DD2426

Robotics
and
Autonomous Systems

VT2009 (robot09)

Patric Jensfelt

Welcome!

Long tradition since 1995

The crew

- Patric Jensfelt (patric@kth.se)
  - "lecturer"
- Jorge Sanchez de Nova (jssdn@kth.se)
  - Project guru

Course homepage

- Web page for the course

  http://www.csc.kth.se/utbildning/kth/kurser/DD2426/robot09

- This is is where you will find information

Rough outline

- Lectures + lab (theory)
- Project (practice)

Idea behind course

- Put the knowledge you have acquired in other courses to use
- Learn about robotics
- Solve a complete and "real" problem, i.e.
  - From start to finish:
    - Analysis, design, implementation, testing
  - Covering many different areas:
    - Mechanics, programming, control, estimation, vision, ...
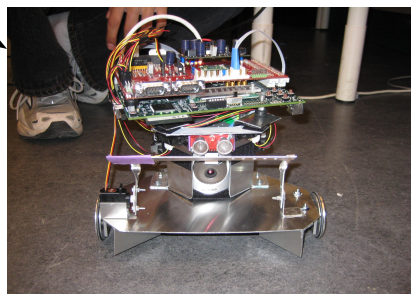- Not to be afraid of large and open-ended problems.
- Problem → Challenge

From idea to a robot
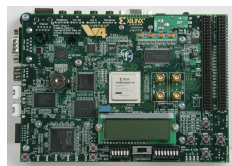
+ idea

Project work

Intended learning outcomes

- After the course you should be able to
  - Explain basic concepts and technologies in robotics
  - Explain possibilities and limitations today
  - Communicate knowledge orally and in writing
  - Analyze a problem from a holistic viewpoint
  - Develop a strategy and solve a problem with methods and tools available
  - Make decisions based on acquired knowledge
  - Assess quality of your work and that of others
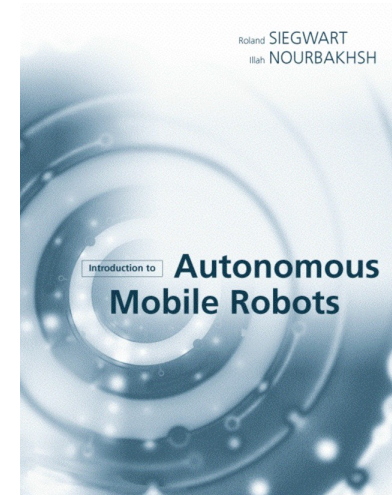 - Work in a project setting

ILO (theory)

- Explain basic concepts and technologies in robotics
- Explain possibilities and limitations today
- Communicate knowledge orally and in writing

Course book

Roland SIEGWART
Illah NOURBAKHSH

Introduction to **Autonomous Mobile Robots**

Lectures

- Lectures will not be conducted in the traditional "preacher" style
- Roughly: We split the chapters between you and You present.

- Observation: You learn 5% of what someone lectures about (very inefficient), but 95% of what you have to tell someone else about.
- We try to make use of this!!!

Lecture format

- 30min presentation by a student group
- 30min discussion in smaller groups about the material
  - What was most important?
  - What was unclear in the material?
  - Any unanswered questions?
- 30min discussion in the whole class

Lectures format

- Key assumption
  - ALL have read the material before the lecture

Lectures format

- Everyone should prepare a one page reflection and questions on the material for the lecture
- Bring 5 copies to the lecture
- You read each others reflections to start off the discussion
- Easier to get your voice heard in a smaller group. Between you, most of the questions will be answered.
- Appoint a secretary that writes down the questions that remain unanswered after the lecture

Lectures aim

- Stimulate a deep learning approach and understanding of concepts.
- Get your questions answered about the material at the lecture and not 12h before the exam.
- Spread the workload!

