Supplementary Course (EVA) at ZHAW School of Engineering

Title: Realtime DAQ and Control using LabVIEW
Short Code: rEVA_LabVIEW

ECTS Credits	3
Profile	Mechatronics & Automation (MA)
Responsible Institute /Centre	Institute of Mechatronic Systems (IMS)
Responsible lecturer and contact informtion	Otto Fluder (fldr)
Type and duration of examinations	2 Projects (50%): • Synchronous data acquisition with DAQmx • FOC control for a stepper-motor with FPGA data acquisition on myRIO 60min written Exam (50%)
Start date and duration	Semester: Autumn Detail: Calendar week 38 - 6
Location	Winterthur
Course type	Weekly, semester rhythm • Contact hours: 40 hrs (3 hrs/week lectures) • Guided self-study: 20 hrs (2 projects) • Independent self-study: 30 hrs (self paced online NI-courses)
Language of instruction	English
Short description (max. 300 characters)	Students learn how to implement synchronous data acquisition using the graphical programming language LabVIEW. They learn all the fundamentals and details of LabVIEW from scratch (no prerequisites). With this basic knowledge they will be capable to extend this to a real time application with FPGA data acquisition and develop a control algorithm on a myRIO system – all three stages (Windows-host, RT, FPGA) programed in LabVIEW.
Contents and Learning Objectives	<u>LabVIEW Core 1/2:</u> The first step in the LabVIEW learning path gives the student the chance to explore the LabVIEW environment and interactive analysis, dataflow programming, and common development techniques in a hands-on format. In this part, they will learn how to develop data acquisition, instrument control, data-logging, and measurement analysis applications. At the end, they will be able to create applications using the state machine design pattern to acquire, analyze, process, visualize, and store real-world data. <u>LabVIEW Real-Time and FPGA:</u> This section delivers hands-on training for prototyping deterministic measurement and control systems. At the end of this part, they will be able to

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<tr><td></td><td>design, develop, and prototype a real-time (RT) application that handles communication between the RT target and a host computer using the LabVIEW Real-Time Module and FPGA.

<u>Case Studies using LabVIEW on a myRIO-System:</u>
They will implement several projects using standard DAQ-tools and different low-level protocols like SPI, I2C, UART to communicate in real-time with sensors. Finally, they develop an FPGA interface for encoder, PWM and triggered current measurement to drive a stepper motor in a FOC-feedback control application.

LabVIEW Core 1:
Create applications that use data acquisition (DAQ) devices
Understand front panels, block diagrams, icons, and connector panes
Create user interfaces with charts, graphs and buttons
Use the programming structures and data types that exist in LabVIEW
Use various editing and debugging techniques
Create and save VIs for use as subVIs
Display and log data
Use the state machine design pattern in your applications
LabVIEW Core 2:
Implement multiple parallel loops and transfer data between the loops
Create an application that responds to user interface events
LabVIEW Real-Time 1:
Determine if a real-time solution is appropriate for a given problem
Choose and configure the RT target hardware for a given real-time application
Implement a deterministic application
Understand how to reduce the jitter in a real-time application
Communicate between a host computer and RT target using network Communication
LabVIEW FPGA:
Design and implement applications with reconfigurable hardware using FPGA
Read and write digital and analog FPGA-I/O's
Realize synchronous and precise timing like SPI-communication
Implement scaling and signal analysis on a FPGA system
Implement RT-host to FPGA-target communication</td></tr>
<tr><td>Prerequisites</td><td>Basic knowledge in feedback control</td></tr>
<tr><td>Literature</td><td>Online courses from NI (National Instruments)
LabVIEW Core1:
https://learn.ni.com/learn/learning-path/labview-core-1-english-2019</td></tr>
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	• LabVIEW Core2: • https://learn.ni.com/learn/learning-path/labview-core-2-2019-english • LabVIEW DAQmx: • https://learn.ni.com/learn/learning-path/data-acquisition-using-ni-daqmx-and-labview-english-1 • LabVIEW Real-Time1: • https://learn.ni.com/learn/course/real-time-1/real-time-1/lesson-content?client=national-instruments • LabVIEW FPGA: • https://learn.ni.com/learn/course/labview-fpga/labview-fpga/lesson-content?client=national-instruments			
Special requirements	none			
Offer for profiles	Aviation (Avi)	☒	Business Engineering (BE)	☒
	Computer Science (CS)	☒	Data Science (DS)	☒
	Electrical Engineering (ElE)	☒	Energy & Environment (EnEn)	☒
	Mechanical Engineering (ME)	☒	Mechatronics & Automation (MA	☒
	Medical Engineering (Med)	☒	Photonics and Laser Engineering	☒
	Information and Cyber Security (ICS)	☐	Civil Engineering (CE)	☒