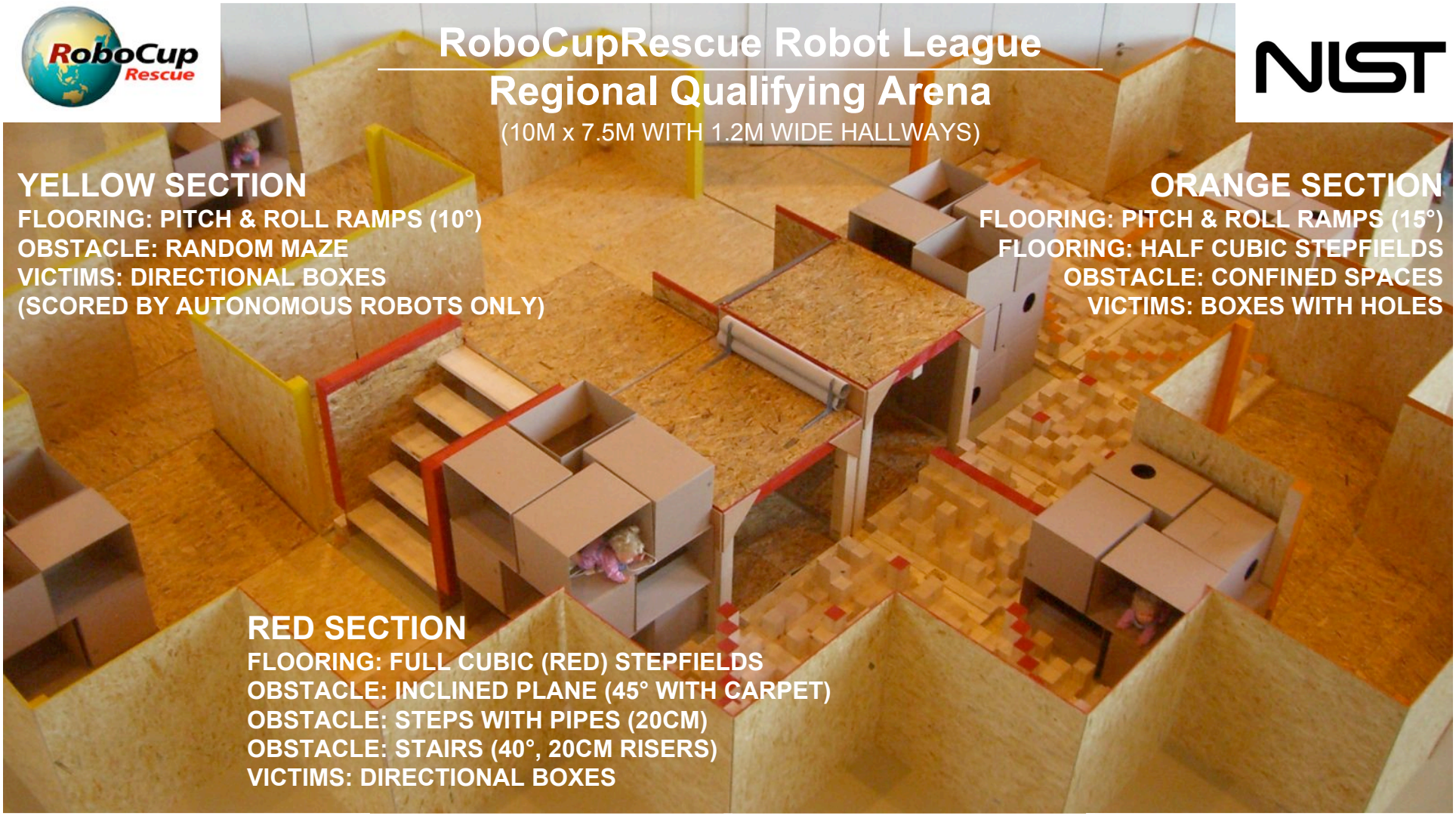
RoboCupRescue Robot League

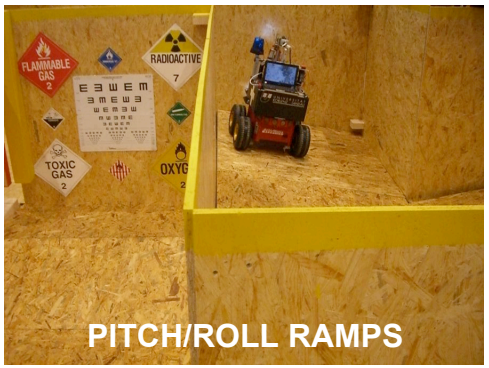
2007 Championship, Atlanta, Georgia, USA

RANDOM MAZE DIMENSIONS ARE 10M x 15M WITH 1.2M HALLWAYS

CHAIR: Adam Jacoff, National Institute of Standards and Technology, USA
