Robot Swarms

Command, Control, and Countermeasures

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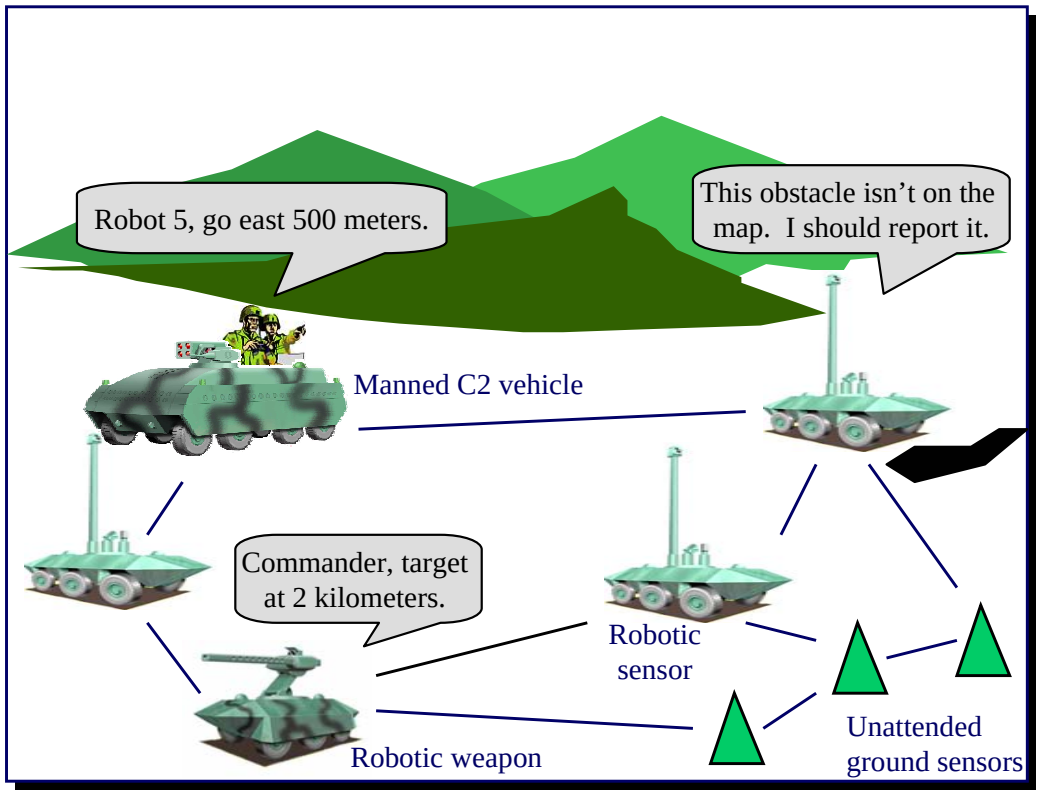
Problem

Enable autonomous systems and humans to work together effectively



Future Combat Systems Cell Concept

Issues for robot teams

- Coordinating teams of robots for reconnaissance
- Human-robot interaction
- Semi-autonomous behaviors for the robots
- Dynamically varying the degree of human supervision

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Background

"It shall be a goal of the Armed Forces to achieve the fielding of unmanned, remotely controlled technology such that --

(1) by 2010, one-third of the operational deep strike aircraft of the Armed Forces are unmanned; and

(2) by 2015, one-third of the operational ground combat vehicles of the Armed Forces are unmanned."

