

## Sensors and perception systems, 4 credits

### *Sensorer och perceptionssystem, 4 hp*

<b>Course Code/Codes</b>	50DT055
<b>Subject Area</b>	Computer Science (Datavetenskap)
<b>School/equivalent</b>	School of Science and Technology (Institutionen för naturvetenskap och teknik)
<b>Valid from</b>	2016-12-15
<b>Approved</b>	2016-12-15
<b>Revised</b>	,
<b>Approved by</b>	Head of School Peter Johansson
<b>Translation to English, date and signature</b>	,

## 1 Course content

The course covers the following topics in the context of sensor and perception systems for robotics:

- The role of sensors in a probabilistic robotic framework
- Positioning sensors: encoders and accelerometers
- Range sensors: sonars, radars and laser range finders
- Image sensors: cameras
- Global positioning sensors: GPS and indoor localization systems
- 3D range sensors: ToF, structured light and stereo vision
- Chemical sensors
- Calibration
- Noise modelling and characterization
- Noise filtering and sensor data processing
- Scene perception: mapping and registration
- Object perception: recognition and detection

## 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)
- the ability to review and evaluate research and other qualified tasks (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 and Understanding

- knowledge of the different types of sensors commonly used in robotic systems
- understanding of the basic principles of operation of different types of sensors
- knowledge of current state of the art perception systems

#### Competence and Skills

- skills to configure, calibrate and use modern sensors in the context of mobile robots
- skills to configure and use standard perception systems

#### Judgment and Approach

- the ability to reason about advantages and limitations of different sensors in different application contexts
- the ability to reason about the advantages and limitations of different perception algorithms
- the ability to discuss common practices and algorithms for processing raw sensor information

## **3 Reading list and other teaching material**

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

Selected scientific articles and slides from lectures

## **4 Teaching formats**

Teaching on the course takes the following format:

The course will consist of a number of lectures and seminars, as well as hands-on experience with sensors and perception systems in a laboratory setting.

## **5 Examination**

Select examination format here.

The course will be examined by means of completing a small project and presenting it orally. Participation in seminars

## **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 is given in English.

## **Transitional provisions**

None.