

Robotics and the National Robotics Initiative

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Overview

- Self-introduction
- President's vision
- National Robotics Initiative
- State of the art
- Three specific applications: nuclear, military bases, logistics
- ... and lots of cool videos



My Own Background

- Carnegie Mellon Robotics Institute, 1979 – present: PhD student, post-doc, faculty, Director 2000 - 2004



جامعة كارنيجي ميلور في قطر

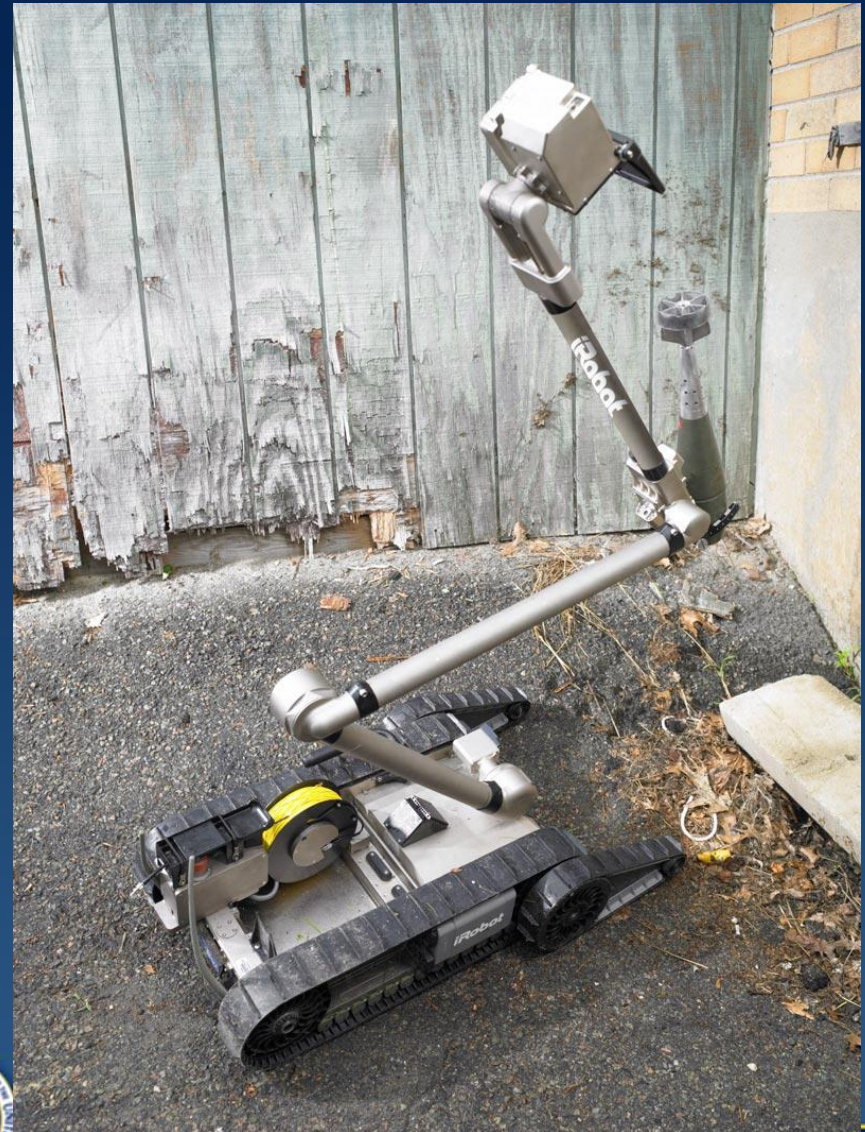


... and a few robots



State of the Art

- Over 6 million robots in use.
- Over 5 million:
- Around 10,000:



1,000,000 Assembly Robots



Robot safety, 1961 - 2011



Robots vs Humans

- Robots

- Fast
- Precise
- Tireless
- Huge memory
- Disposable

- Humans

- Reasoning
- Perception
- Adaptable

So why is there a fence between
them?



May 21, 2009



A Roadmap for US Robotics From Internet to Robotics

Organized by

Georgia Institute of Technology

University of Southern California

Johns Hopkins University

University of Pennsylvania

University of California, Berkeley

Rensselaer Polytechnic Institute

University of Massachusetts, Amherst

University of Utah

Carnegie Mellon University

Tech Collaborative

Sponsored by



POTUS and Robots



Presidential Priorities for Robots



The President's Mission

- “You might not know this, but one of my responsibilities as Commander-in-Chief is to keep an eye on robots. (Laughter.) And I’m pleased to report that the robots you manufacture here seem peaceful -- (laughter) - - at least for now.”



