Aalto University
School of Engineering

Mechatronics project

MEC-E5002
8.1.2019

Mechatronics project

Course personnel:

- **Petri Kuosmanen, Professor, Teacher in charge**
- **Panu Kiviluoma, Senior University Lecturer**
- **Project instructors**
- **Laboratory personnel**

Mechatronics project

Lectures: Tue 14…16

- **When needed, check the schedule in MC**

Project

- **Approx. 4 person team**
- **Research topic**

Circus + Conference

- **Circus Thu April 4th**
- **Conference TBA**

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http://www.tekniikkatalous.fi/tekniikka/opiskelijat-kehittivat-automaattisen-soppatykin-patentti-haussa-katso-video-6639702

http://www.sahkoala.fi/opiskelu/Ajankohtaista_opiskelu/fi_FI/mekatroniikan_sirkus_esitteli_teollista_internetia/

Mechatronics project

Workload

10 cr = 270 workhours

13 weeks → 21 hours/week

Weekly hour accounting

- 1st week individual
- 2nd week → by teams, Mon by noon
- Workhours + short description of tasks

Learning outcomes

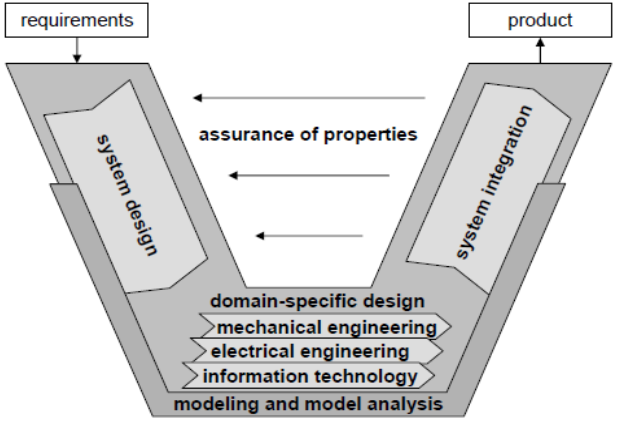
After completion of the course the student is able to

- **design and build a new mechatronic product or test equipment according to task description.**
- **work systematically in a multidisciplinary team**
- **analyze different alternative solutions to make motivated decisions on basis of this**
- **choose the essential methods, practices and components to design and build a mechatronic machine.**

Assessment

Peer assessment

- **Other projects**
- **Own project**
- **Own team**
- **Own learning**



Scientific paper & presentation

Circus appearance

Project outcome

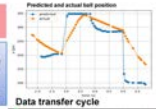
MECHATRONICS 2018

Jouni Hannonen, Sanchayan Rajeetharan, Quoc Huynh

Experiment on control communication from Raspberry Pi over to a CNC machine

Objective
Experiment feasibility on communication method between CNC system and Raspberry pi

Method
Developing a ball game to demonstrate communication between CNC system and Raspberry Pi equipped with machine vision. Implemented communication methods are GPIO and OPC UA. Trace and analyze the performance of both communication methods in fast response application.



Data transfer cycle

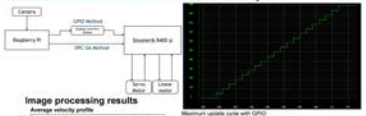
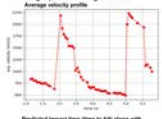
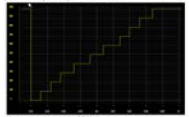
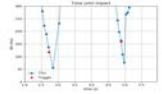


Image processing results



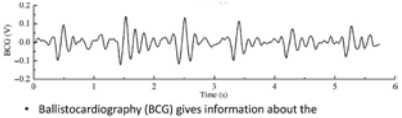




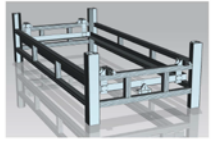
Conclusion
Data update cycle monitored with GPIO is 4 ms (250 Hz) and OPC UA 14 ms (71 Hz) by average.
OPC UA is easy to implement and doesn't require additional hardware.
Amount of information with GPIO implementation is limited due to the number of inputs and outputs.