Lecture follow-up

- After each lecture the secretary of each group collects the questions still unanswered and posts these.
- A team of students are responsible for trying to find the answer to these
- Post answers within a week

Doodle poll for selection of lectures

- Go into http://www.doodle.com/participation.html?pollId=
- (http://www.doodle.com/participation.html?pollId=gw69h8v6b8a2u423)
- See course webpage to see lecture schedule

ILO (theory)

- Explain basic concepts and technologies in robotics
- Explain possibilities and limitations today
- Communicate knowledge orally and in writing
  - Active participation in lectures
  - Write reflection + open questions on lecture material before each lecture
  - Prepare one lecture in group or answer unanswered questions after the lecture

Examination theory

- The lectures are a "safe" learning environment
- You are not assessed for what you do there
- But you need to participate

- Assessment of the knowledge comes at the exam

ILO (Practice)

- Communicate knowledge orally and in writing
- Analyze a problem from a holistic viewpoint
- Develop a strategy and solve a problem with methods and tools available
- Make decisions based on acquired knowledge
- Assess quality of your work and that of others
- Work in a project setting
  - Project work

Project "Robot rescue"

Picture from www.dis.uniroma1.it/~iocchi/

"Robot rescue" in DD2426

- Go into a maze and "rescue" orange golf balls
- Need to find your way in
- Find the golf balls
- Find your way out with the balls

- Performance metric
  - Do it as fast as possible "the victims are dying!"
  - Innovative solutions

Skills needed to solve the task

- Mechanical design
- Estimation
- Control
- Computer vision
- Electronics (maybe)
- Programming high/low level on embedded platform
- Project management
- Reasoning

Observation

- Highly interdisciplinary
- Many different components needed
- Integration is a large part of the work

Registration

- Fill in registration list
- Mark your skills in different areas
  - 1: little experience
  - 5: expert

Project groups

- 4 in each group
- We will form groups so that the skills are spread out

Project "workshops"

- Will organize workshops along the way to
  - Instructions about hardware
  - Help with common problems
  - Discuss progress
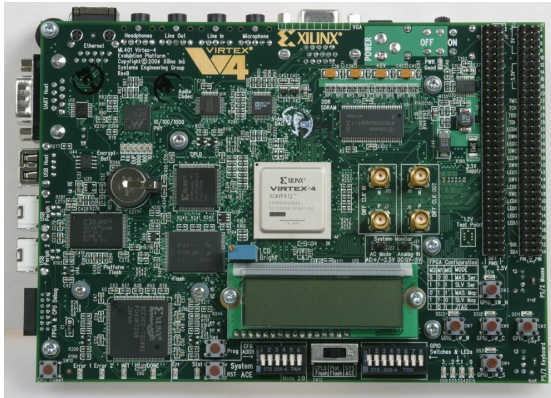 - Discussion solutions (if you want to share)

Lab space

- 1535 (CSC main building, 5th floor)
  - Computers (1 linux PC per group)
  - Soldering
  - Test maze
- 1621 (CSC main building, 6th floor)
  - Workshop

Hardware

- Embedded platform
- Requires low and high level programming

Additional stuff

- Motors and wheels
- Sensors (IR, sonar, camera, compass, gyro, bumpers, accelerometers)
- Servos
- Metal to build with

- Not allowed to use off-board processors
- Can add I2C and SPI devices, or anything that is attached to the general purpose pins
- Can reconfigure FPGA if you know how

Examination I
(Practice)

- In group
  - Solve a "real" world problem in a group
  - Write a project report
  - Present the work

- Not part of examination but highly encouraged: Make a project plan
  - Helps you plan and structure the work
  - Address differences in levels of ambition
  - The grades will not be the same in the group!

Examination II (Practice)

- Individually
    - Write a statement about what you hope to learn
    - Keep a log of what you do and how much time you spend
    - Report after the course on
        - Reflect on your work in the project
            - How did it match your expectations? What did you spent time on? What did you learn?
        - Reflect on the work of the group
            - What worked in the group, what did not? Analyze the work
    - Comment on 1 other group's report

- This is the postmortem of the project. A necessity to improve and build experience.

What we hope that you will pick up

- Communication between people is important and hard (influence of context, background, etc)
- Insight into embedded platforms and programming
- Know how to adapt a solution to the resources available (software, hardware, time, space, weight, etc)
- Work with open-ended problem definition
- System integration is HARD => do not underestimate it in the future!

Add for a related course

- If you want to learn more about estimation which can be used for
    - Localization and mapping of robots
    - Sensor processing
    - ...

- Pop in at EL3320, Applied Estimation
- Starts today in V21, 15-17
- Runs in period 3
- Topic of the projects are robot localization
- Adds some more depth to that area