# FOCUS

## Focus Electrical Engineering & Focus Mechanical Engineering

University of Applied Sciences Vorarlberg

FHV
University of Applied Sciences

Winter Term 2015

# Content

# Introduction

- In the course FOCUS you design, develop and test a mechatronic system.
- Lectures empower you on the one hand to implement the project and on the other hand to think outside the box.
- You build a manipulator which uses a snap connection for gripping work objects.

# Introduction

- Lectures and project are **tight coupled**, lectures fit to project
- In the project you develop a **gantry robot** (Portalroboter) including a toolholder (snap connection)
- **5 work stations** are available => group size is 4-6
- All project groups work on the **same** mechatronic project
- Each project group consist of **electrical and mechanical engineers**

# Learning Outcomes

## Focus Mechanical Engineering & Focus Electrical Engineering

- you can elicit requirements and know how to document requirements
- you can program a sequence control in the PLC programming language *Structured Text*

# Learning Outcomes

## Focus Mechanical Engineering

- Students can design and manufacture a snap connection.
- Students can design and manufacture a simple manipulator.
- you can apply FEM (finite element method)

# Learning Outcomes

## Focus Electrical Engineering

- You can describe the process of risk analysis
- You can apply selected best practices and design guidelines for thermal management, protection circuits, EMC and further selected topics
- You can read and apply data sheets and application notes for circuit design
- You are able to design and dimension basic circuits for power electronics (H-bridge) and measurement technology (instrumentation amplifier)
- You are able to design PCB prototypes considering the most important layout design rules
- You can program a microcontroller (digital IO, ADC, SPI communication, UART communication)

# Schedule

- Phases
  1. Theory — September
  2. Design — October
  3. Implementation — November
  4. Test — December

- Schedule

| | |
|---|---|
| Start | 7. September 2015 |
| Examination | 20. October 2015 |
| Project Presentation | 15. December 2015 |

# Lectures

- Lectures empower you on the one hand to implement the project and on the other hand to think outside the box

## Teaching Hours

| **Focus Mechanical Engineering** | **Focus Electrical Engineering** |
|---|---|
| Mechatronic Topics | |
| Mechanics | Electronics |

# Lectures

## Focus Mechanical Engineering & Focus Electrical Engineering

### Requirements Analysis, Specification, Acceptance - Alfred Mandl

requirements elicitation, requirements documentation, checking and reconciling requirements, requirements management, systems development lice cycle, SysML

### Programmable Logic Controllers - Clemens Maier

the automation pyramid, PLC versus microcontrollers, PLC versus soft-PLC, operation of a controller, introduction into the IEC61131-3, applications with PLC, security

### Project Overview, Coordination - Robert Amann

project coordination, place to go: W1 10

# Lectures

## Focus Mechanical Engineering

### Construction, CAD and Manufacturing - Michael Brill

snap connections, manipulator, NX

### FEM - Johannes Steinschaden

computer aided X, computer aided engineering, principle of finite element method, types of structural analyses, general role for simulating structures, finite element analyses procedure, preprocessing, boundary conditions, element types, material, mesh, common mistakes in modeling

# Lectures

## Focus Electrical Engineering

### Practical Aspects - Michael Böhnel

industrial volume products, standards, risk analysis (FMEA), thermal management, protection circuits, EMC, design guidelines, reliability

### E-CAD and E-Manufacturing - Reinhard Schneider

electronic systems and components, electronic systems and components description methods, packaging, tools (overview), types of circuits, information coding, measurement circuits, communication, digital interface circuits, signal interfaces, schematic design and PCB layout, manufacturing and assembling of electronics