Measuring Ballistocardiography Signals in a Bed Frame using Force Sensors

Maximilian Siebert, Samu Sorvari, Raimo Sepponen, Panu Kiviluoma, Petri Kuosmanen



- Ballistocardiography (BCG) gives information about the deterioration of the heart effiency
- The risk of heart failures could be detected a long time before they appear



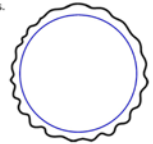
- Easy-to-use measurement system integrated in the bed frame
- Contactless measurement without patient-applied sensors
- Real-time monitoring is possible

MEC-E5002 Mechatronics project 2018

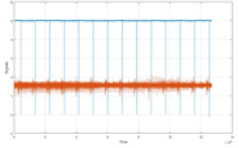
SUPERFINISHING

Grinding machine for paper machine rolls.

1. Measuring barring
   - By accelerometer
2. Analyzing data
   - Matlab
3. Grinding
   - By controlling voice coil motor



Blue - target shape
Black - barring



Blue - encoder
Red - accelerometer

Improving the load positioning accuracy of an automated overhead crane

WHAT?
An accurate load positioning system for an overhead crane. The task for the system is to automatically place metallic cylinder inside the frame. The play between the cylinder and the frame is only 0.5 mm.

WHY?
Cranes are important in different assembly operations that require lifting and moving heavy objects. The inspiration for this project is the assembly operation of an electric motor. The cylinder represents the stator of the motor that is shrink fitted inside a frame.

HOW?
The system performs the task in multiple phases. First, indoor positioning system (Marvelmind) gives coordinates of the frame. The crane moves the cylinder to that location in order of few centimeters. Time of Flight laser sensors place the cylinder more accurately with resolution of 1 mm. Inductive sensors perform the final positioning with resolution of ~10 µm.

Characterisation of SLS powder flowability properties

Background

In selective laser sintering, uneven spreading of the powder bed can affect the quality of the result. The purpose of this device is to obtain quantitive data about the powder's properties in order to further improve SLS manufacturing.

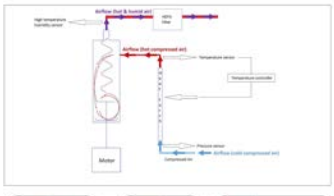
By measuring the angle of the powder profile inside the rotating drum, we can evaluate its angle of repose and cohesiveness at different rotational speeds.

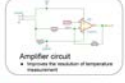
Description	Angle of repose
Very free flowing	25-30°
Free flowing	30-38°
Fair to passable flow	38-45°
Cohesive	45-55°
Very cohesive	>55°

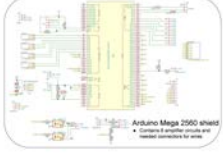
Department of Mechanical Engineering
Jarna Verho, Ali Ouzir, Jonathan Vleth

References
https://granutools.com/products/granudrum/
Bodtmage, A.E., 2004. Correlation between physical properties and flowability indicators for fine powders (Doctoral dissertation).

Pulp dryer







Aalto-yliopisto

Remote Controlled Visual Condition Monitoring of Overhead Crane

KONECRANES

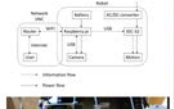
T. Penttala, L. Kourula, A. Miettinen

Background
- Overhead cranes need regular maintenance and the inspection is done visually by a service technician
- The technician must visit the site physically to perform inspection and technician is not able to prepare for the visits because of lack of information

Benefits
- No need to visit the site physically
- More frequent inspection intervals
- Technicians can prepare for maintenance in advance
- Saves time
- Increases efficiency
- Reduces costs

System description
- 5-degrees-of-freedom robotic arm
- Raspberry Pi 3 + camera module
- Logitech C525 web camera
- VNC server allows remote control

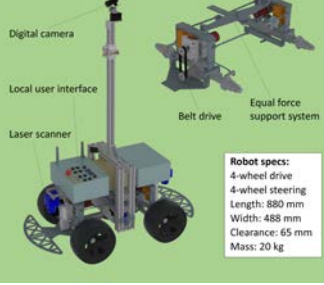
Results
- The system is able to capture sharp images from specified parts remotely over internet



FIELD ROBOT 2018

Goal of the project:
To design and build a robot that will compete in Field Robot Event 2018. In the competition, the robot will navigate autonomously and do specified tasks in a corn field.