Robotics Vision: Machines Who Think

- Building smart machines
 - “Disappearing robots”
 - “Co-workers of the future”
- Building embodied intelligence
 - “Where AI meets the real world”
 - “Why computer science matters”
- Building smart people
 - STEM education
 - K – PhD
- Building smart industry
 - Making the robot revolution happen in the US
 - Moving technology out of the labs and into society



National Robotics Initiative (NRI)

The realization of co-robots acting in direct support of individuals and groups

- manufacturing; exploration; discovery; agriculture; security;

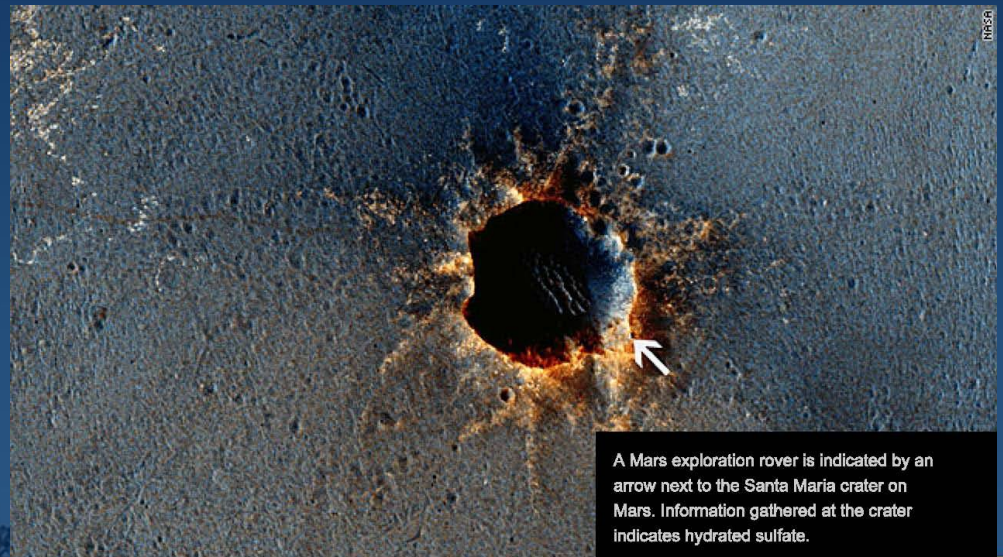


The NRI

- Multi-agency SBIR
- DURIP
- Prizes and Competitions
 - RoboBowl, AFRL, ...
- New applications
- Multi-agency RFP: Co-Robots
 - 680 LOIs for small projects / 445 proposals
 - 67 LOIs for large projects / 261 proposals



NASA



A Mars exploration rover is indicated by an arrow next to the Santa Maria crater on Mars. Information gathered at the crater indicates hydrated sulfate.

A visual visit to Mars

HIDE CAPTION

USDA



NIH



NRI Research Areas

Fundamental research in robotics science and technology

Controls and dynamical systems

Computational models of human cognition

Application-inspired topics

Platform specific topics

- micro- and nano-robotics,

- neuro-robotics,

- humanoid robotics, and

- networked multi-robot team

Understanding of the long term social, behavioral and economic implications of co-robots across all areas of human activity

