Outline

• Exam #1 solutions

• Assignment #2 solutions/discussion

• Assignment #3 discussion

• Introduction to Formations

• Student Presentation: Daisy Tang

• Discussion of Formations
Discussion: Data Presentation

- Select right graph type for the data!
- Don’t interpolate lines unless they are meaningful!
Data Presentation (con’t.)

• Here’s how to show standard deviation:
Clarifications to Assignment #3

Your Assignment #3 solution must adhere to the following:

1. Include a Makefile with your code
   • “make all” should compile all of your code
2. Use a revised version of the script handed out today so that all 6 copies of the robot code can be run from one xterm window
   • OR: You can fork off separate processes
3. “Style” counts!
   • “Jerky” or excessively slow robot motions won’t get full credit
4. Submit your code so that it uses Nserver port # 7019.
5. Provide at least minimal documentation for the “meat” of your code (i.e., at least clearly defining the starting point of subroutines and describing what they do)
6. Remove all debugging print statements from your code. Only print out informative statements that are helpful to the casual user (me and the TAs!) to indicate the status of the program run.
7. Plot data correctly!
Formations in Multi-Robot Teams: Objectives

- Understand key issues in formation-keeping

- Understand various formations studied by Balch and Arkin and their advantages/disadvantages

- Be able to determine best formation for given circumstances
Key Issues in Formation-Keeping

- What is desired formation?

- How do robots determine their desired position in the formation?

- How do robots determine their actual position in the formation?

- How do robots move to ensure that formation is maintained?

- What should robots do if there are obstacles?

- How do we evaluate robot formation performance?
Example Movies of Column Formation-Keeping

Column formation (follow the leader)

Parker, 1995

Speed = 4x

Parker et al., 2001
Student Paper Presentation


• Presented by Fang (Daisy) Tang
What is desired formation?

• Dependent upon mission objectives, e.g.:
  – Minimize penetration through barrier
  – Maximize surface area coverage (e.g., “Graze”)
  – Maintain certain constraints
    • E.g., Maintain convex hull area less than specified amount
  – Stay together while getting to goal
  – Moving object through environment
What is desired formation? (con’t.)

• Dependent upon environment:
  – Obstacle-free
  – A few obstacles
  – Cluttered

• Dependent upon sensing/communication capabilities and requirements:
  – Ability to detect other robot positions
  – Ability to communicate with each other
  – Ability to sense effect of formation-keeping “through the world”
Possible formations

• Formations can be “hard-coded”, in the sense that they specify Cartesian positions for all robots.

• Example “hard-coded” formations:

  - **Circle**
  - **Wedge**
  - **Line**
  - **Diamond**
  - **Column**
Possible formations (con’t.)

• Or, formations can be defined by constraints, which allow variation in Cartesian positions for robots

E.g., Move object across room

E.g., Maintain LOS (line-of-sight) visibility
Next Time…

• Wrap-up Formations

• Pursuit/Herding