trajectories for spacecrafts
- Program attitude estimation based on Extended Kalman Filtering
- Design control architectures for GNC as LQR and MPC
- Design basic applications in computed vision for GNC
- Apply the underlying knowledge in realistic labs

Contents

1. Trajectory generation
2. Attitude estimation
3. Space Sensors for Navigation
4. path Planning
5. Trajectory Tracking
6. LQR/LQG control
7. MPC control for satellite
8. Machine Vision for Space applications I
9. Machine Vision for Space applications II
10. Visual Servoing
11. Spacecrafts / Rover Kinematics
12. Rockets kinematics, dynamics and control
13. Manipulator Kinematics

Realization

Each course occasion's language and form is stated and appear on the course page on Luleå University of Technology's website.

The course realization will take place through: a) lectures and b) labs. The aim is to demonstrate the fundamental concepts of advanced spacecraft control in real-life experimental setups to strengthen the learning objectives of the course.

The course will involve realistic simulations and experiments to demonstrate the learning objectives of the course, while providing the necessary background to the students to understand, design and utilize GNC systems. The course will be finalized with a research oriented project that will be defined with the examiner.

Examination

If there is a decision on special educational support, in accordance with the Guideline Student's rights and obligations at Luleå University of Technology, an adapted or alternative form of examination can be provided.

The course examination will be based on the evaluation of a final project that the student should select and formulate with the help of the examiner.

The final project is reported with a written final report. The labs are also reported with a written lab report. The students should have at least a passing grade for the labs and the final grade is based on the performance in the final project and the labs (Final Grade = 30% grade on the labs and 70% grade on the final project)

Unauthorized aids during exams and assessments

If a student, by using unauthorized aids, tries to mislead during an exam or when a study performance is to be assessed, disciplinary measures may be taken. The term "unauthorized aids" refers to aids that the teacher has not previously specified as permissible aids and that may assist in solving the examination task. This means that all aids not specified as permissible are prohibited. The Swedish version has interpretative precedence in the event of a conflict.

Course offered by

Department of Computer Science, Electrical and Space Engineering

Modules

Code	Description	Grade scale	Cr	Status	From period	Title
0002	Laboratory work	G U 3 4 5	3	Mandatory	A22	
0003	Final project	G U 3 4 5	4.5	Mandatory	A22	

Last revised

by Jonny Johansson, HUL SRT 2022-02-11

Syllabus established

by Jonny Johansson, HUL SRT 2020-02-21