Signals, Information and Images

Programme course

8 credits

Signaler, information och bilder

TSKS21

Valid from:

Determined by
Board of Studies for Mechanical Engineering and Design

Date determined
2017-01-25

Replaced by
TSKS24

Main field of study
Electrical Engineering

Course level
First cycle

Advancement level
G2X

Course offered for
- Computer Science and Software 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
Ordinary differential equations and difference equations of low orders. Matrix- and vector concepts, determinant, inner product, bases, the least-square method. One-dimensional and multi-dimensional calculus, especially derivatives and integrals. General ability to program, preferrably including Matlab.

Intended learning outcomes

After passing the course, the student should be able to

- analyze a given passive electrical circuit with respect to direct current and alternating current properties.
- determine the output from both time-continuous and time-discrete stable LTI systems, given a description of the input and the system, in the time domain as well as in the frequency domain.
- understand and apply the sampling theorem.
- describe the fundamentalk limits for compression and transmission of signals and information, perform simple calculations related to these, and understand how these relate to the physical reality.
- describe and exhibit ingineering understanding of the basic principles for techniques for storing and transmission of information that are used in practice.
- describe 2D continuous and discrete signals in the spatial domain, sampling, convolution and the most common cores.
- interprete the result of a 2D Fourier transform fouriertransform of an image, such as understanding what a spatial frequency means / interpretation of the most common filters.
- describe fundamental geometrical image transformations and color models.
- account for the connection between different concepts in the course in a structured way using adequate terminology.

Course content

Electrical cirquits:

- Direct Current – Ohm's law, Kirchhoff's laws.
- Alternating Current – the j-omega method.
  Signals and Systems, in continuous time as well as in discrete time – the concept of LTI systems and their connection to difference and differential equations.
- Examples of signals in applications of electrical engineering.
- Analysis in the time domain – Unit impulses, impulse response, convolution.
- Analysis in the frequency domain – Fourier series and transforms. Also the cosine transform, used in JPG. The Sine-in-sine-out principle for stable LTI systems.
- Sampling and reconstruction using pulse-amplitude modulation. The sampling theorem.
- Quantization, noise.

Information:

- Entropy
- Data compression – Huffman codes
- Error correction – Hamming kodes – Fundamental limits.

Images:

- The JPG format – Compression of images using the JPG format.
- From 1D to 2D: Fourier transforms, DFT, sampling, and convolution.
- Linear operations on digital images.
- 2D geometry.
- Color models and histogram operations.

Teaching and working methods

Teaching is given in the form of lectures, tutorials and laborations.

Examination

LAB1	Laboratory work	2 credits	U, G
TEN1	Written examination	6 credits	U, 3, 4, 5

Grades

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

Department

Institutionen för systemteknik

Director of Studies or equivalent
Klas Nordberg

Examiner
Mikael Olofsson

Education components
Preliminary scheduled hours: 64 h
Recommended self-study hours: 149 h

Course literature
Mandal & Asif, Continuous and Discrete Time Signals and Systems, Cambridge University Press, 2007. Magnusson, Signal- och Bildbehandling, kompendium, ISY, LiU, 2013. Kompletterande material som distribueras under kursen.

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.