CS494/594:  
Autonomous Mobile Robots  
Fall 2008  
Tuesday/Thursday 5:05-6:20 PM  

Instructor: Dr. Lynne E. Parker  

TAs (1/4-time each):  
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Hi Future Roboticists!

Sorry I can’t be with you today. I’m helping teach a week of summer school in a castle in Germany this week on the topic: “Monitoring and Coordination Across Networked Autonomous Entities” (see http://gkmm.de/summerschool/).

So, you get a short day in class today! I’ll be back with you on Tuesday.

Cheers,
--Lynne Parker (parker@eecs.utk.edu)
Outline

• Overview syllabus and class policies

• Introduction to class

• Overview of assignment #1: Introduction to robotic simulator
Overview of Syllabus and Class Policies

(See handout)
What is a Robot?

• Notion derives from 2 strands of thought:
  – Humanoids -- human-like
  – Automata -- self-moving things

• “Robot” -- derives from Czech word *robota*
  – “Robota”: forced work or compulsory service

• Term coined by Czech playwright Karel Capek
  – 1921 play “R.U.R” (Rossum’s Universal Robots”)

• Current notion of robot:
  – Programmable
  – Mechanically capable
  – Flexible

• Our working definition of *robot*: physical agent that generates “intelligent” connection between perception and action
We’ll be studying *mobile* robots

- What is a “mobile” robot?
  - One whose entire body moves with respect to the environment

**Examples of *mobile* robots:**

**Examples of *non-mobile* robots:**
Strengths: What are mobile robots good at?

• Providing specialized access – hazardous environments (no air, etc.), distance/time (Mars)

• Reducing operating costs – lower overhead, reduced maintenance costs (gentler treatment of the machinery)

• Increasing productivity – “permanent” availability, more hours, higher throughput

• Improved product quality – accuracy, consistency

• Inventing new human services! – human interactivity
State of Robotics Applications

• Moving from manufacturing, industrial manipulators to:
  – Entertainment robotics
  – Personal service robots
  – Medical robots
  – Industrial applications beyond factory (e.g., mining, agriculture)
  – Hazardous applications (e.g., military, toxic cleanup, space)
  – And others…
Purpose: What Could Mobile Robots Do? (i.e., applications)

- Space (Robonaut, Sojourner, Opportunity, Spirit, etc.)
- Cleaning (Roomba)
- Agriculture (Demeter harvesting robot)
Purpose: What Could Mobile Robots Do? (i.e., applications) (con’t.)

• Medical service

• Mining/excavation (Groundhog robot)

• Entertainment robots
• Security (MDARS interior robot)

• Distance driving (Stanley)

• Military (Packbot)
Purpose: What Could Mobile Robots Do? (i.e., applications) (con’t.)

- Handicapped Aides (Japan’s WL-16RIII)
- Undersea (Oberon)
- Pipe inspection
Purpose: What Could Mobile Robots Do? (i.e., applications) (con’t.)

• Lawn Care (Cyber Blue)

• Power Line Inspection (WireMonkey)

And many, many more applications!
Example Robot Systems

(Movies)

- Hexapod1.mpg
- 3-robot-deploy-fast-clipped.wmv
- SwarmBot-followTheLeader.mpg
- OmniTread_UMich_Borenstein.wmv
- asimo2.mpg
What is in a Robot?

- **Sensors**
- **Effectors and actuators (i.e., mechanical)**
  - Used for locomotion and manipulation
- **Controllers for the above systems**
  - Coordinating information from sensors with commands for the robot’s actuators
- **Power**

- Robot = an **autonomous** system which exists in the **physical world**, can **sense** its environment and can **act** on it to achieve some goals
What are Basic Robot Software Issues?

- How do you perceive?
- How do you control?
- How do you generate action?

Perception → Control → Action

(sense/detect) → (behave, plan, react, reason, …) → (through effectors: wheels, legs, tracks, …)

Environment
Challenges

- Perception
  - Limited, noisy sensors
- Actuation
  - Limited capabilities of robot effectors
- Thinking
  - Time consuming in large state spaces
- Environments
  - Dynamic, impose fast reaction times
Uncertainty

• Uncertainty is a key property of existence in the physical world

• Environment is stochastic and unpredictable

• Physical sensors provide limited, noisy, and inaccurate information

• Physical effectors produce limited, noisy, and inaccurate action

• Models are simplified and inaccurate
Uncertainty (cont.)

• A robot cannot accurately know the answers to the following:
  – Where am I?
  – Where are my body parts, are they working, what are they doing?
  – What did I just do?
  – What will happen if I do X?
  – Who/what are you, where are you, what are you doing, etc.?...

Example:

(pictures from Thrun, CMU)
This semester, we’ll study various aspects of mobile robotics

Topics we’ll cover:

- Robot control architectures
- Locomotion
- Representation issues
- Sensing/perception
- Adaptation
- Path planning
- Navigation
- Localization
- Mapping
- Multi-robot systems
Assignment #1: Getting familiar with Player/Stage Simulator

- The Player-Stage-Gazebo simulator (playerstage.sourceforge.net)
  - **Player** is a general purpose language-independent network server for robot control
  - **Stage** is a Player-compatible high-fidelity indoor multi-robot simulation testbed
  - **Gazebo** is a Player-compatible high-fidelity 3D outdoor simulation testbed with dynamics
  - **Player/Stage/Gazebo** allows for direct porting to Player-compatible physical robots.

Movie examples of Player/Stage

- Deploy_100_far.avi
- idn_interceptor1.mpg
See you Tuesday!

- Dr. Parker will be back

- We’ll begin with Chapter 1 of text next time (i.e., Read Chapter 1!!), along with some other introductory material