Project in Automatic Control FRT090

2013

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

Course plan

- w1 Form groups and planning
  - Wednesday March 20: group announcement
    - Course home page

http://www.control.lth.se/Education/EngineeringProgram/Projects-in-Automatic-Control-2013.html

  - Friday March 22 deadline for project plans
  - Tutorials

2.5 weeks of holiday and exams

- w2-w7 Project work
  - Feedback seminars 1
  - Feedback seminar 2
  - Presentations in w7 or the week after

Project infrastructure

- Version control system – Git
  - Version control
  - Collaborative development
  - http://en.wikipedia.org/wiki/Git_%28software%29

  Project management – Trac
  - Wiki documentation
  - Ticket-driven development
  - http://trac.edgewall.org/

- **Tutorial Wed. March 20 15:15-17:00, Lab A**
- by Anders Nilsson, Department of Automatic Control
  - **Topics: Git and Trac**

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 sub tasks and a suggested allocation of the project resources to key tasks.
- A time plan

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 written mini-report two days before seminar
- All groups prepare presentations
  - Choices of methods
  - Results
  - Lessons learnt
- 3-4 groups get to present
- Emphasize feedback between groups and knowledge transfer

Examination

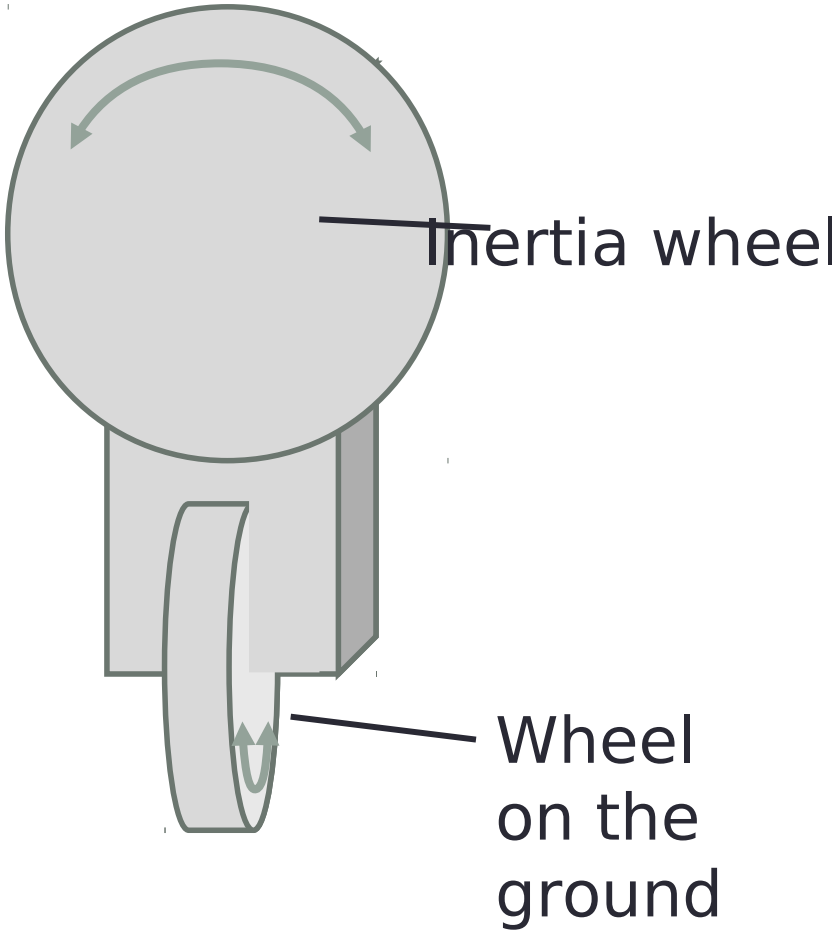
- Complete project task
- Active participation in feedback seminars
- Oral project presentation
- Participation in demo session
- Written report

Project allocation

- Course participants submit:
  - Desired projects
    - Rank first, second and third
  - Proposals for project groups
  - March 19th (tomorrow Tuesday!) before 12:00
  - Send e-mail to anders.robertsson@control.lth.se
- Groups and projects announcement
  - March 20th (Wednesday!)
  - See the course home page

1. 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?
- http://www.youtube.com/watch?v=OnRV-ggJmQ4
- http://www.youtube.com/watch?v=mJJeb3cvwjY&feature=related

