DD2426 – Robotics and Autonomous Systems
Lecture 0: Introduction

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Outline

- Examples of swedish robotics
- Some application domains
- A case study

Swedish robotics

- Sweden has traditionally be quite strong in robotics
  - ABB - industrial robots
  - Electrolux - vaccuum cleaner
  - Husqvarna - lawnmower

ABB - Industrial robots

- Car industri for spot welding, spray painting, ...

Husqvarna - Autonomous Lawnmower

Electrolux Autonomous Vacuumcleaner Trilobite

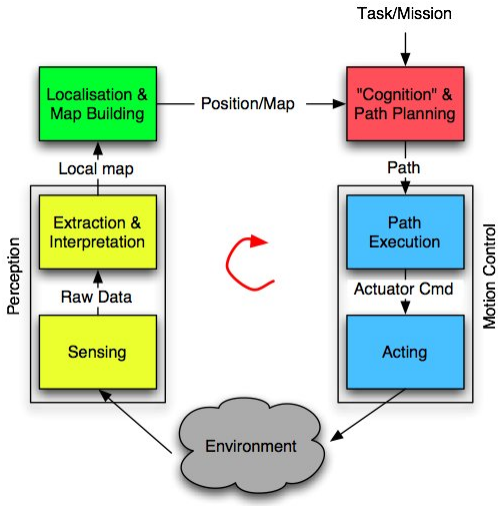
Autonomous?

- The robot should be able to operate in an environment where not everything is known a priori
- React to unforeseen events
- Make decision based on sensor input

Mobile?

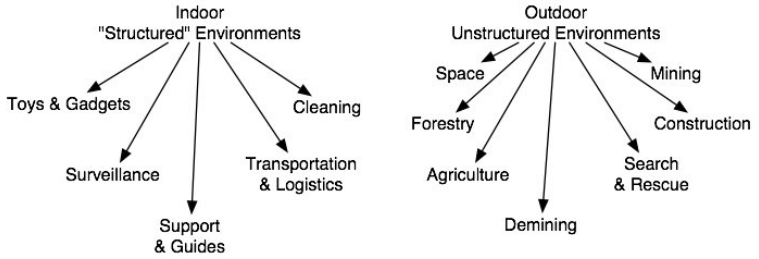
- Traditional (industrial) robots are bolted to the floor
- Are very good at what they do, but
- They cannot move!

System overview



Applications

- Applications quite different indoor and outdoor

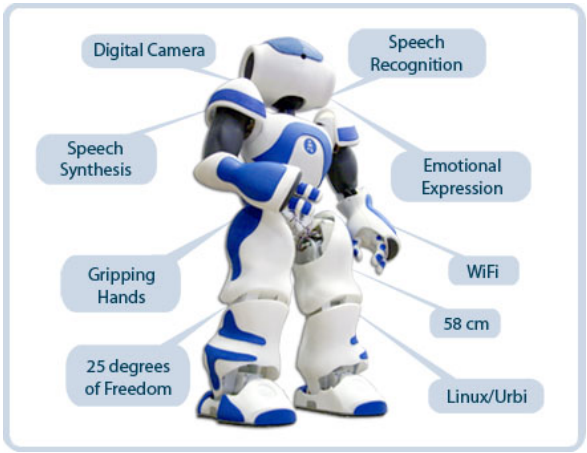


Toy example

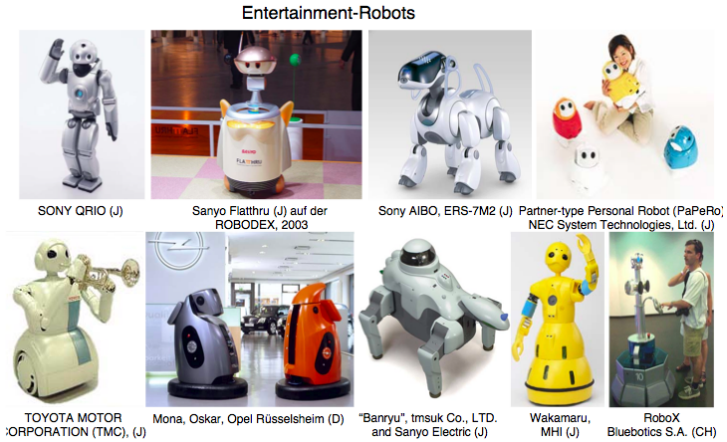
- The Sony AIBO indended initially as a companion
- Price about $2000
- RoboCup 4-legged league
- Now discontinued