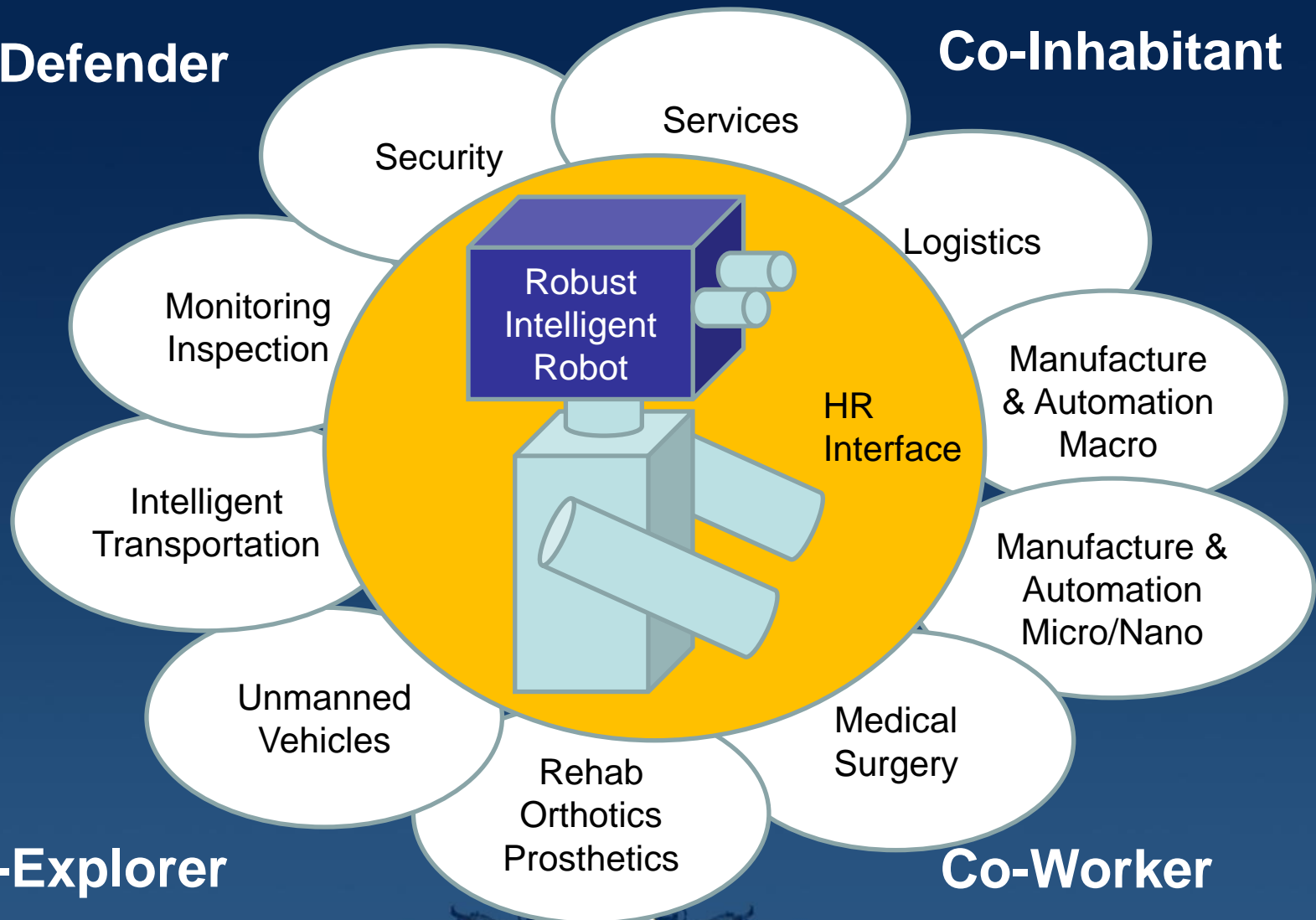
Use of co-robots for STEM learning K-16



NRI: The Application Space

Co-Defender

Co-Inhabitant



Co-Explorer

Co-Worker



Co-Robots: Task Cooperation



Co-robots: Safety through Control



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 orders