2. Vision-based lego-robot playing ruzzle

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

- Lego NXT

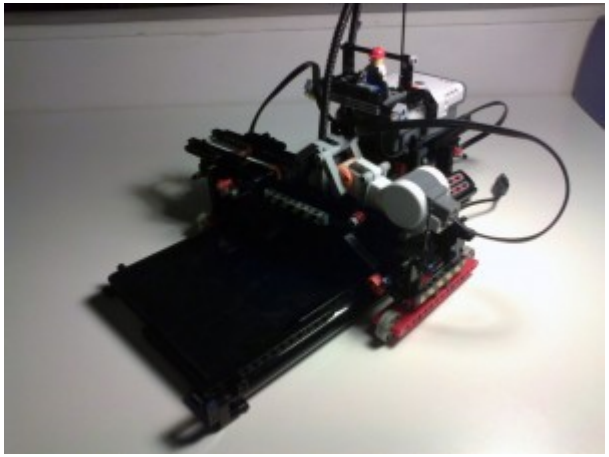
  several language options

  NQC/NXC, Java(or something else)

Optimization-based strategy

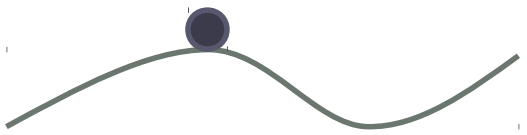
- ”Which words in what order”

- Final competition during presentation



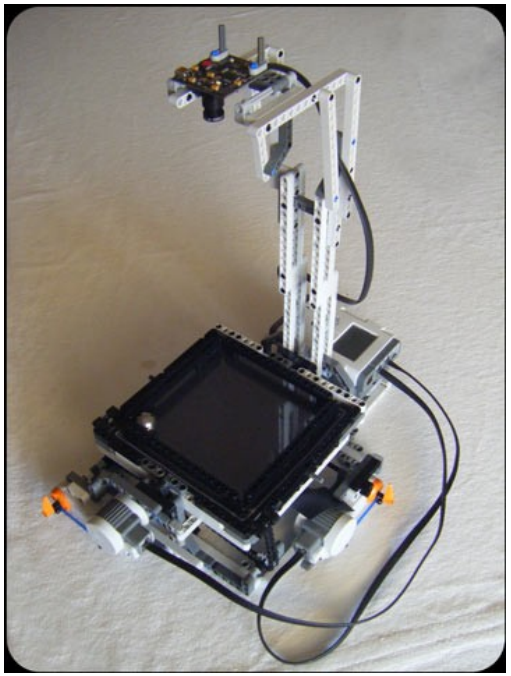
3. Vision-based control of an unusual ball and beam process

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



4. Vision-based control a ball and plate process

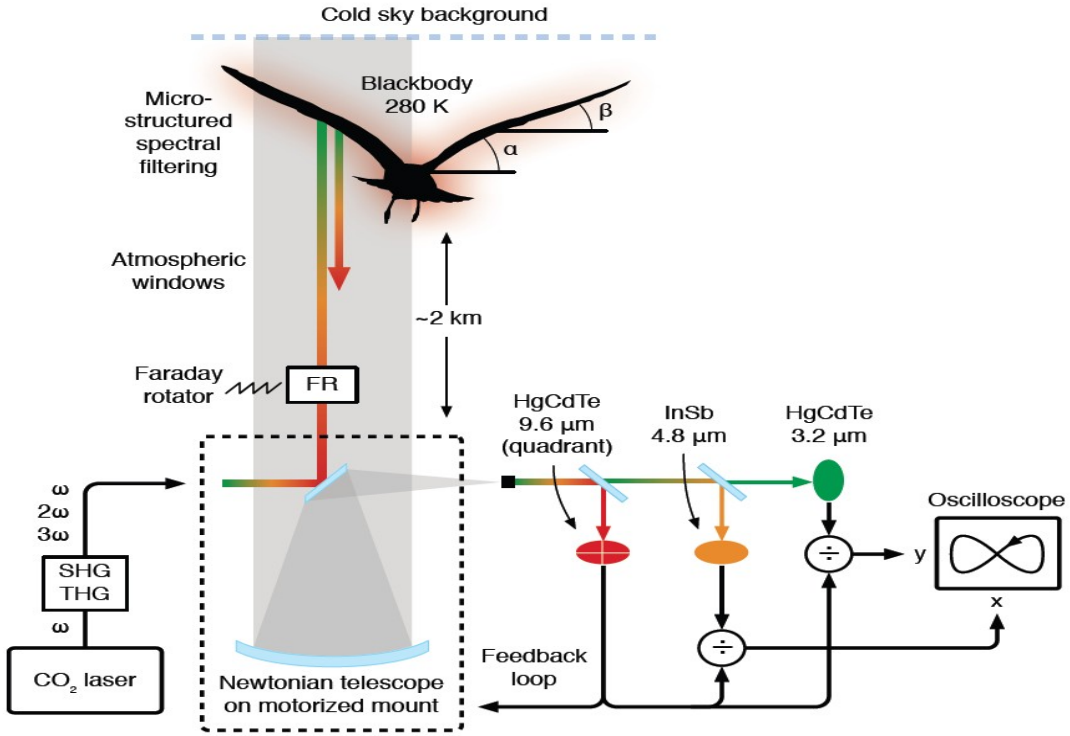
- Ball and Plate Process
- Camera to measure ball position
- Lego NXT (or something else)