Successor of Aibo in Robocup

- Nao new official platform for Robocup Standard League from 2008



More toys

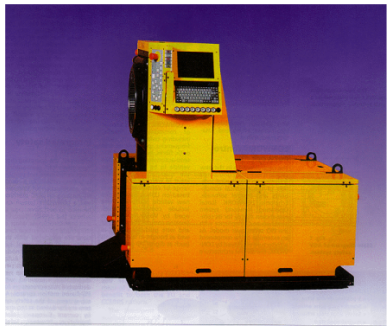


Guide robots

- Popular at museums
- Helps for elderly

Logistics and transportation

- In Volvo Factories many of the transportation tasks are automated such as motor transport, supply chain , etc. AGVs for special purpose platforms for transportation of goods
- More than 4000 vehicles in use by Volvo at its factories



Logistics and Transportation

- Material delivery in hospitals
  - Nurses spend $>$ 10% of their time on transportations

Cleaning

- One of the first application domains
- Electrolux first on the market
- Now many different brands

Roomba and Scooba from iRobot

- Over 2 million Roombas sold

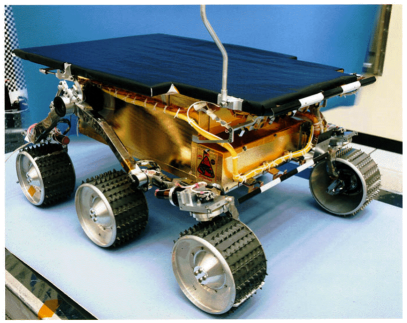
Commercial cleaning

Outdoor applications

- Forestry
- Search and resuce
- Space and exploration
- 3D: Dull, dangerous and dirty

Space exploration

- Sojourner, Spirit, Opportunity
- Go beyond human reach



Search and rescue

- 8 robots were used at WTC 13 Sept 2001
- "Bomb" robots (used by police, firedepartment and military
- Often teleoperated

Some robots at KTH

Robot technology in everyday products

- Robot technology is sneeking up on us
- Small steps at a time
- What was science fiction yesterday is everyday technology today
  - Car keeping distance automatically, collision checking
  - Quality control
  - Navigation systems for cars, planes and boat
  - ...

Androids


by Hiroshi Ishiguro

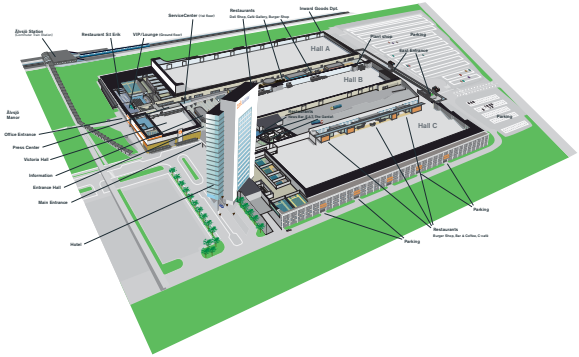
Raises questions about ethics. What are we allowed to do with robots?

Building a robot system

- Many components are needed to build a robot system
- The field is highly inter-disciplinary
- Study a "simple" test case

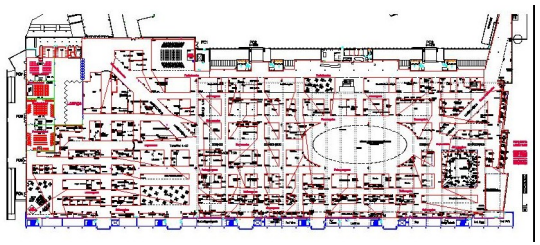
Floor marking at Stockholm International Fairs

- 70 regular fairs
- 1.000 congresses, conferences and seminars a year.
- 3 main halls, total 56,500m^2