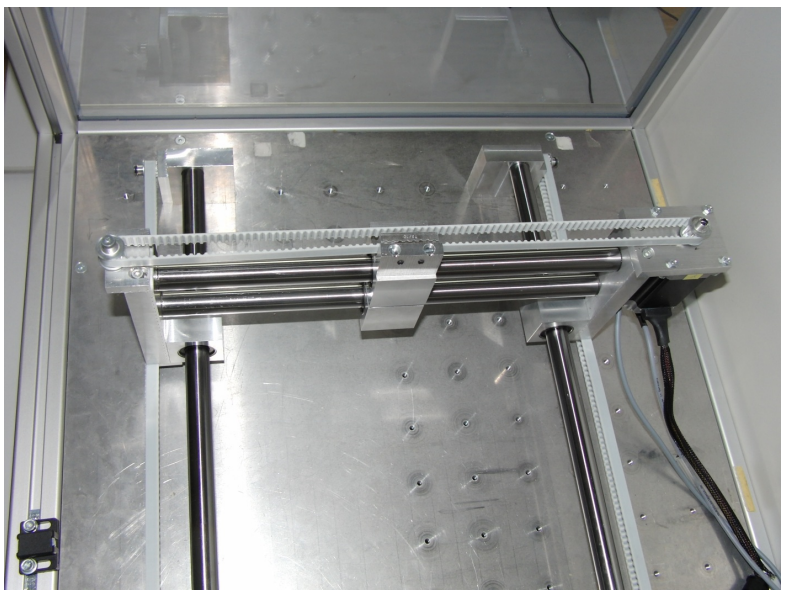
### Embedded Systems - Patrick Ritschel

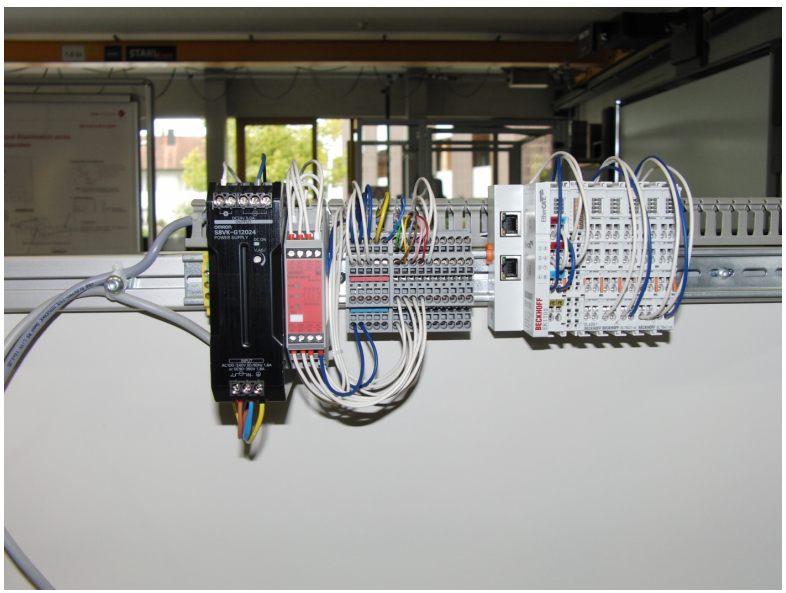
ARM Cortex M0, programming of atmel SAM D20

# Project

## Task Assignment

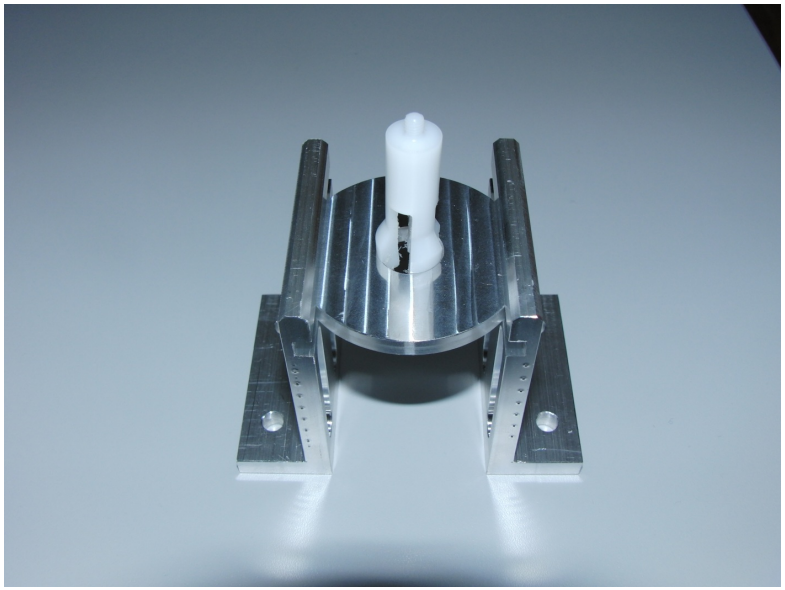
- You build a manipulator which can put and get a work object from a repository.





# Task Assignment

- The work object is a disc with a diameter of 100mm, a thickness of 5mm made of aluminum.
- In the center a circular area with a diameter of 20mm can be used freely for gripping.
- The manipulator uses a snap connection for gripping the work object.

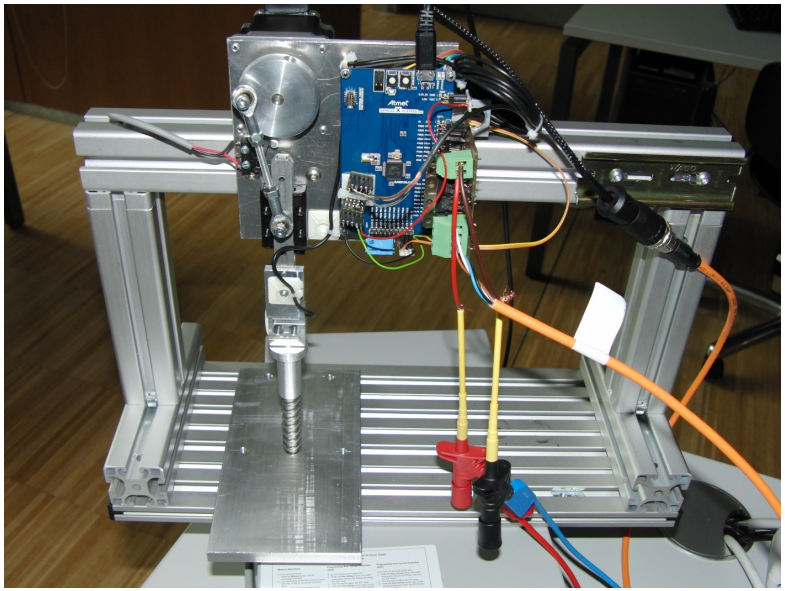


# Task Assignment

- A graphical user interface (GUI) is used to start the process:
  - move home
  - put object to repository (respectively get object from repository)
  - move home
- Home and repository have to be in diagonally opposite positions
- The gripping force has to be monitored.