5. Robust tracking control-

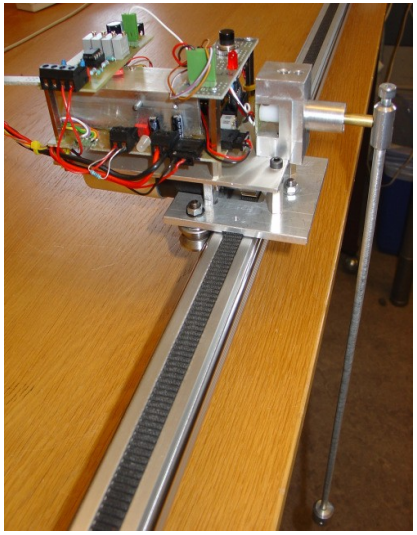
implementation in a novel biosphere observatory for classification of nocturnal migratory birds.

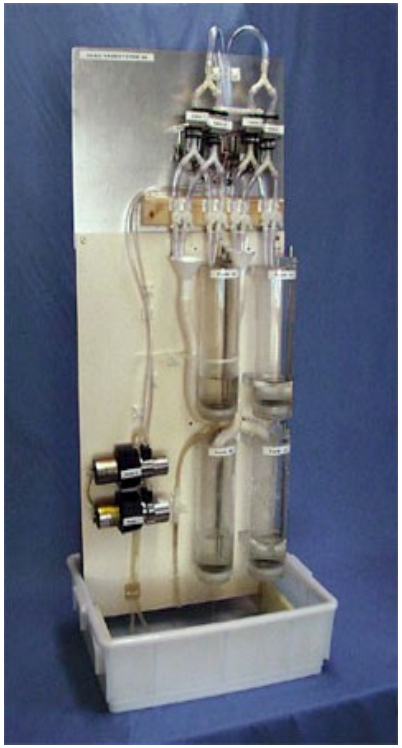
- Collaboration LCCC and CAnMove
- Unique opportunity
- See special handout



6. Python in Control

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





7.Optimization and Software Interfacing for Mobile Robots

Based on a mobile robot with omnidirectional wheels (successor of Care-O-bot 3)

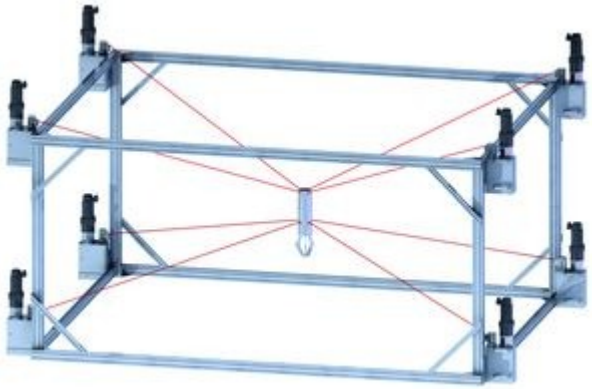
Study trajectory generation/path planning and control for obstable avoidance

- Interface to ROS via rospy
  - http://www.ros.org/wiki/
  - http://www.ros.org/wiki/rospy

8. Cable robotics

Building and controlling a cable robot

Step 1: Lab setup with two antagonistic motors working along one cable



Step 2: Planar “lecturing robot” (4 wires), drawing on white board

Comprises: embedded control, kinematics, motor drives, some mechanical construction

9. Electronics

Prerequisite: Experienced in electronics (ETF):

Mixing analog and digital controller for lab development at EIT and Department of Automatic Control

Example: Levitating magnet: