Modulhandbücher MEI, MEE

Lehrveranstaltung	
Elektronische Schaltungen und Systeme (Electronic Circuits and Systems)	ESS

Verantwortlicher
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Verpflichtende Voraussetzungen
Technical Bachelor degree

Empfohlene Vorkenntnisse
Documents English, teaching language is German or English, depending on students.

Lehrform
50% theory & computer-aided simulation, 50% practical training in the lab

Zeitaufwand in Stunden für Präsenzstudium und für Eigenstudium (Aufgeteilt in Vor- und Nachbereitung sowie Prüfungsvorbereitung)
56h campus program, 62h preparation and follow-up, 32h exam preparation

Inhalte / Contents

Part A: Seminaristic Classroom Teaching with Computer-Aided Simulation
1. Introduction and Overview
2. Main Example: A Switch-Mode Step-Down Converter
3. A/D and D/A Converter Modeling
4. Control Loops
  4.1 *LTI* Feedback Loops
  4.2 *Matlab/Simulink* Modeling
  4.3 *Fuzzy* as Non-Linear Control Loop Example
5. Analog PID Controller Setup for DC/DC Conversion
6. Digitization of Analog PID Controllers
7. Embedded (Hardware/Software Codesign) Aspects
 	
Part B: Practical Training in the Laboratory
  • Getting Started with DE1-SoC Board According to Instruction
  • Getting Started with DC/DC Buck Converter Board (DCDCbuck) According to Instruction
  • Characterization of DC/DC Buck Converter Board (DCDCbuck) According to Instruction
  • Group oriented: related projects

Lernziele: Fachkompetenz
After successfully completing this module, the students are able to …

- create top-level mixed analog/digital electronic systems using *Matlab/Simulink* (3), and to optimize control loops employing model based design (MDB).
- calculate PID control parameters on the base of open-loop gain measurements "by hand" as well as to define a Fuzzy logic solution.
- identify required modules of the system (2) and create linear and time-invariant (LTI) analog and/or digital models of them (3).
- handle digital hardware by modifying and compiling VHDL code (3) and downloading it into an FPGA (2).
- handle analog hardware by reading and understanding (2) its schematic and PCB layout.
- operate complex measuring equipment in the lab and use it in a qualified manner, e.g. for open-loop gain measurements according to the method of Middlebrook (2).
- extract LTI model parameters for analog / digital hardware blocks from circuit schematics (3), appropriate for higher level simulation, e.g. using *Matlab/Simulink*.
- read FPGA internal signals using embedded (hardware/software codesign) techniques.

Lernziele: Persönliche Kompetenz
Siehe Präambel

Angebotene Lehrunterlagen
Skripten, Übungen, Praktikumsanleitungen, Literaturliste

Lehrmedien
Tafel, Beamer, Einrichtung des Elektroniklabors (S081)

Literatur

[1] *V-Model*, available: https://en.wikipedia.org/wiki/V-Model

[2] *Agile software development*, available: https://en.wikipedia.org/wiki/Agile_software_development

[3] *Scrum software development*, available: https://en.wikipedia.org/wiki/Scrum_(software_development)

[4] M. Schubert, *Linear Feedback Loops*, available:
https://hps.hs-regensburg.de/~scm39115/homepage/education/lessons/LinearFeedbackLoops/LinearFeedbackLoops.pdf.

[5] H. Mann, H. Schiffelgen R. Froriep, K. Webers, *Einführung in die Regelungstechnik*, Carl Hanser Verlag München 2019, ISBN 978-3-446-45002-B, E-Book-ISBN: 978-3-446-45694-5

[6] *Buck Converter*, available: https://en.wikipedia.org/wiki/Buck_converter

[7] Robert Sheehan, *Understanding and Applying Current-Mode Control Theory*, Texas Instruments Literature Number: SNVA555, available:
http://www.ti.com/lit/an/snva555/snva555.pdf

[8] Henry J. Zhang, *Basic Concepts of Linear Regulator and Switching Mode Power Supplies*, Analog Devices, Application Note 140, Oct. 2013, available:
https://www.analog.com/media/en/technical-documentation/application-notes/AN140.pdf.

[9] *Eagle* design software available: https://de.wikipedia.org/wiki/Eagle_(Software).

[10] *Simulink User's Guide*, available: https://www.mathworks.com/help/pdf_doc/simulink/sl_using.pdf.

[11] *Matlab*, available: https://de.mathworks.com/help/matlab/.

[12] Middlebrook's and Rosenstark's loop gain measurements, EDN, Dec. 26, 2018, available: https://www.edn.com/middlebrooks-and-rosenstarks-loop-gain-measurements/