

Project in Automatic Control FRT090

2014

Department of Automatic Control
Faculty of Engineering
Lund University

Projects in Automatic Control

- Team effort
 - Collaborative problem solving
- Get practical experience
- Apply course knowledge
 - Modeling
 - Identification
 - Control design
 - Implementation



<http://www.control.lth.se/Education/EngineeringProgram/FRT090.html>

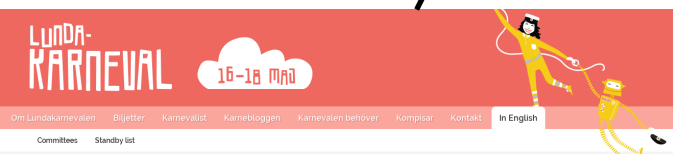
Time line

VT-2014 Study period 4 part 1: 2014-03-17--04-11

VT-2014 Study period 4 part 2: 2014-05-05--05-23

- 3 weeks of Eastern holiday and exams

In addition



Course plan

- w1 Form groups and planning
 - Wed 19/3 Intro-meeting
 - Thursday 20/3
 - » lunch: mail wishlist with 3 projects in prio order (and possibly list of group members)
 - » evening: group announcement
 - Friday/Monday: Meet project supervisor
 - Wednesday 26/3: deadline for submitting project plans
- w2-w7 Project work include
 - Tutorial (git)
 - Feedback seminars 1
 - Feedback seminar 2
 - Presentations on May 28, 2014

Project infrastructure

- Version control system – Git
 - Version control
 - Collaborative development
 - http://en.wikipedia.org/wiki/Git_%28software%29
 -
- **Tutorial (TBA)**
- by Anders Nilsson, Department of Automatic Control
 - Topic: Git

Project plan

- An overview of the project.
- Descriptions of the key parts of the project, including materials and methods to be used.
- A decomposition of the project into subtasks and a suggested allocation of the project resources to key tasks.
-
- A **time plan** (e.g., Gantt diagram)

Hints for project planning

- Break project into manageable subtasks
- Establish dependencies between subtasks
- Estimate time required each subtask (manhours/days)
- For each week estimate how many hours every member of the team will work
- Plan deadlines for each subtask using the estimates above
- Put any spare time you might have in the end of the schedule, not the beginning!
- Every week follow up on your progress **compared to your timeplan**, and reschedule if you are falling behind.

Feedback seminars

- Two feedback seminars with different themes
 - Modeling/Design
 - Implementation
- Hand in link to written mini-report on git-repo before seminar
 - To project supervisor+“review group”
- All groups prepare presentations
 - Choices of methods
 - Results
 - Lessons learnt
- 3-4 groups get to present
- Emphasize **feedback between groups** and knowledge transfer

Examination

- Complete project task
- Active participation in feedback seminars
- Oral project presentation
- Participation in demo session
- Written report

Project allocation

- Course participants submit:
 - Desired projects
 - Rank first, second and third
 - Proposals for project groups
 - **March 20th (Thursday) before 12:00**
 - Send e-mail to anders.robertsson@control.lth.se
- Groups and project announcement
 - **March 20th (Thursday evening)**
 - See the course home page
 -

Contact with your project supervisor already this week!

1. Vision-based lego-robot playing ruzzle

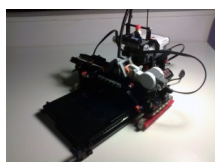
Lego-robot moving pen in XY + plus up/down over touch screen

- Lego NXT
- several language options
- NQC/NXC, Java(or something else)

Optimization-based strategy

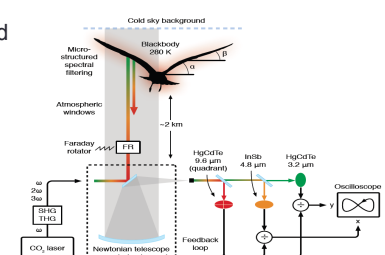
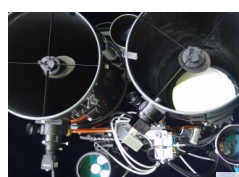
- "Which words in what order"

- Final competition during presentation



2. Tracking of Migrating Birds Using a Telescope and Thermal Radiation

- Collaboration LCCC and CAnMove
- Unique opportunity



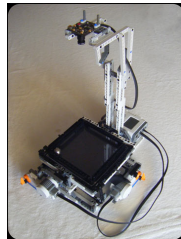
2. Tracking of Migrating Birds Using a Telescope and Thermal Radiation, cont'd



