LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Bildanalys
Image Analysis

FMAN20, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED F/Pi
Date of Decision: 2023-04-18

General Information

Main field: Machine Learning, Systems and Control.
Main field: Virtual Reality and Augmented Reality.
Compulsory for: MMSR1, MVAR1
Elective for: BME4-sbh, BME4-bdr, C5, D4-bg, E4-mt, E4-bg, F4, F4-bg, F4-bm, L5-gi, Pi4-biek, Pi4-bam
Language of instruction: The course will be given in English on demand

Aim

The main aim of the course is to give a basic introduction to theory and mathematical methods used in image analysis, to an extent that will allow the student to handle industrial image processing problems. In addition the aim is to help the student develop his or her ability in problem solving, both with or without a computer. A further aim is to prepare the student for further studies in e.g. computer vision, multispectral image analysis and statistical image analysis.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- be able to explain clearly, and to independently use, basic mathematical concepts in image analysis, in particular regarding transform theory (in space as well as in the frequency domain), image enhancement methods, image compression and pattern recognition.
- be able to describe and give an informal explanation of the mathematical theory behind some central image processing algorithms (both deterministic and stochastic).

- have an understanding of the statistical principles used in machine learning.

Competences and skills
For a passing grade the student must

- in an engineering manner be able to use computer packages to solve problems in image analysis.
- be able to independently apply basic methods in image processing to problems which are relevant in industrial applications or research.
- with proper terminology, in a well structured manner and with clear logic be able to explain the solution to a problem in image analysis.

Contents

Basic mathematical concepts: Image transforms, Discrete Fourier Transform, Fast Fourier Transform.

Image enhancement: Grey level transforms, filtering.

Image restoration: Filterings, inverse methods.

Scale space theory: Continuous versus discrete theory, interpolation.

Extraction of special features: Filtering, edge and corner detection.

Segmentation: graph-methods, active contours, mathematical morphology.

Bayesian image handling: Maximum A Posterori (MAP) estimations, simulation.

Pattern recognition: Classification, SVM (Support Vector Machine), Principal Component Analysis (PCA), learning.

Registration

Machine Learning: Training, testing, generalization, hypothesis spaces.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Compulsory assignments comprising both theory and computer implementations. Approved results on these are enough to pass the course. To get a higher grade, a written and an oral test are required.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Admission

Assumed prior knowledge: FMAF05 Systems and Transforms, or similar (for example FMAF10 Applied Mathematics - Linear Systems).
The number of participants is limited to: 145
Selection: Incoming qualified exchange students have priority to 10 places. The ranking

among such applicants is performed by the course coordinator based on relevant courses taken. Among the remaining applicants priority is given according to the number of completed university credits within the program. Priority is given to students enrolled on programmes that include the course in their curriculum. Among such students place is guaranteed to students in the Master's Programmes in Machine Learning, Systems and Control and in Virtual Reality and Augmented Reality, for whom the course is compulsory.
The course overlaps following course/s: FMA170, FMA172, MATC20

Reading list

- Szeliski, R.: Computer Vision, Algorithms and Applications. Springer, 2010, ISBN: 9781848829343. It is possible to pass the course without owning the book, using material available through the course home page.

Contact and other information

Director of studies: Anders Holst, studierektor@math.lth.se
Course administrator: Studerandeexpeditionen, expedition@math.lth.se
Teacher: Magnus Oskarsson, Magnus.Oskarsson@math.lth.se
Course homepage: https://canvas.education.lu.se/courses/20289