given it by human beings except where 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.

Isaac Asimov - The Caves Of Steel, p. 177-179, 1942



Co-Robots: Go where people can't



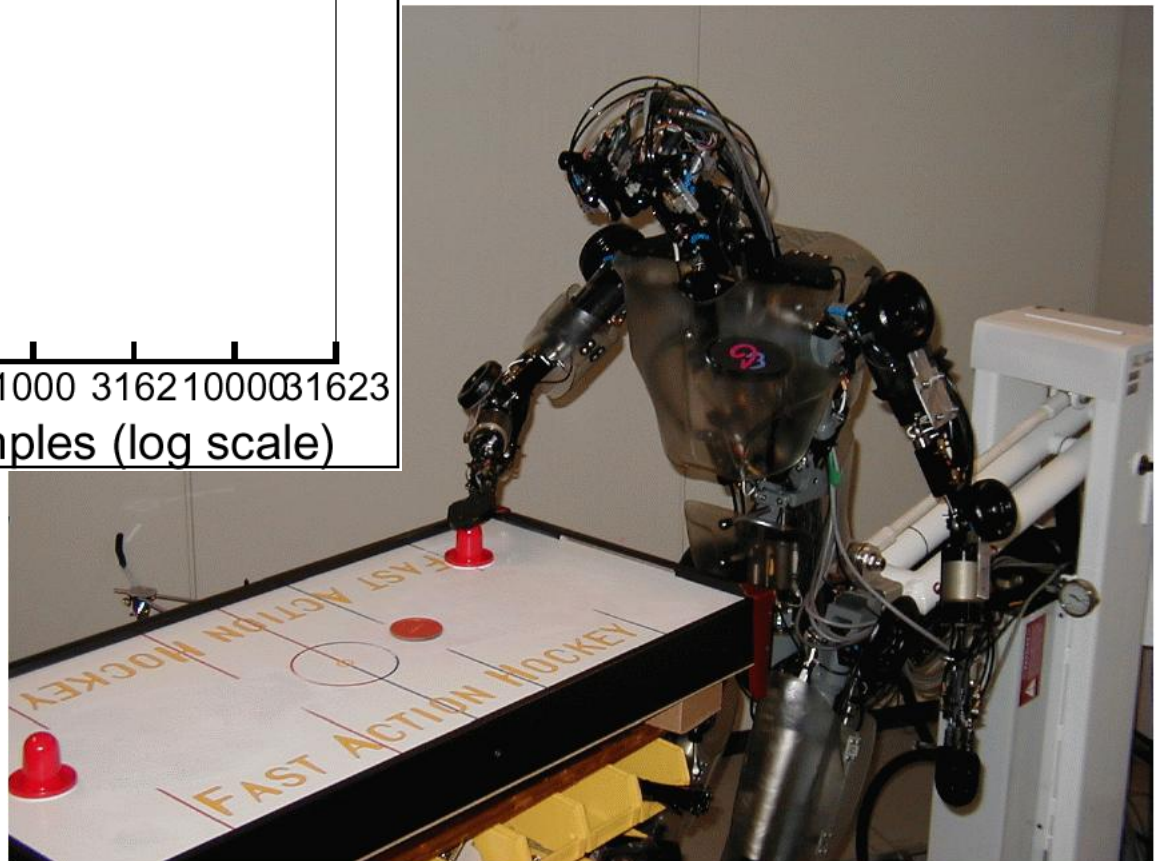
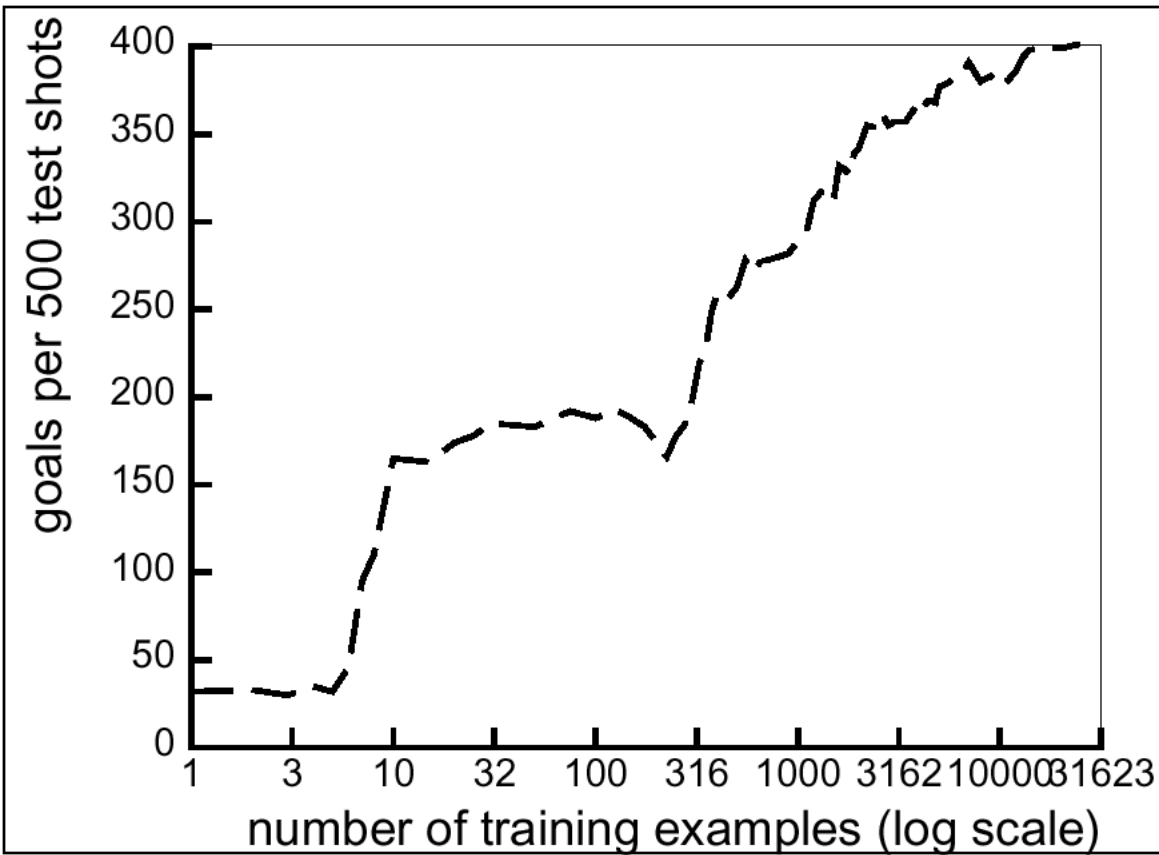
Co-robots: carry the load



