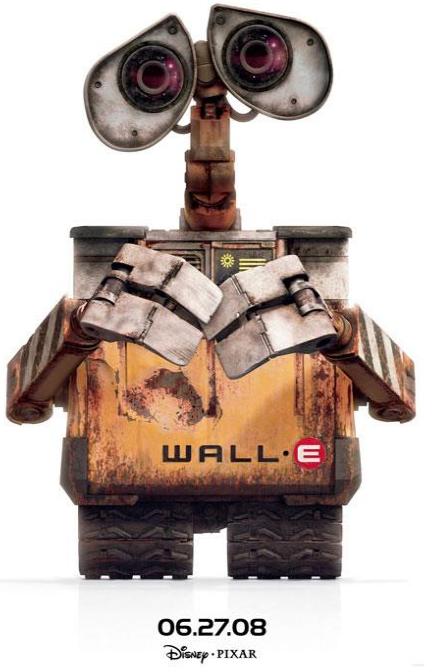
Robot modeling and control



Graduate course @ Automatic Control

http://www.control.isy.liu.se/student/graduate/robot/

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Contributions from : Johanna Wallén, Erik Wernholt, Stig Moberg

Course content

- Robot modeling
  - Kinematics
  - Dynamics
- Path and trajectory planning
- Robot control
  - PID-based control
  - Computed torque
  - Adaptive control
  - Force control
- Tools (such as Robotics Toolbox, Modelica, RobotStudio)
- Programming in Rapid (ABB's language for robot programming)
- Robot programming – hands on (unfortunately only simulated in RobotStudio)

Robot modeling and control

Course elements:

- 5 lectures
- Small project that includes the main features in the course
  - Modelling
  - Control
- Lab with small exercise in RobotStudio

Course literature:

- **M.W. Spong, S. Hutchinson, and M. Vidyasagar: Robot Modeling and Control**
- L. Sciavicco and B. Siciliano: Modelling and Control of Robot Manipulators (2nd edition)
- J.J. Craig: Introduction to Robotics Mechanics and Control
- R.M. Murray, Z. Li, and S.S. Sastry: A mathematical introduction to Robotic Manipulation
- W. Stadler: Analytical Robotics and Mechatronics
- J-J. E. Slotine and W. Li: Applied Nonlinear Control

Robot modeling and control

M.W. Spong, S. Hutchinson, and M. Vidyasagar: Robot Modeling and Control

- Covers the course well.
- Has chapters on ”Computer vision” and ”Vision based control”.
- Uses the same notation as we will use in the lectures.

L. Sciavicco and B. Siciliano: Modelling and Control of Robot Manipulators (2nd edition)

- Covers the course well.
- Has chapters on actuators and sensors as well as system architecture

J.J. Craig: Introduction to Robotics Mechanics and Control

- Covers the course well.
- Has chapters on manipulator design, robot programming and off-line programming

Robot modeling and control

R.M. Murray, Z. Li, and S.S. Sastry: A mathematical introduction to Robotic Manipulation

- Covers kinematic modeling and dynamic modeling well.
- Has a more mathematical approach compared to the other books.
- Contains chapters on “hand dynamics” and grasping.
- Introduces “Lie groups and robot kinematics”.

Schedule

- See homepage
  - http://www.control.isy.liu.se/student/graduate/robot/Robschedule.html

Schedule

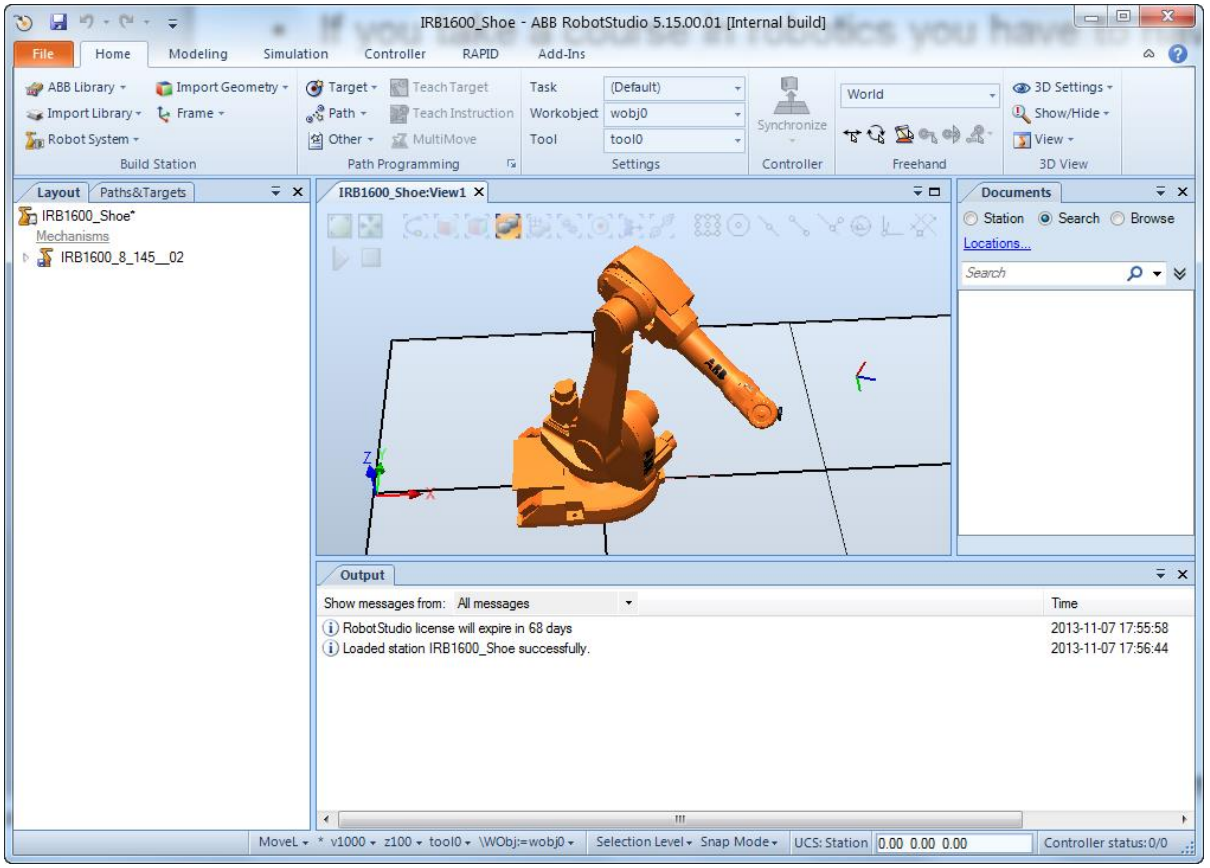
- 19/11
- 29/11
- 3/12
- 17/12
- 14/1

Exercises

- Robot modeling
  - Kinematics
  - Dynamics
  - Physical parameters will be available
- Control
  - Stabilization
  - Tracking and disturbance rejection

Lab – RobotStudio

- If you take a course in robotics you have to have some practical experience!
- Introduction to motion programming



Projects (additional 3hp)

- Further analysis of some aspect of robotic modeling and control
  - Modeling of robots with closed kinematic chains
  - Path planning and control of kinematic redundant manipulators
  - Kinematic configuration to avoid/reduce effect of singularities
  - Sensor fusion
  - Application of non-linear control
  - Detailed component modeling
    - Motor
    - Gear-box
  - Diagnosis
  - Path planning with sensor inputs (for example pick and place from conveyor)
  - …