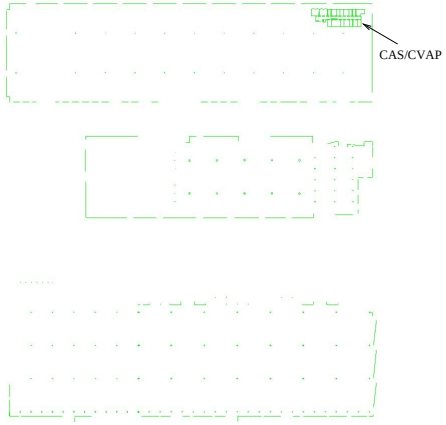


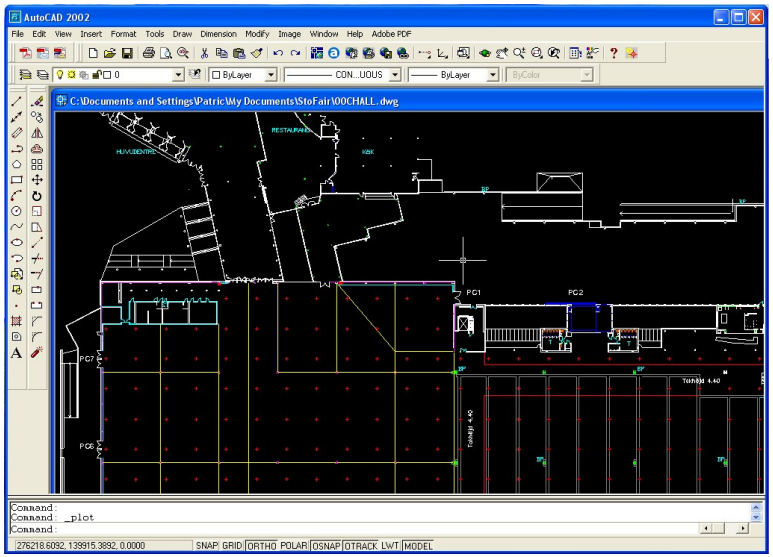
Marking the stands

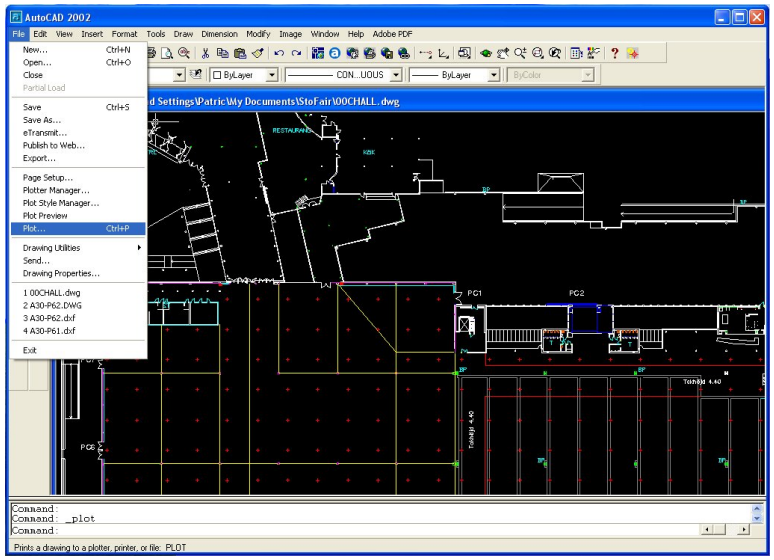
- Flexible layout
- Manual labour with tape measure and tape
- Can be hundreds of stands per fair and in the order of a thousand points to mark
- Often odd hours (e.g. nights)
- Very tedious and boring