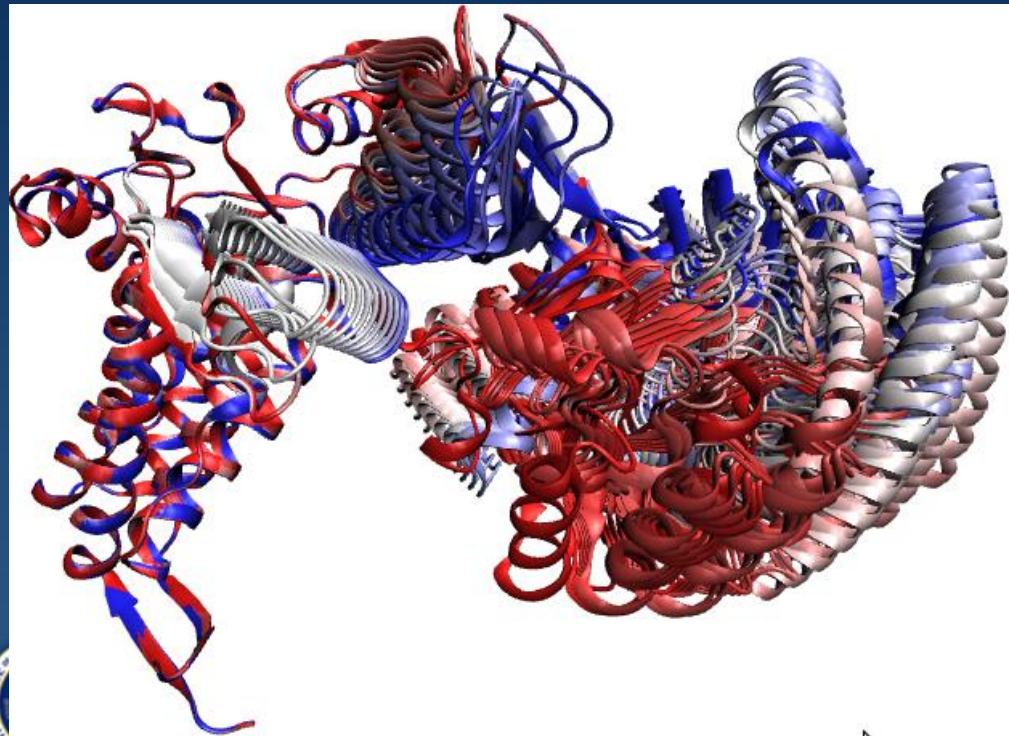
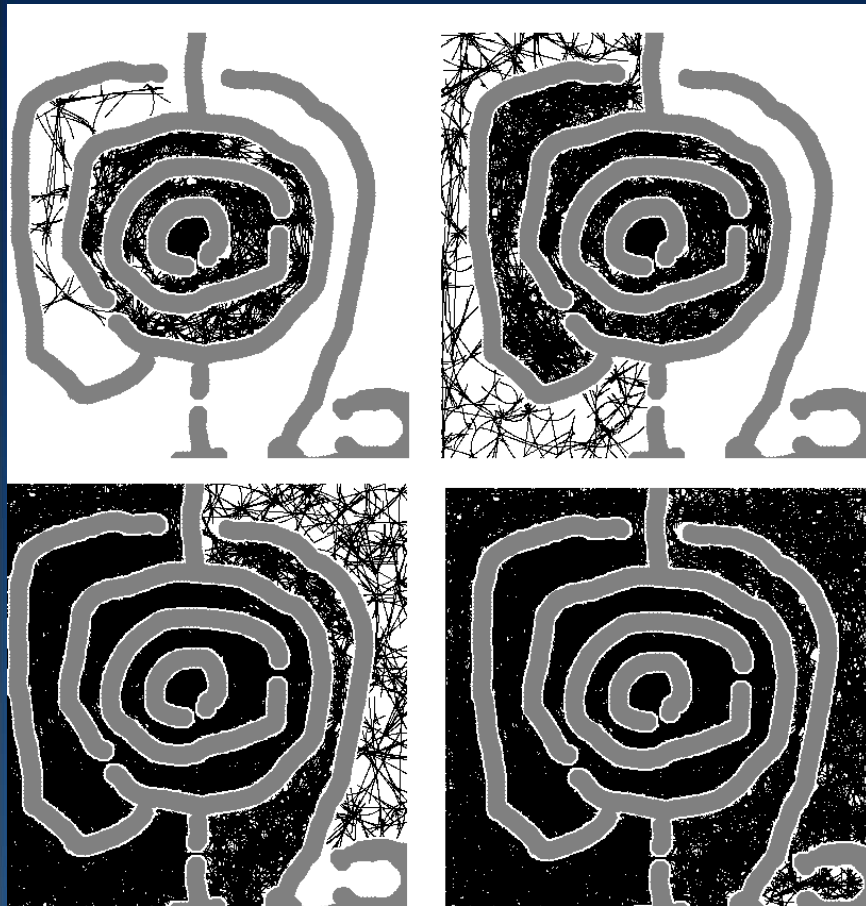
The Evolution of Dogs