-- Senate Armed Services Committee Bill S.2549, National Defense Authorization Act for FY 2001

Technology Transition Targets

- **Network-Centric Warfare Programs (e.g., FCS)**
- **Intelligence Programs**
- **Homeland Security (border security, disaster response)**
- **DARPA Programs and Military ACTDs**

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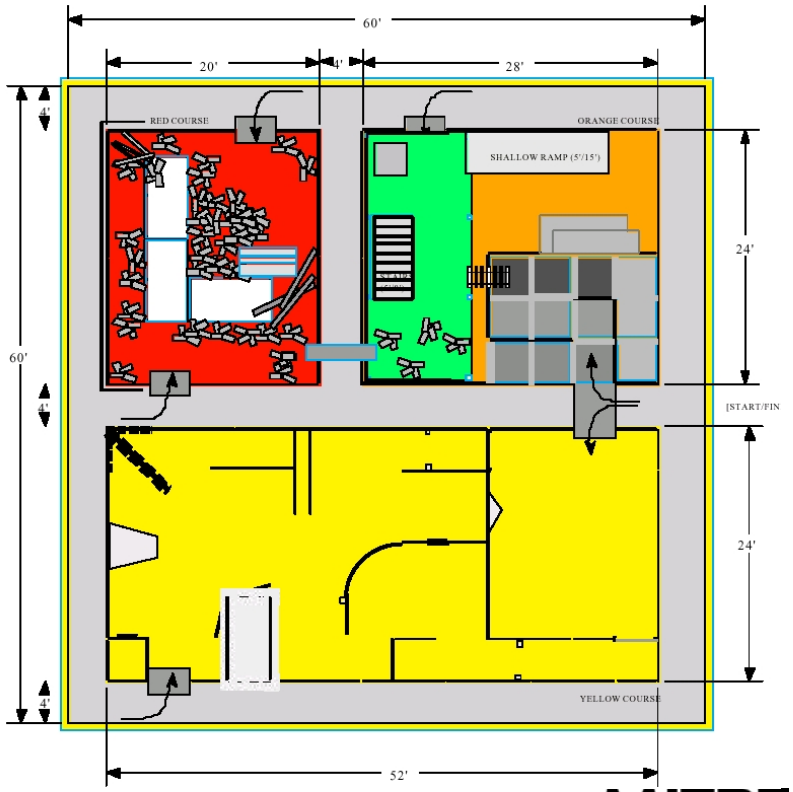
Objective

Demonstrate collaborative human-robot teaming

- Current Testbed: NIST Search & Rescue Test Course
- RoboCup-Rescue and AAAI Search & Rescue Competitions



The S&R task fits our broader interest in reconnaissance teams

- Urban recon and target ID
- Building clearing
- Facility security

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Activities

- Software Development
  - Robot Behaviors
    - Obstacle Avoidance, Navigation, Mapping, Target Recognition
  - Communications
  - Data Fusion
  - Operator Interface
  - Simulator
- Sensor Integration
- Robot Repairs and Upgrades
- Participation in S&R Competitions

