Computer Vision

Programme course

12 credits

Datorseende

TSBB15

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical Engineering, Physics and Mathematics

Date determined
2017-01-25

Offered for the last time
Spring semester 2022

Replaced by
TSBB33 och TSBB34

Main field of study
Computer Science and Engineering, Electrical Engineering

Course level
Second cycle

Advancement level
A1X

Course offered for
- Computer Science and Engineering, M Sc in Engineering
- Industrial Engineering and Management - International, M Sc in Engineering
- Industrial Engineering and Management, M Sc in Engineering
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- Applied Physics and Electrical Engineering, M Sc in Engineering
- Information Technology, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering

Specific information
Exchange students may apply for the course after arrival to the university but before it starts. The international officer for exchange studies must be contacted before applying.

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Projective spaces, homogeneous representations of 2D and 3D geometry, probability theory, estimation theory, the least-squares-method, partial differential equations, frame theory, 1D & 2D linear system theory (deterministic and stochastic). Basic image processing: thresholding, segmentation, edge detection. Use of Matlab.

Intended learning outcomes

After having passed this course, the student is expected to be able to describe problems and algorithms for the following basic computer vision and image processing tasks:

- tracking of image regions
- triangulation from stereo images
- estimation of optical flow
- detection of several image features
- matching of image features
- graph and tree structures and other image representations
- generative image models
- segmentation of image regions
- enhancement of images
- debugging and visualisation
  These are relevant for applications 3D reconstruction, camera pose estimation, object detection, motion estimation, visualization, and quality control within the areas of 3D vision, object tracking, scientific imaging, and industrial imaging.

Course content

Computational methods related to the various applications mentioned in the course aims. For each application, a number of standard methods are being presented. Necessary mathematics is being introduced. Alternative methods and related research areas are mentioned.

Teaching and working methods

The course consists of two parts that are presented in parallel. One part is more theoretical and is based on a larger number of lectures and computer exercises that present and illustrate basic methods in computer vision. This part concludes with a written examination. The other part is more practical and begins with an introduction to two application areas: 3D-reconstruction and tracking of objects in image sequences. After that follows focused work in small projects and with guidance. The course participants are divided into small groups, and each group carries out both these applied projects, which shall demonstrate a number of methods presented in the theoretical part of the course. The results from each project group are presented orally at seminars and are documented in reports. Guidance for the projects is only given during the course semester. Each project is concluded by an analysis and reflection of the project work.

Examination

PRA2	Project Assignment 2	3 credits	U, 3, 4, 5
PRA1	Project Assignment 1	3 credits	U, 3, 4, 5
LAB1	Laboratory Work	3 credits	U, G
KTR1	Optional Written Test	0 credits	U, G
TEN1	Written Examination	3 credits	U, 3, 4, 5

The course has a written examination that includes the theoretical and method describing part of the course. Each of the project assignments consist of implementation, report writing, and an oral presentation. The projects are graded with 4 if passed directly. If initially failed, they may be passed with grade 3 after meeting the stipulated requirements. Attaining grade 5 for a project requires, beyond this, an individual or group based work as described on the course web page. The course gives a total grade as a weighted average of the grades from the written examination and the two projects. The voluntary mid-term examination includes only the half of the course that has been presented in about half the course period. Passing the mid-term examination gives credit points in the written examination TEN1. A passed mid-term examination is valid one year from the date it was written, and gives credit points in the written examination TEN1.

Grades

Four-grade scale, LiU, U, 3, 4, 5

Department

Institutionen för systemteknik

Director of Studies or equivalent

Klas Nordberg

Examiner

Per-Erik Forssén

Course website and other links

http://www.cvl.isy.liu.se/education/undergraduate/tsbb15

Education components

Preliminary scheduled hours: 96 h
Recommended self-study hours: 224 h

Course literature

Klas Nordberg: Introduction to Representations and Estimation in Geometry. ISY-kompendium. Milan Sonka, Vaclav Hlavac, Roger Boyle: Image Processing, Analysis, and Machine Vision, tredje utgåvan. Kompletterande material delas ut eller tillgängliggörs på kursens web-sida.

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.