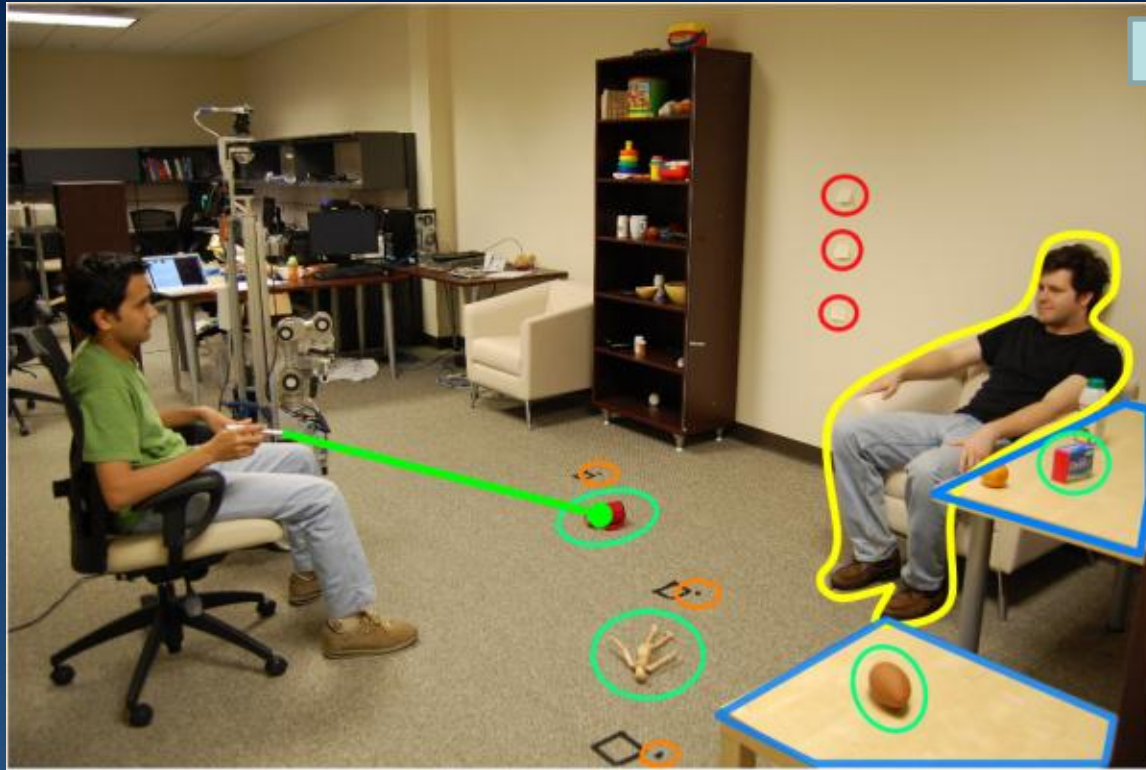
Robot Learning



Tangent: Robots and Proteins



Co-robots: Robot-Ready House; House-Ready Robot



... and Really Really cute design: RoboBowl

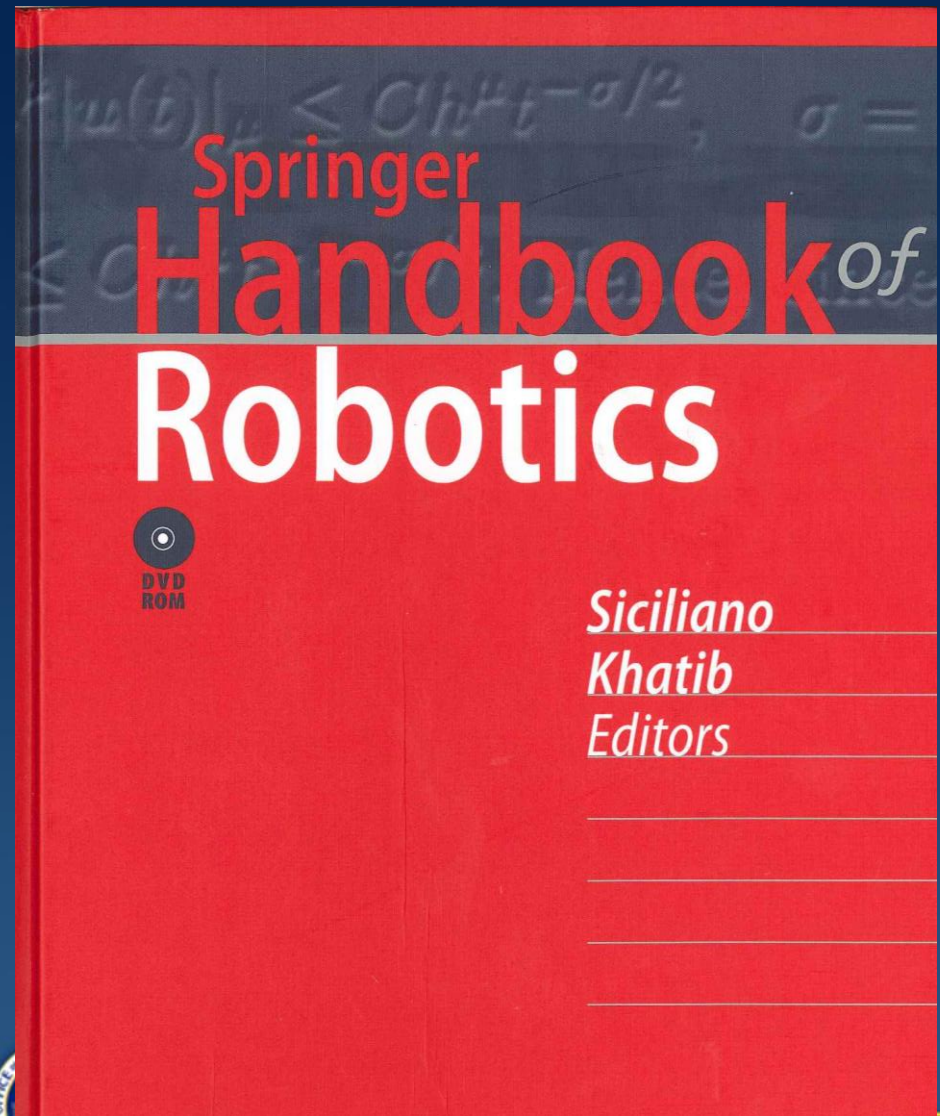


- 5-part competition
- Business plans
- Round 1, Health Care Robotics
- Winner: Interbots



How International is Robotics?

Australia	7
Belgium	2
Canada	7
Finland	1
France	13
Germany	10
Italy	20
Japan	14
Korea	4
Norway	1
Portugal	1
Spain	1
Sweden	2
Switzerland	5
Taiwan	2
Turkey	1
UK	3
US	67