- Description:
- The aim of this project is to track migrating birds as they fly past Lund. The birds should be detected and tracked using their thermal radiation. The aim is then to record data (flight speed, frequency of the wing flaps etc.) of the birds.
- In short, the work consists of getting data from the thermal four-pixel sensor, and if a bird is detected, the telescope should track it and the data from the thermal sensor should be recorded to file.
- The challenges include estimating the position of the bird based on the difference in intensity between the four pixels, and to quickly control the telescope to follow a bird when it is detected, so it doesn't fly out of the field of view.
- The existing code base is developed in Visual Studio using C++. In order to get a quick start of the project, it is desired that at least one group member has experience of C++.
- The experiments will be performed using LUMBO (<http://canmove.lu.se/sv/node/916>), and hopefully the results can help us get better knowledge about when and how birds migrate (<http://canmove.lu.se/sv>)

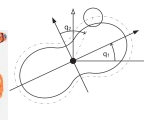
4. Vision-based control a ball and plate process / maze-game

- Ball and Plate Process
- Camera to measure ball position
- Lego NXT / Arduino
- (or something else)
- Maze with obstacles/holes



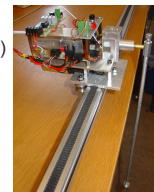
3. Vision-based control of an unusual ball and beam process

- Ball and Beam Process
- Possibly camera and image processing to measure ball position
- Programming in Java/Python
- Model-based state-feedback control design
- Differently shaped beams
- Possible extension to robot
- Is it possible?



5. Python in Control

- Controlling a labprocess using python
 - (Pendulum on cart, Quadrtank etc)
- Relatively new area
- Examples
 - Using cvxgen for optimal control
 - Particle filtering with new Python toolbox for sensor fusion
 - MPC (model predictive control)



6. Bitcraze/Crazyflie

Presentation:

Marcus Eliasson, Bitcraze

<http://www.bitcraze.se/crazyflie/>



Crazyflie autopilot using Kinect and a PC

<http://www.youtube.com/watch?v=UzFwg2Fpv4E>

7a. "Sony/ABB-demo med NFC/IMU"

Using IMU-units (accelerometer + gyro + ??) for balancing Android phone/tablet with industrial robot

The control will be based on a recent IMU-app for Android.

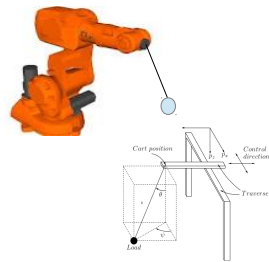
Prestudy for SONY/ABB-demo



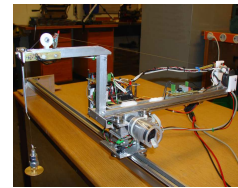


7b. Robot crane

Path planning and control along trajectory



Compare lab 3 in
Multivariable control



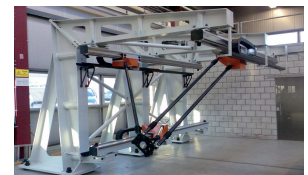
7B Crane / Robot cont'd

Prerequisite: Multivariable control



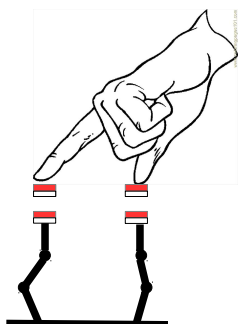
http://www.youtube.com/watch?v=08K_aEajzNA

(8. Co-project with Computer Vision)



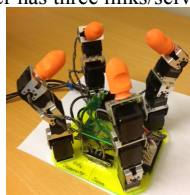
Tracking and 3d reconstruction
+ path planning

9. Haptic gripper interface



Model and control interaction of forces
for each finger
Simulation of dynamics to “haptically
show” shapes

Each finger has three links/servos

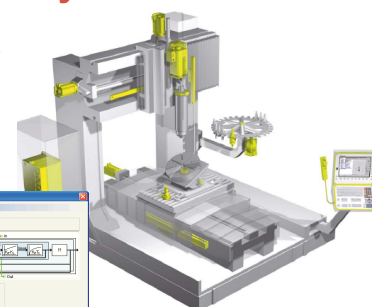
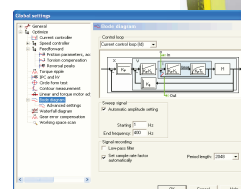


Demo - Gripper by Prof T. Yamada, Gifu

10. Commisioning of industrial control system

Industrial control system servo
control for CNC-machine
at IKDC

Servo control, tuning,
calibration



11. Own project ideas

Design and control of a Lego Segway

Build a self-balancing robot with Lego Mindstorms + some kind of remote control (android etc)

- Balance in the forward direction with a wheel on the ground
- Lateral balance with an inertia wheel
- State estimation with gyros and accelerometers
- Programming on Lego NXT
 - * several language options
 - * NQC/NXC, Java

* Can it be done?

¹ <http://www.youtube.com/watch?v=OnRV-ggjmQ4>

² <http://www.youtube.com/watch?v=mJjeb3cvwY6&feature=related>