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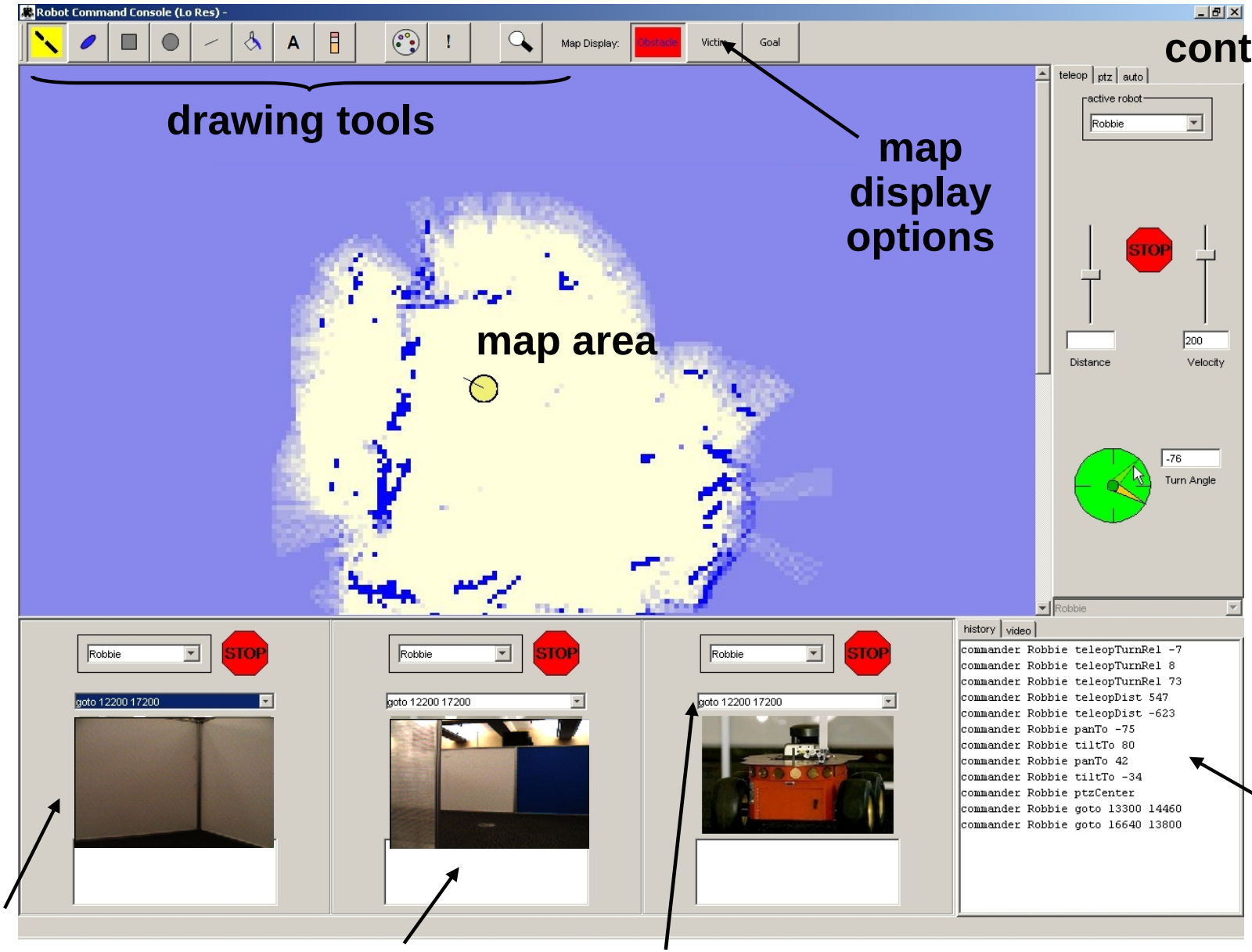
Highlight: Command Interface