Ultimate in Human-Friendly Robots



Application 1: Nuclear Disasters



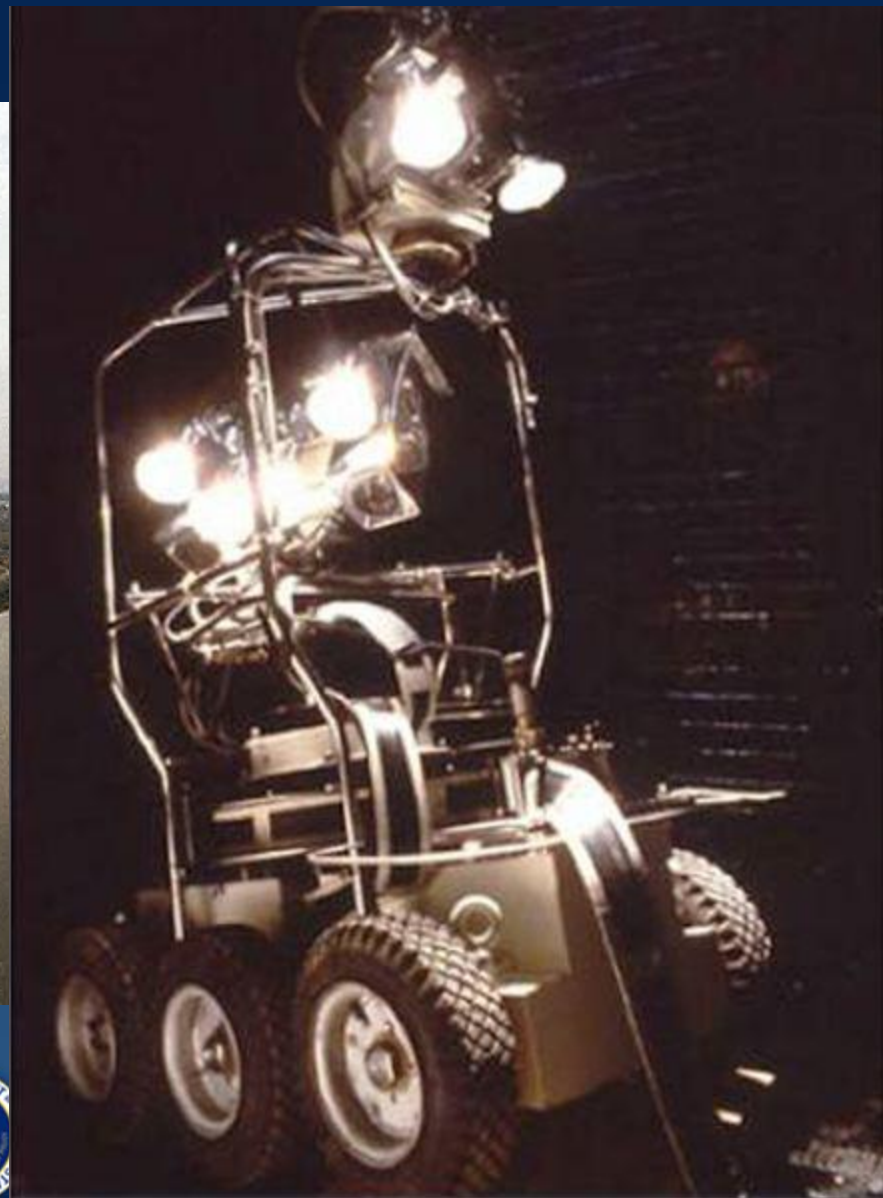
Quince

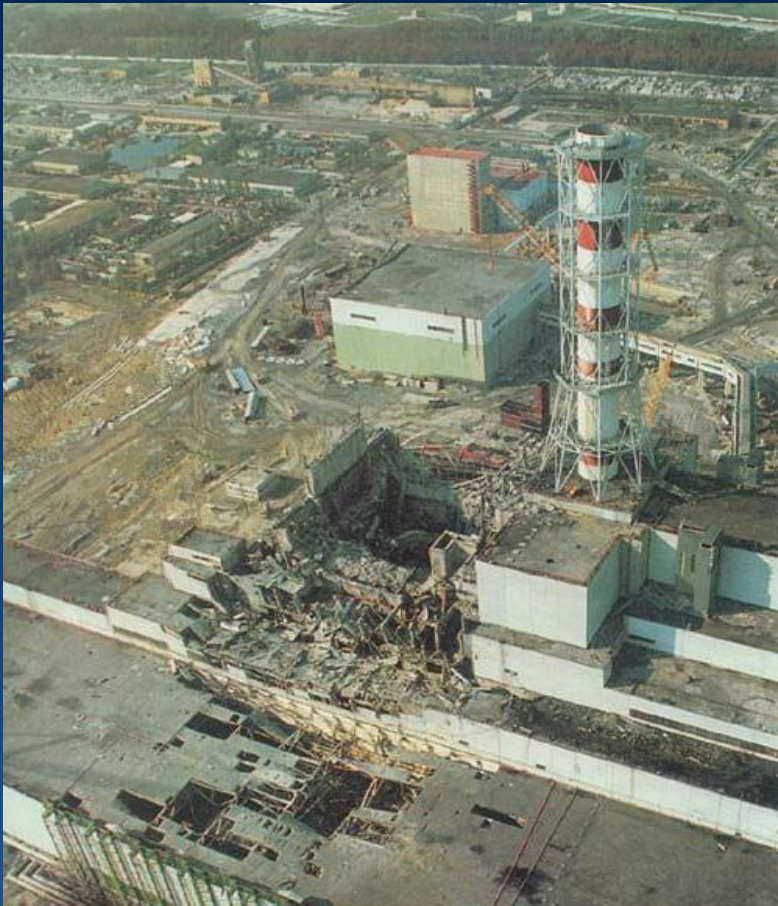
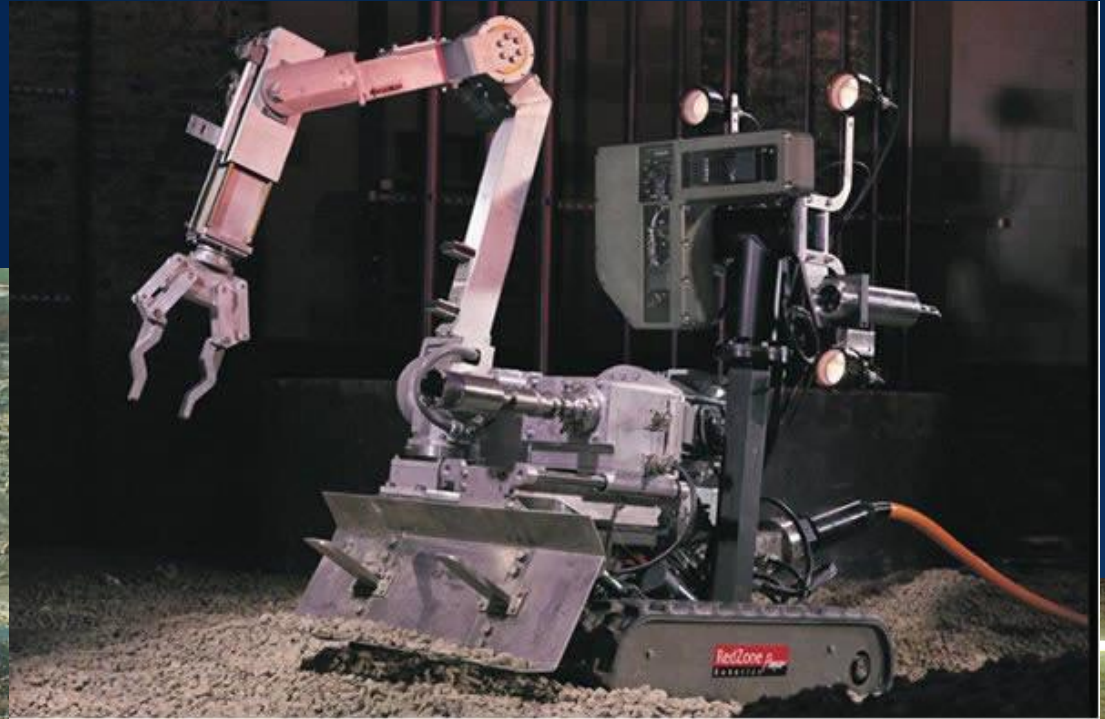


Qinetiq Bobcat









French and German Rad-Nuke Robots



KHG
Kerntechnische
Hilfsdienst GmbH

**INTRA:
Group of Robotics INTervention on
Accidents (INTRA)**



Robots for Nuclear Disaster Response

- Who's in charge?
- Who has the capability?
- DNDO
- NNSA
- NE
- FEMA
- DOJ / FBI
- AMCOM
- DTRA
- iRobot
- Qinetiq
- Sandia
- INL
- SPAWAR



Nuclear Response Robots

- Rad-harden some camera sleds
- Generate roadmap for disaster response
 - Mobility
 - Communications
 - Manipulation
 - User interfaces
 - Air, land, underwater
 - Commonality across CBRN, IED, civil platforms and interfaces
- Solve the robotics problem



Robots on Military Bases

- Let's get robots running on military bases
- LtG Lynch
- What can robots do today?



Carry Stuff



... Lots of stuff



Operate your warehouse – Kiva version



Seegrid Version



Collect your garbage

DustCart Robot in Peccioli





Our robots get to work once your students and educators go home for the day.

Education

Proven cost savings and consistent cleaning that meet the demands of cleaning schools and universities.

Educational environment operating software

The robots' long-range sensors offer a perfect solution for cleaning gymnasiums and cafeterias.

Reporting and accountability allow school districts and educational facilities to maintain the highest sanitation standards.

