Multidimensional Signal Analysis

Programme course

6 credits

Multidimensionell signalanalys

TSBB06

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
- Computer Science and Software Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
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- Biomedical Engineering, Master's programme
- Mathematics, Master's programme

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
Basic Linear Algebra: vector spaces, bases, scalar product, least squares problem, eigenvalue problems. Basic signal processing (corresponding to Linear Systems): sampling, convolution and Fourier transform of one-variable signals. Basic skills in Matlab is recommended.

Intended learning outcomes

Passing the course means that the student is able to use concepts and methods in signal and image processing that are based on linear algebra. The student is then able to:

- Use homogeneous coordinates for the Euclidean geometry of two and three dimensions. This includes points and lines in two dimensions, points, planes, and lines in three dimensions, homographies and camera projections.
- Estimate geometric objects based on various types of least sqaures techniques.
- Use linear representations: bases, subspace bases, and frames for signals.
- Apply linear signal representations on practical problems, such as filter optimization, normalized convolution, over-sampling, PCA, wavelet-transform and filter banks.

Course content

Signal spaces and signal bases, dual bases. Least squares problem, filteroptimering, normalized convolution. Eigenvalue and singular value analysis. Principal component analysis. Frames. Wavelet transform and filterbanks. Projective spaces, homogeneous coordinates, homographies, camera projections. Representation and estimation of various types of geometric objects.

Teaching and working methods

The course has lectures that present basic concepts and theory, accompanied by lessons that exemplify some of the calculations. In a set of mandatory computer exercises, each participant must demonstrate the ability to carry out more complex calculation and answer related questions. The course runs over the entire autumn semester.

Examination

KTR1	Optional Written Test	0 credits	U, G
LAB1	Laboratory Work	3 credits	U, G
TEN2	Written Examination	3 credits	U, 3, 4, 5

The written examination is divided into four parts that correspond to the four course objectives, and in order to pass the examination a certain level is required for each of the four parts. A failed examination can be completed if at least three of the parts are passed and if it is done as specified in the current course information. The optional test covers the first half of the course and its result can be used in the first written examination after the course. 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: Computer Vision, Image and Audio Coding, Medical Image Analysis, Neural Networks and Learning Systems, Image Sensors

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: 68 h
Recommended self-study hours: 92 h

Course literature

Additional literature

Compendia

Prerequisites for studies at advanced level in Image Science at Linköping University
A supplementary compendium, describes prerequisites for the course. In addition to these, articles and exerpts from book and compendiums are used, in accordance with the course information at the start of the course.
Klas Nordberg, Introduction to Representations and Estimation in Geometry
Covers the geometry part of the course.

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.