teleoperation, camera, or autonomous behavior controls

command history or video closeup

robot video

robot history

command queue

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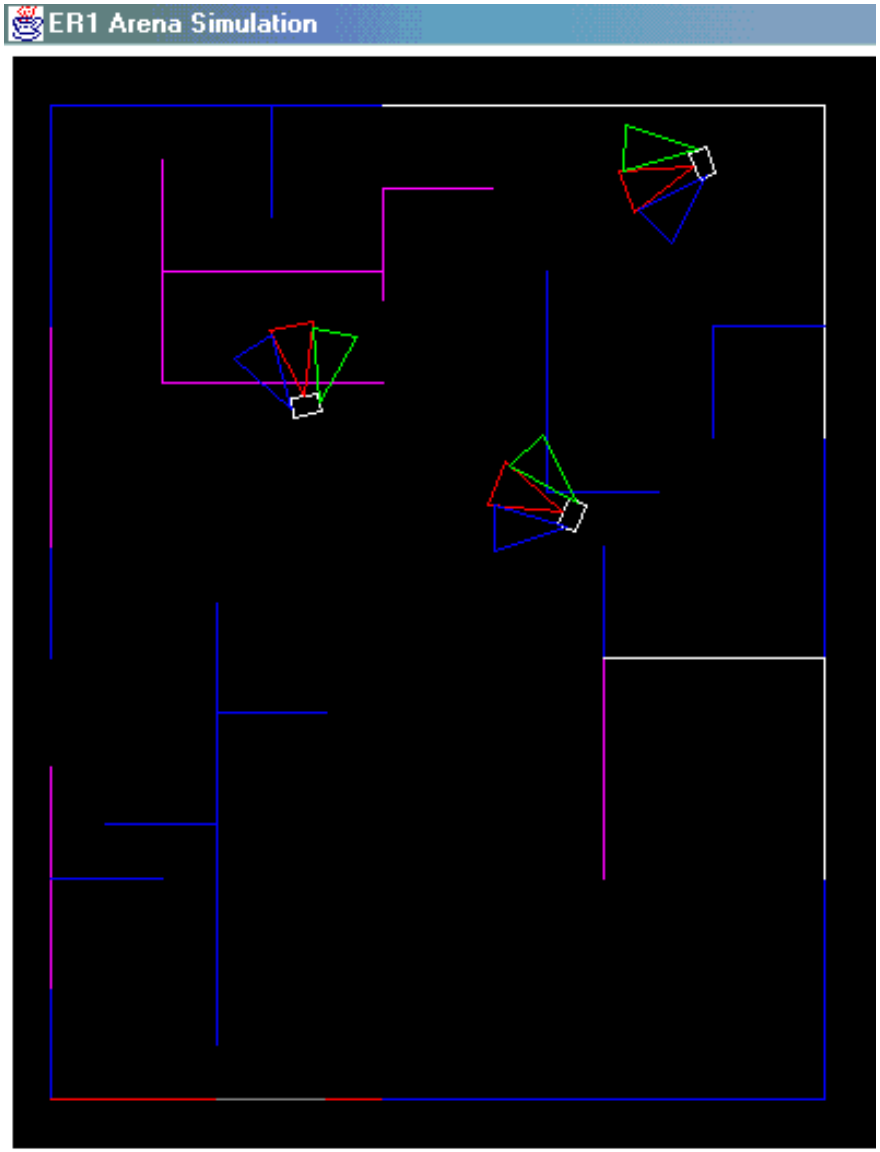
Highlight:
Physically Realistic Simulator

- Builds on Weatherly/Kuhl project to build a Java simulation framework
- We add
  - Sensors
  - Effectors
  - Behavior-based control



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Impacts

- Extend MITRE's expertise in command and control into the robotics domain
- Prepare to meet sponsor needs during the next 10 years
  - Future Combat Systems
  - Autonomous ground, sea, and air vehicles
  - Autonomous teaming and coordination
  - Automated reconnaissance
- Develop expertise in human-robot interaction

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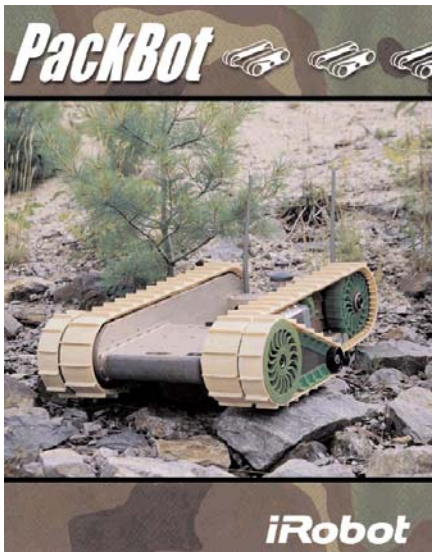
Future Plans

- Increase robot team size from three (currently) to 10–20
- Revise current interface to support larger team sizes
- Enhance autonomous capabilities so that robots can be effective with 1/10 to 1/20 of the operator's attention
- Integrate smaller, less capable robots with larger, more capable robots
- Explore countermeasures for robotic swarms



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