The Intellibot robot takes care of your floor cleaning needs every night, freeing up your labor staff to concentrate on high-maintenance zones like restrooms and cafeterias.

Our current clients include:

Mesa Public Schools, Mesa, AZ

Upper Merion School District,

Upper Merion, PA

Neshaminy School District,

Langhorne, PA

United States Military Academy,

Westpoint, NY

University of California, Long

Beach, CA

Onslow County School District,

Jacksonville, NC

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and calculate ROI.

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near you.

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Patrol your perimeter



... affordably



Darpa Urban Challenge

Lead Software Developer for Finalist Team VictorTango

Transitioning autonomous vehicle technologies.

Read More 



Application 3

- Robotics and logistics
 - Lots already happening
 - Lots left to do
 - <your ideas go here>



Research Areas

- Touch sensors
- Advanced power sources
- Soft actuation
- Safety skins
- Object recognition
- Intention inference
- Multi-robot cooperation
- Multi-level human interfaces
- Advanced architectures
- House of the future
- Internet interfaces for robotics
- Underwater, surface, air, space, ...



So where are we?

- Lots of open problems:
 - Object recognition
 - Human intention inference
 - Mobility and power and comms and
- Lots of successes:
 - Ready for deployment
- The Robot Revolution is underway
- ... and they're peaceful: Co-robots



