

Lecture Intro

Design of Embedded Hardware and Firmware

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Hans Doran – ZHAW

TSM_EmbHardw

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Prof. A. Habegger
Bern University of Applied Sciences

Agenda



Course Information

Topics

Obj and Org

Lab

Test

Homework

- ▶ **Course Information**
 - ▶ Main Course Topics

- ▶ Objectives and Organization

- ▶ **Practical Work**

- ▶ **Let's do a 20' refresh**

- ▶ **Homework**

Where to Get the Stuff

All material will be available online on MS Engineering Moodle platform.
Grading scheme may change within coming two weeks.

Duration

Three lectures a week @ fourteen weeks.

Grading

1st intermediary test (20 %)
2nd intermediary test or miniProject (20 %)
Final exam at the end (100 %, 80 %, or 60 %)

Docs

Online on MSE Moodle platform
<http://moodle.msengineering.ch>

Course

TSM_EmbHardw

PWD

SoPC



Course Information

Topics

Obj and Org

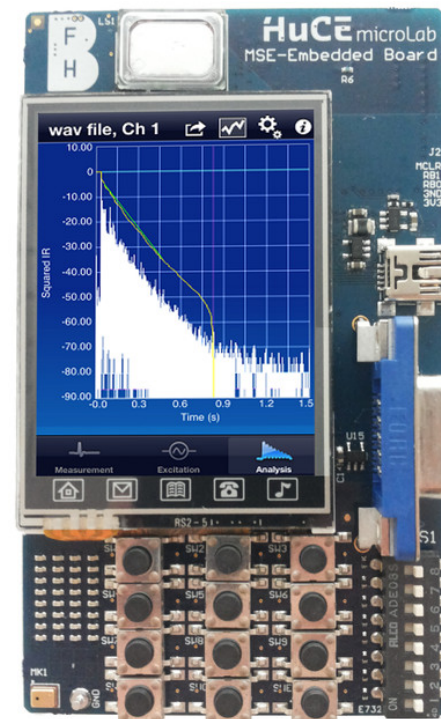
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Course Description

- ▶ This module introduces the student to advanced concepts in modern embedded systems engineering.
- ▶ The course concentrates on the architectures used in FPGA/SoC development and associated interfacing.
- ▶ Exercises are practice-oriented and will be tested on a mobile development platform. The goal is to consolidate acquired knowledge through hands-on practice.
- ▶ Each student get a development board until the end of the semester. (At last course day you have to give the board back to the lecturer.)
- ▶ The board documentation is public available on HuCE wiki platform (QR-Code on box cover or URL <https://www.microlab.ti.bfh.ch/wiki/huce:microlab:projects:internal:mse-em-board>)



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Learning objectives and acquired competencies

- ▶ The student will be able to design systems using state machines, soft-core processors, micro sequencers as well as interfacing peripherals to these automats.
- ▶ The student will be able to design and commission complete designs in an FPGA.
- ▶ The student will understand and be able to apply methodologies and strategies for test and verification of embedded systems.
- ▶ Exercises will be completed and applied on an Altera Cyclone IV device.



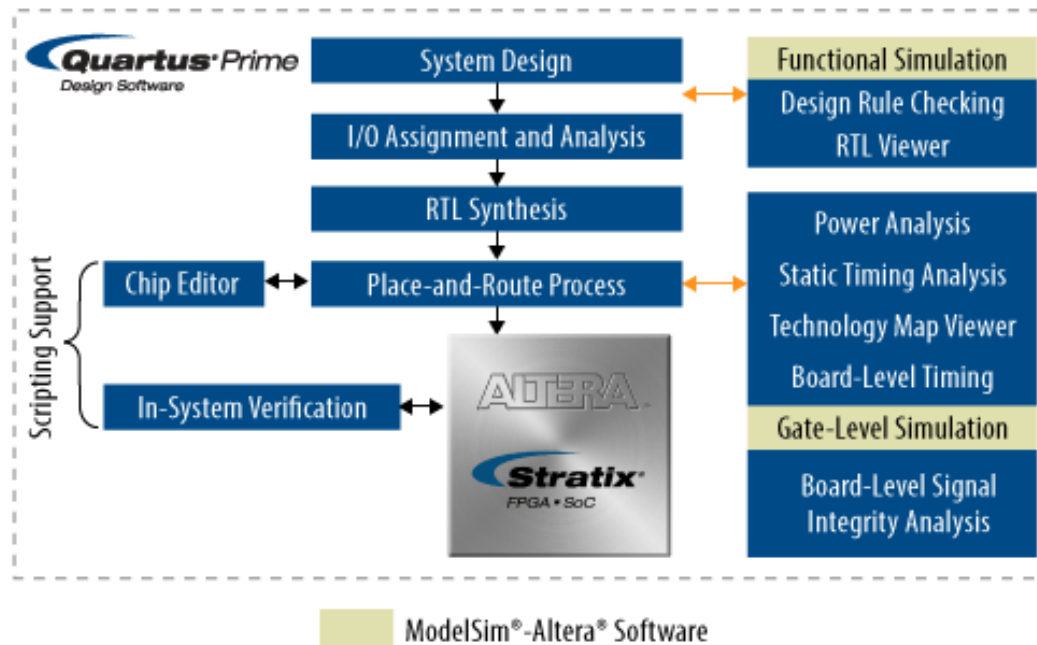
Course Organization

- ▶ 1st trimester (7 weeks): will be given by Andreas Habegger with a main focus on **Hardware Design, SoPC architectures, DMA transfers**.
- ▶ 2nd trimester (7 weeks): will be given by Hans Doran Kluter with a main focus on **HW/SW partition** and **optimization**.
- ▶ Material on Moodle <http://moodle.msengineering.ch>
- ▶ Each student get a development board
- ▶ The development environment is a live system based on Debian Linux



Practical Work : Tool-Set

- ▶ Hands-on-work practice:
 - ▶ QuartusPrime Lite Edition from Altera.
 - ▶ Qsys
 - ▶ Eclipse (C,C++)
- ▶ System setup:
 - ▶ You bring your own laptop...
 - ▶ You install tools and drivers at your own...
 - ▶ You run an Ubuntu distribution from USB stick.



