Robot Manipulation Control, 4 credits

Reglerteknik för objekthantering med robotarm, 4hp

1 Course content

The course covers the following topics in the context of robot manipulation control:
- Analysis of linear (and in part of nonlinear) systems
- Stability criteria
- Observability and controllability
- Common motion control schemes applied to robotic systems (PID control, linearization and decoupling, predictive control, passivity-based control)
- Overview of interaction control schemes (force control, impedance control)

2 Outcomes

2.1 The course in relation to the doctoral programme

The course shall primarily refer to the following intended learning outcomes for third-cycle courses and study programmes as described in the Higher Education Ordinance, i.e. the doctoral student shall demonstrate:

Knowledge and understanding
- broad knowledge and systematic understanding of the research field (part of outcome 1)
- advanced and up-to-date specialised knowledge in a limited area of this field (part of outcome 1)
- familiarity with the methods of the specific field of research in particular (part of outcome 2)

Competence and skills
- the capacity for scholarly analysis and synthesis (part of outcome 3)
- the capacity to review and assess new and complex phenomena, issues and situations autonomously and critically (part of outcome 3)
- the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively (part of outcome 4)
- the ability to plan and use appropriate methods to undertake research and other qualified tasks within predetermined time frames (part of outcome 4)

Judgement and approach
- intellectual autonomy and disciplinary rectitude (part of outcome 9)

The intended learning outcomes are listed in the same order as in the general syllabus for the programme.

2.2 Intended course learning outcomes

To obtain a passing grade, the doctoral student shall demonstrate:

- knowledge of the different control schemes commonly used in modern robotic systems
- an understanding of the control requirements in terms of controllability and stability
- skills to synthesize and tune control schemes for the robotic application at hand
- a capacity to reason about limitations and advantages of different controllers in different application contexts
- an ability to discuss common practices and algorithms to implement these controllers

3 Reading list and other teaching material

The following course readings and teaching material will be used on the course:

Bruno Siciliano, Lorenzo. Sciavicco, Luigi Villani and Giuseppe Oriolo (latest edition)
Robotics: modelling, planning and control
A Springer Science & Business Media

4 Teaching formats

Teaching on the course takes the following format:

The course will be given in the form of a number of lectures and obligatory laboratory exercises.
Students who have been admitted to and registered on a course have the right to receive tuition and/or supervision for the duration of the time period specified for the particular course to which they were accepted (see, the university's admission regulations). After that, the right to receive tuition and/or supervision expires.

5 Examination

The course is assessed through the following examinations which will be graded separately:

Theory.
Written exam.
Laboratory Work.
Written presentation of laboratory work in English.
For examinations consisting of several examination components, the following applies: If during the course it is concluded that a doctoral student is unable to complete a certain examination component, the examiner may set a substitute assignment provided that circumstances do not reasonably allow for the course component to be completed at a later date during the run of the course.

6 Grades

Examinations on third-cycle courses and study programmes are to be assessed according to a two-grade scale with either of the grades ‘fail’ or ‘pass’ (local regulations).

The grade shall be determined by a teacher specifically nominated by the higher education institution (the examiner) (Higher Education Ordinance).

To obtain a passing grade on examinations included in the course, the doctoral student is required to demonstrate that he/she attains the intended course learning outcomes as described in section 2.2. Alternatively, if the course consists of multiple examinations generating credit, the doctoral student is required to demonstrate that he/she attains the outcomes that the examination in question refers to in accordance with section 5.

A student who has failed an examination is entitled to a retake.

If an examination consists of several examination components, and a student fails an examination component, the examiner may, as an alternative to a retake, set a make-up assignment with regard to the examination component in question.

A doctoral student who has failed an examination twice for a specific course or course element is entitled, upon his/her request, to have another examiner appointed to determine the grade.

7 Admission to the course

7.1 Admission requirements

To gain access to the course and complete the examinations included in the course, the applicant must be admitted to a doctoral programme at Örebro University.

7.2 Selection

Selection between applicants who have been admitted to doctoral programmes at Örebro University and who otherwise meet the admission requirements as listed above is made according to the following order of precedence:

If no other selection criteria are specified in this section, priority shall be given to applicants with a lower number of course credits left before the award of their degree over applicants with a higher number of remaining course credits. Should two or more students have equal number of credits, selection will be done through the drawing of lots. This also applies within any selection groups listed unless otherwise stated.

7.3 Other applicants than doctoral students admitted at Örebro University

Other applicants than doctoral students admitted at Örebro University may be given access to the course on the grounds of provisions for and/or agreements regarding contracted courses, joint degrees, national graduate schools or cooperation in other respects with other universities.
Any decisions on what such other applicants may be given access to the course are made separately and on the basis of the provisions and/or agreements that occasion the student to apply for the course.

For participation in the course in other respects, the same provisions shall apply as for doctoral students admitted to Örebro University.

8 Transfer of credits for courses, study programmes and other experience

Provisions on the transfer of credits can be found in the Higher Education Ordinance and on the university’s webpage.

9 Other information

The course will be given in English

Transitional provisions

None.