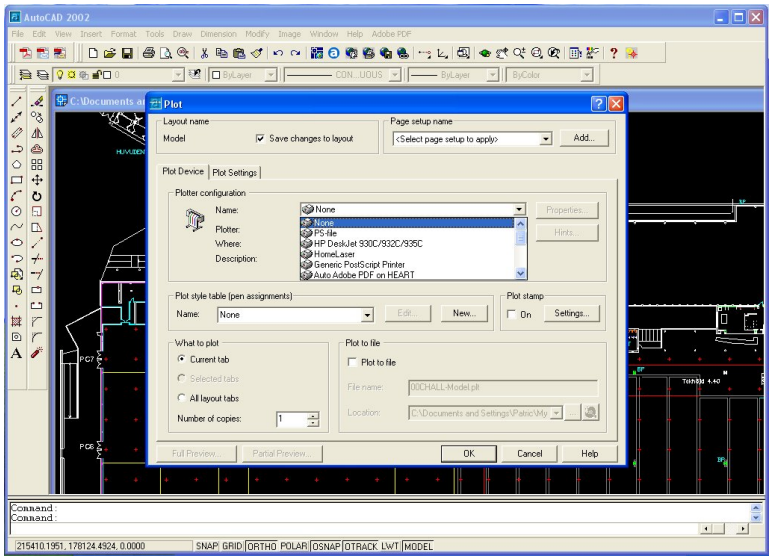


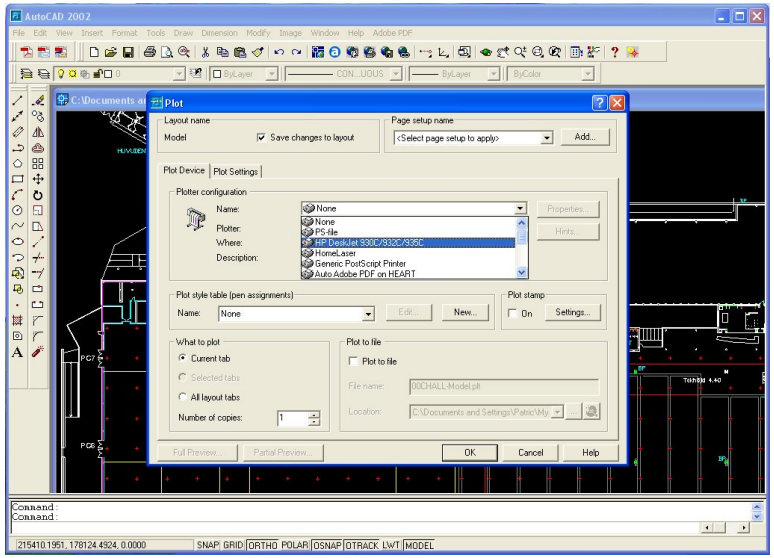
The StoFair Environment

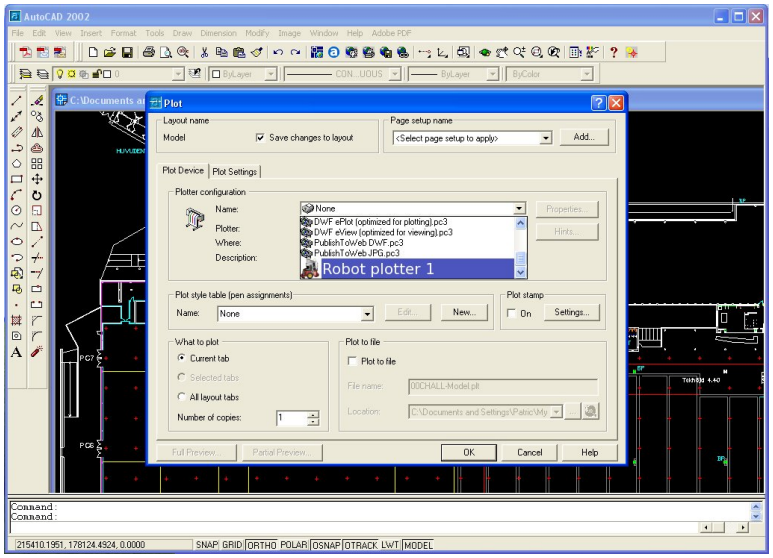




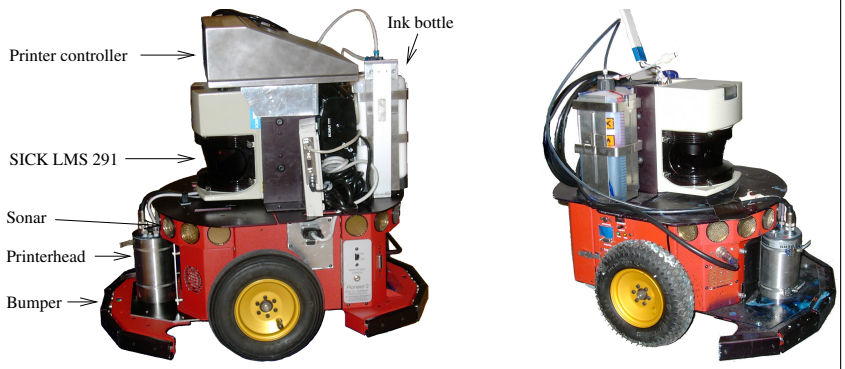




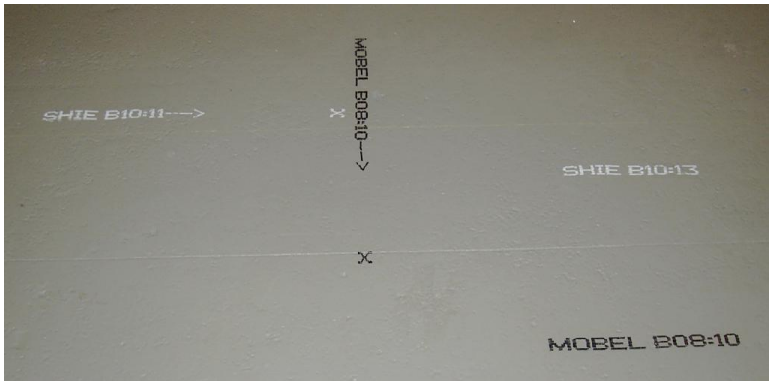




Meet Harry Plotter and friend!



Example mark



Harry plotting

Harry following Erik

Results

- Gain in productivity
  - Before: 2 people 8h
  - Now: 1 robot + 1 operator 4h
- Been running in production since August 2003

Main components in StoFair system

- Positioning system (where is the robot)
  Where am I?
- Marking device (mark on the floor)
  Actuation in general. Manipulation, etc
- Obstacle avoidance (don't run into things)
  Navigation
- Trajectory planning (what order to mark, "TSP")
  Planning, reasoning, etc
- User interface (how to operate it)
  How to communicate?

To come

- Learm more about some of the building blocks of a robot
  - means of locomotion
  - kinematics
  - sensors
  - perception
  - planning
  - navigation
  - localization
  - mapping