Design of Embedded DSP Processor

Programme course

6 credits

Konstruktion av inbyggda DSP-processorer

TSEA26

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
Computer Science and Engineering, Electrical Engineering

Course level
Second cycle

Advancement level
A1X

Course offered for
- Electronics Design Engineering, M Sc in Engineering
- Computer Science and Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Computer Science, Master's programme
- Electronics Engineering, Master's programme
- Information Technology, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, 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
Microprocessor fundamentals corresponding to the contents of Computer hardware and architecture. Basic knowledge of DSP, corresponding to the contents of Signals and systems. Basic knowledge of VHDL or Verilog, corresponding to the contents of Computer hardware and architecture or Design of Digital Systems.

Intended learning outcomes

To give student industrial design experiences to design application specific instruction set processors as well as embedded systems. After completing the course, students shall:

- have knowledge of the concepts of embedded systems, DSP implementation, DSP processor architecture, DSP hardware with finite data precision.
- be able to design an application specific instruction set including profiling, instruction set specification, SW-HW co-design, instruction set coding, and instruction set benchmarking
- be able to design the microarchitecture of a processor or other computation unit, including the design of the register file, ALU, MAC, control path, memory subsystem, and peripherals
- be able to write efficient firmware for computation kernels with finite data precision on a DSP processor
- have knowledge of firmware development toolchain
- have knowledge of processor integration and verification.

(The roman numbers in parenteses are used in the IUAE matrix for this course.)

Course content

General DSP processors. ASIP (Application Specific Instruction Set Processors) for DSP. Differences between CPU and DSP. ASIP design methods. Numeric representations for DSP and its hardware. Data path design, memory- and bus architecture, and DSP Addressing. Instruction set design. Performance analysis and evaluation of DSP processors. Control path design. Peripherals and DMA. DSP Firmware design, assembly simulators, debuggers and development environments. Processor verification techniques.

Teaching and working methods

Lectures, tutorials, and laborations. During the labs each student will complete a small DSP processor.

Examination

LAB1	Laboratory assignments	3 credits	U, G
TEN1	Written examination	3 credits	U, 3, 4, 5

Grades

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

Other information

Supplementary courses: Computer Hardware - a system on chip

Department
Institutionen för systemteknik

Director of Studies or equivalent
Tomas Svensson

Examiner
Dake Liu

Course website and other links
http://www.isy.liu.se/en/edu/kurs/TSEA26/

Education components
Preliminary scheduled hours: 54 h
Recommended self-study hours: 106 h

Course literature

Additional literature

Books

Morgan Kaufmann, (2008) *Dake Liu: Embedded DSP Processor design, Elsevier*
ISBN: 9780123741233

Compendia

Andreas Ehliar, Exercise collection for TSEA26

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.