EQ2300 Digital Signal Processing 7.5 credits

Digital signalbehandling

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for EQ2300 valid from Spring 2019

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Electrical Engineering

Specific prerequisites

For single course students: 120 credits and documented proficiency in English B or equivalent

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After passing the course the student is expected to be able to:

· Give examples of signal processing problems that can be solved using digital signal processing.

· Implement digital signal processing methods in MATLAB (or an equivalent programming language) based on a given algorithmic description or theory.

· Explain and give examples of how digital filters can be implemented in software and hardware, and show some insight into thepositive and negative aspects ofdifferent implementations.

· Approximate filters with given impulse responces and transfer functions using FIR filters, and to quantitively and qualitatively assess the approximation.

· Show some insight into the underlying principle of the FFT algorithm, use this algorithm to filter digital signals in the frequency domain, and calculate its complexity.

· Estimate the power spectral density (PSD) of a time-discrete stochastic process using non-parametric and parametric methods and show some insight into thepositive and negative aspects of thedifferent approaches.

· Formulate and implement MMSE-optimal FIR filters for a given signal model.

· Implement and use methods to increase and decrease the sample rate of a signal and explain, quantitively and qualitatively, how this signal is affected in the time and frequency domains.

· Implement and use a filterbank to split a signal in sub-bands and then reconstruct the original signal.

· Show some insight into what happens when a filter is implemented on a fixed point processor, be able to model and calculate quantization and fixed point noise, and based on the calculations choose between implementations.

· Combine the methods and results described above to solve simpler signal processing tasks, and be able to report and motivate the chosen solution in the form of a written technical report.

A student that is approved with a higher grade (than E) shoud also be able to:

· Combine the methods above to solve more complex tasks and signal processing problems.

· Provide convinsing and technically accurate motivations for solutions and methods chosen, as for example for a chosen spectrum estimator.

· Show deeper insights into the theoretical results of the course than what is required to mecanically apply the relevant formlulas.

Course contents

The course address classical results and methods in digital signal processing, both in terms of fundamental principles and mathematical theories. In particular:

· Implementation of digital filters and approximations of target impulse responces and trasfer functions using FIR filters.

· Spectral estimation methods including the periodogram, the modified periodogram, and auto regressinve (AR) model based spectral estimation methods and their connection to prediction.

· The FFT algorithm and its use in spectral estimation and filtering.

· Upsampling and downsampling of time-discrete signals.

· Filterbanks for splitting a signal into sub-bands.

· Effects of quantization and fixed point implementations of filters and systems.

Disposition

The course is based on lectures where key results and theories are presented with the help of simple examples and demonstrations, and tutorials where the theory is applied to solve signal processing problems. The tutorials consist of some problems that are solved by a tutorial assistant, and some that are solved by students (potentially with the help of the tutorial assistant). The course also contains a project task and a hardware lab that gives an opportunity to apply the theory in practise.The course is given in English.

Course literature

See course home page.

Examination

- LAB1 - Laboratory Work, 0.5 credits, grading scale: P, F
- PRO1 - Project Assignment, 1.0 credits, grading scale: P, F
- TEN1 - Examination, 6.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

The theoretical skills are examined by a written 5h exam. Implementation skills are trained and examined by a more extensive project involving both theory and programming. The results are then presented in a written report. The abilities to connect theory and practice are trained and examined through a laboration.

Other requirements for final grade

Completed hardware lab (LAB1) with approved preparatory assignmnets. Approved project (PRO1) that is completed and reported in the form of a technical report in groups of maximum two students. Passing grade on final written exam (TEN1)

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.