Welcome to

CSE 571
AI-based Mobile Robotics

Instructor: Dieter Fox

Teaching Assistant: Benson Limketkai

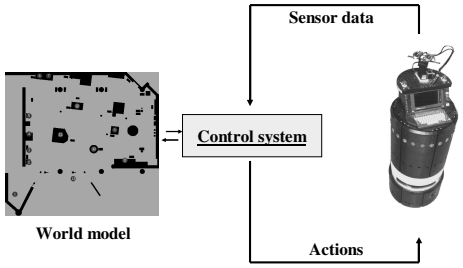
Organization

- T/Th 12:00 – 1:20
  - Mostly lectures, discussions (EE1 026)
  - Some lab meetings (CS 491)
- Web page:
  - www.cs.washington.edu/571

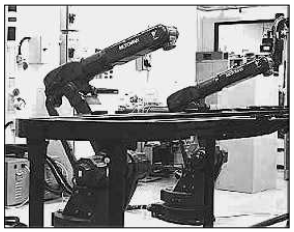
Goal of this course

- Provide an overview of problems / approaches in mobile robotics
- Probabilistic reasoning: Dealing with noisy data
- Hands-on experience

AI View on Mobile Robotics



Robotics Yesterday



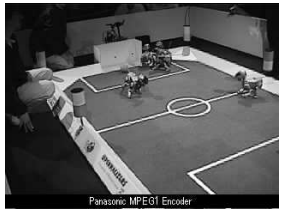
Current Trends in Robotics

Robots are moving away from factory floors to

- Entertainment, toys
- Personal services
- Medical, surgery
- Industrial automation (mining, harvesting, …)
- Hazardous environments (space, underwater)

Robotics Today

RoboCup-99, Stockholm, Sweden

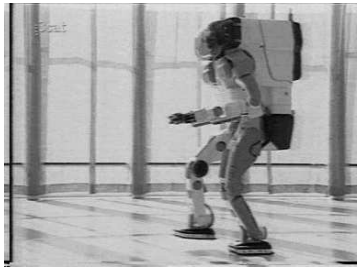


RoboCup-04, Lisbon, Portugal

Mobile Manipulation

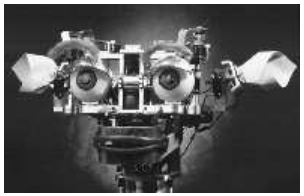
[Brock et al., Robotics Lab, Stanford University, 2002]

Humanoids: P2



Honda P2 '97

Emotional Robots: Cog & Kismet



[Brooks et al., MIT AI Lab, 1993-today]

General Background

- Autonomous, automaton
  - self-willed (Greek, auto+matos)
- Robot
  - Karel Capek in 1923 play R.U.R. (Rossum's Universal Robots)
    - labor (Czech or Polish, robota)
    - workman (Czech or Polish, robotnik)

Asimov's Three Laws of Robotics

1. A robot may not injure a human being, or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given it by human beings except when such orders would conflict with the first law.
3. A robot must protect its own existence as long as such protection does not conflict with the first or second law.

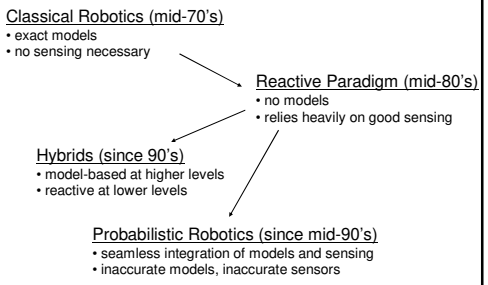
[Runaround, 1942]

Wiener, Cybernetics

- Studied regulatory systems and their application to control (antiaircraft gun)
- "it has long been clear to me that the modern ultra-rapid computing machine was in principle an ideal central nervous system to an apparatus for automatic control; and its input and output need not be in the form of numbers or diagrams, but might very well be, respectively, the readings of artificial sensors such as photoelectric cells or thermometers, and the performance of motors or solenoids".

[Electronics, 1949]

Trends in Robotics Research



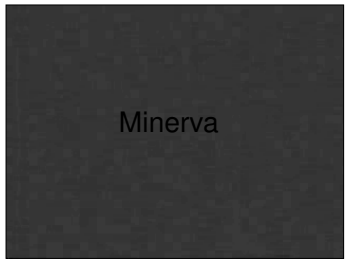
Brief Case Study: Museum Tour-Guide Robots

Rhino, 1997

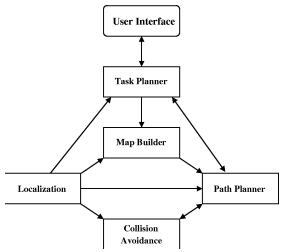
Minerva, 1998

Rhino (Univ. Bonn + CMU, 1997)

Minerva (CMU + Univ. Bonn, 1998)



Architecture of the Control System



Course Outline

Week	Content	Project
	Introduction and Paradigms	
#1	Introduction, control paradigms	
	Probabilistic Models / State Estimation	
#2	Bayesian state estimation	Particle and Kalman filter localization
#3	Motion and sensor models	
	Localization / Mapping / Tracking	
#4	Robot localization: grid, particle filters, EKF	
#5	Project 1 demo	Project 2
#6	Map building: EKF-SLAM, Fast-SLAM	
#7	Tracking and other applications	
	Control	
#8	Collision avoidance, path planning	
#9	Decision making: exploration, (PO)MDPs	
#10	Review, lab session	Final Demo