# Task Assignment

- The Z-Axis is completely built by yourself!



# Project Organization

- Many things are given **fix**
  - hardware components, systemdesign
  - because of limited time (september - december)
- Requirements are **not** described in details
  - Requirements analysis at the beginning of the course (with support of Alfred Mandl)
- Project management ist **not** compulsory

# Manufacturing of parts

**Important**

Before manufacturing of parts, the CAD drawings have to be released by Michael Brill.

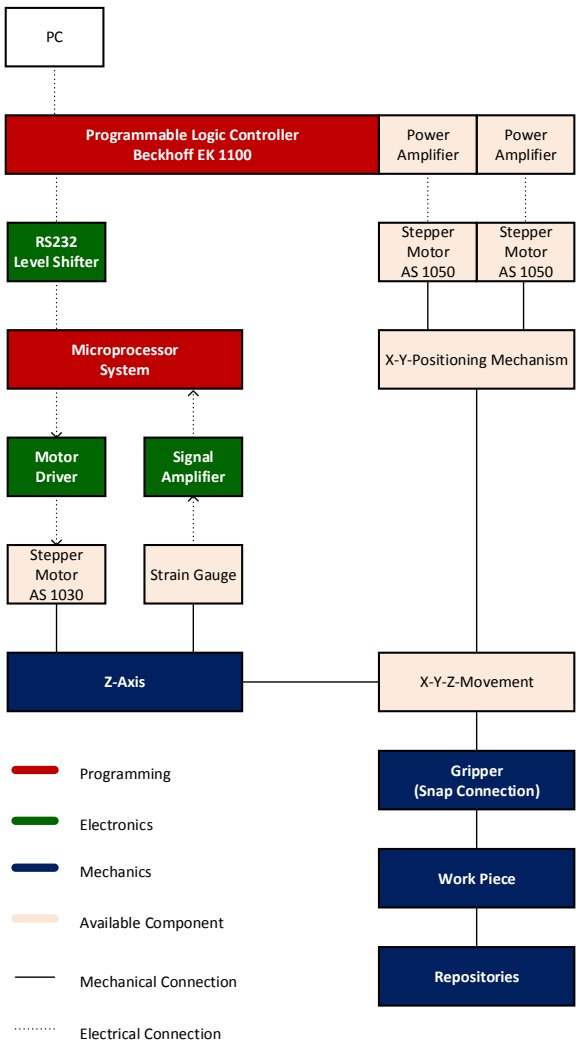
# Presentation

- Main Points of Presentation
  - Technical solution
  - Considered concepts
  - Final design
  - Implementation
  - Experimental results (Test)
- Time: 20 minutes presentation, 10 minutes discussion

# Fair Trade

- The project groups demonstrate their products to interested persons (teachers, students, etc.) in room W001.

# System Design



# Prerequisites Focus Mechanical Engineering

- Fundamentals of mechanical engineering
- Crash course NX

# Prerequisites Focus Electrical Enginnering

- Fundamentals of programming
  - data structures, control structures
  - programming experience in any structured programming language
- Fundamentals of electrical engineering

# Assessment

## Written Exam & Project Work

- In the written exam the content of the lectures is assessed.
- The results of the project work are
  1. requirement specification documents (group assessment)
  2. developed system components (individual assessment)
  3. technical documentation (individual assessment)

# Assessment

## Grade

| | |
|---|---|
| written examination | 40% |
| requirement specification documents | 10% |
| quality of developed system components and technical documentation | 50% |
| good job at fair trade | possible bonus: 10% |

In order to pass the course "Focus", you need a total score of 50 points (or higher).

# Assessment

## written examination - Focus Mechanical Engineering (ME)

- written examination

| | |
|---|---|
| requirements analysis | 8% |
| programmable logic controllers (PLC) | 8% |
| FEM | 4% |

- ILIAS submission - Mechanical Engineering - CAD

| | |
|---|---|
| CAD drawing | 20% |

# Assessment

## written examination - Focus Electrical Engineering (ME)

- written examination

| | |
|---|---|
| requirements analysis | 8% |
| programmable logic controllers (PLC) | 8% |
| practical aspects | 8% |
| E-CAD and E-manufacturing | 8% |
| embedded systems | 8% |

# Questions

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