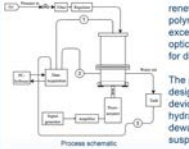
Team:
Elias Ala-Kaila (ME)
Benjamin Nikolov (ME)
Timo Birnkraut (ME)
Albert Georgs (CRAS)
Matti Siponen (CRAS)
Timo Mauranen (CRAS)
Instructor: Timo Oksanen



Robot specs:
4-wheel drive
4-wheel steering
Length: 880 mm
Width: 488 mm
Clearance: 65 mm
Mass: 20 kg

MEC-E5002 – Mechatronics Project

Hydraulic pulsation device for nanocellulose dewatering



Nanocellulose can be used as an renewable alternative to artificial polymers. With nanofibers, excellent surface-, strength- and optical properties can be achieved for different applications

The purpose of this project was to design and build an experimental device to study the effect of hydraulic pulsation on the dewatering rate of nanocellulose suspension

- Hydraulic pulsation is created with a piezo actuator
- The pressures inside the chambers are monitored
- The excess water is collected and measured gravimetrically to study the dewatering rate

The device filled with nanocellulose suspension

Team members:
Toni Niinivirta, Aleksi Heikkinen, Juuso Pulkkinen

Aalto University
School of Engineering

Schedule

Period III

- **14.1. Teams & Topics**
- **22.1. Scientific Writing**
  - 23. & 24.1 Team meetings/Staff
- **29.1. Project Pitch**
  - 5. & 6.2. Team meetings/Peer review

Documentation

4.2. *Title/Intro/Draft*

Schedule

Period IV

- 26./27.2. Team meetings/Peer review
- 12.3. Team meetings/Peer review
- 26./27.3. Team meetings

- *5.4.* Mechatronics Circus
  - *Tested device/prototype*
  - *Finished research*
- TBA Conference

Documentation

25.2. *Methods*

11.3. *Update*

25.3. *Update*

Final paper

Presentation

Project topics 2019

1. Direct-Driven Hydraulic Actuator Package
2. Smart vehicle camera system for machine vision applications
3. Laboratory Pressure Former for Nano papers
4. Dimensiometer
5. Sick Innovation Competition 2019
6. AnaKConda
7. Binder jetting 3D printer
8. Multimaterial extrusion
9. CAD-CAM-AM-ROBOTICS
10. Two material syringe extrusion
11. Wet spinning of CNF
12. Siemens Linear Motor
13. Vibration measurement of a rotor utilizing strain gauges
14. Loading device for a paper machine roll to simulate paper track
15. Overhead Crane Positioning Uncertainty - OCPU

Project application

- **DL Sunday 13th Jan 23.55**
- **Pdf (max 1 sheet)**
- **MyCourses**

Name

Background

- Studies, work experience, hobbies, special interests, ...

Skills

- Mechanical, electrical, software, manufacturing, programming, control, communication, team/project work, ...

What would you like to learn on this course/project

3 most interesting project ideas (in order)

- Reasons and motivation, your contribution, your vision

Home assignment

Find a scientific article related to *Mechatronics research and/or design*

Read the additional material in MyCourses related to scientific writing

Report (max 1 page):

- **DL Thu 17th Jan 23.55**
- **Pdf (max 1 sheet)**
- **MyCourses**

- Reference data of the article
- Was the article organized according to the guidelines (IMRAD)? (Why/why not?)
- Did you get some new ideas about scientific writing or mechatronics? Was it useful to read the article? Please explain.
- Did this raise some questions about scientific writing?