LINKÖPINGS UNIVERSITET

Image Sensors

Programme course

6 credits

Bildsensorer

TSBB09

Valid from: 2017 Spring semester

Determined by

Board of Studies for Electrical
Engineering, Physics and Mathematics

Date determined

2017-01-25

Main field of study

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
- Information Technology, M Sc in Engineering
- Biomedical Engineering, M Sc in Engineering
- Media Technology and Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering

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

Linear algebra: points, lines and planes in two and three dimensions, vector spaces and linear maps. Basic optics (secondary): light spectrum and light refraction in lenses. Multidimensional signal analysis: Projective space and homogeneous representations of 2D and 3D geometry, homografier and kameramatrix, estimation theory. Basic use of Matlab.

Intended learning outcomes

After the course the student should be able to design and use systems that include image sensors, for example digital cameras or or other types of image sensors. This means to be able to

- describe the geometric image formation process and electronic measurement process related to various light sensors.
- describe the general design, applications, and limitations or various non-light sensors which produce images.
- solve computational problems which emerge when two or more images of the same scene have to be managed.

Course content

The course is focused on digital cameras (for still and video images) and describes the process which from the light flow into the camera generates pixel values that can be output in the form of an image. This includes optics, geometry, electronics and standards for image transmission. The course also presents special types of cameras such as infra-red cameras, range cameras and magnetic cameras. Finally, the course presents the basic gemetric relations which exist betwen two images of the same scene, so-called epipolar geometry. Main topics of the course are:

- The image formation process of the pinhole camera
- Measurement of the image in digital cameras and video cameras
- Infra-red cameras
- Projective geometry, camera matrix, homographies
- Epipolar geometry
- Camera calibration, lens-effects
- Computer tomography, 3D visualization
- Range cameras
- Extreme cameras

Teaching and working methods

The course has approximately 10 lectures which present theory and basic concepts. A number of problems and general solutions are also presented which later are examined in more detail during practical exercises, some using camera equipment some based on calculations in Matlab.

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Examination

LAB1	Laboratory work	3 credits	U, G
TEN2	Written examination	3 credits	U, 3, 4, 5

The written examination is divided into three parts that correspond to the three course objectives, and in order to pass the examination a certain level is required for each of the three parts. A failed examination can be completed if at least two of the parts are passed and if it is done as specified in the current course information. Some assignments of the laboratory work may include a small written exam that must be passed by the student before the rest of the assignment can be completed.

Grades

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

Other information

Supplementary courses: Course in computer vision, computer graphics, image coding, and project courses in the image area.

Department

Institutionen för systemteknik

Director of Studies or equivalent

Klas Nordberg

Examiner

Klas Nordberg

Course website and other links

https://www.cvl.isy.liu.se/education/undergraduate

Education components

Preliminary scheduled hours: 56 h
Recommended self-study hours: 104 h

Course literature

Additional literature

Books

Chapters in textbooks and articles that are provided at course start

Other

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.