Img ref. : <https://www.altera.com/>



Practical Work : MSE - Embedded Board

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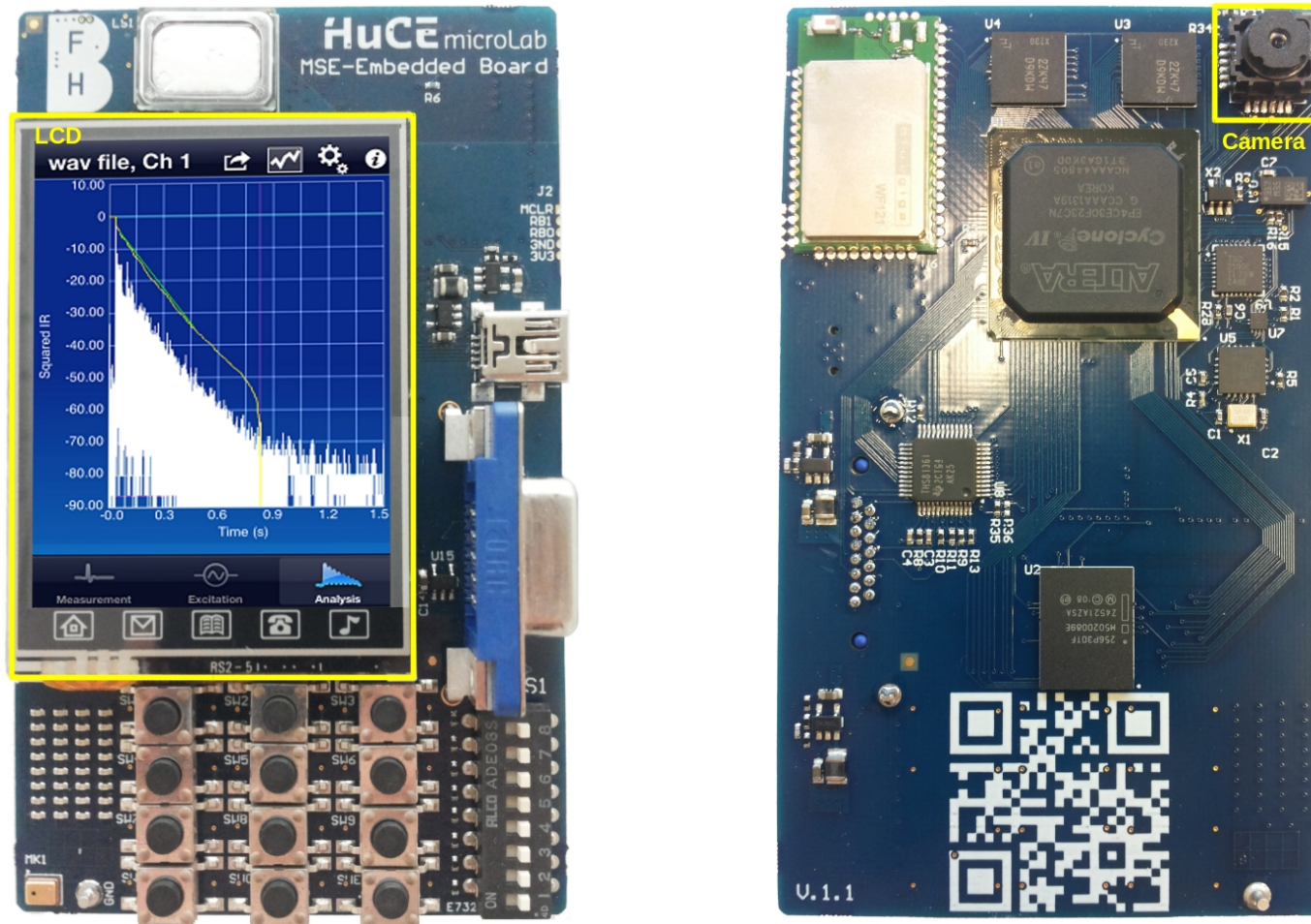
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[https://www.microlab.ti.bfh.ch/wiki/huce:microlab:projects:
internal:mse-em-board](https://www.microlab.ti.bfh.ch/wiki/huce:microlab:projects:internal:mse-em-board)

Practical Work 1st trimester (AH)

- ▶ Introduction to SoPC design tools: Quartus, Qsys, Eclipse.
- ▶ Build your own peripheral interface: LCD controller interface.
- ▶ Optimization of memory access: DMA for LCD controller interface.
- ▶ Optional: Camera data acquisition.



Topics of 2nd trimester (HD)

- ▶ Introduction - HW/SW co-design
- ▶ Scheduling and bus systems
- ▶ SW optimization
- ▶ Caches
- ▶ Algorithm Optimisations / HW acceleration / custom instructions
- ▶ Pipelines (HW and processor)
- ▶ Project presentation



Today...

- ▶ Evaluation Test
- ▶ Introduction to FPGAs (refresh of the topic only)
- ▶ Introduction to “System On Programmable Chip” (SoPC) focusing on Altera (Nios II – Avalon Bus)
- ▶ Board distribution and initial platform test



Homework

- ▶ Repeat stuff discussed in this week session
- ▶ Finish practical exercises of this week
- ▶ Repeat VHDL basics
- ▶ Check one day before next session for new course material