rescue.robot.league@nist.gov or 301-975-4235

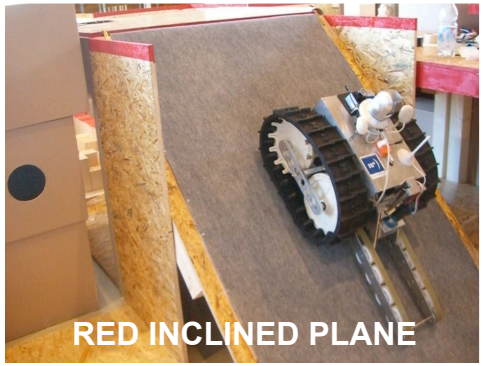
RoboCupRescue Robot League
Regional Qualifying Arena
(10M x 7.5M WITH 1.2M WIDE HALLWAYS)

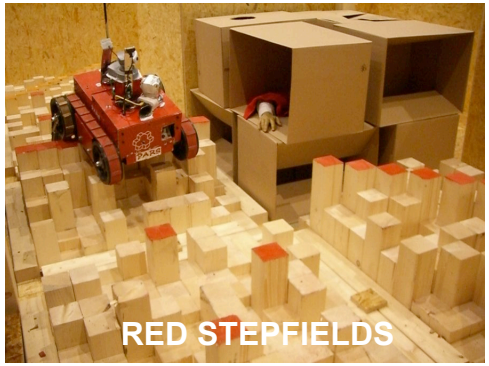




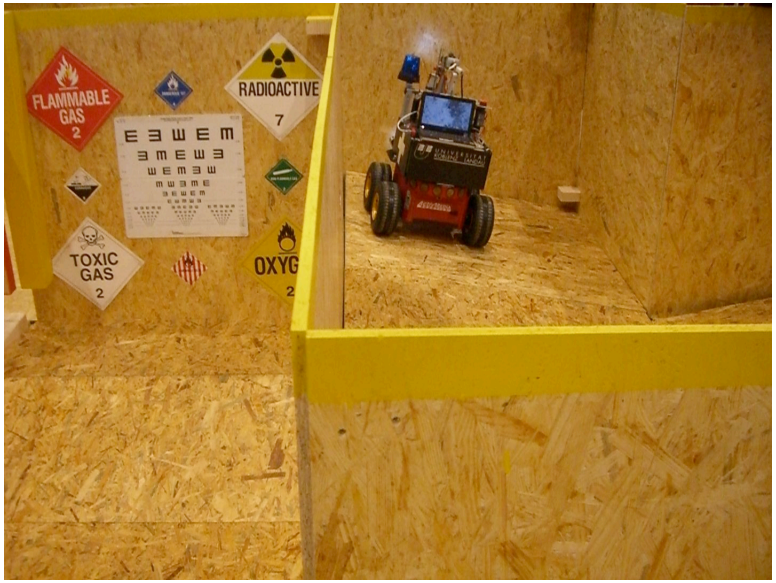
PITCH/ROLL RAMPS

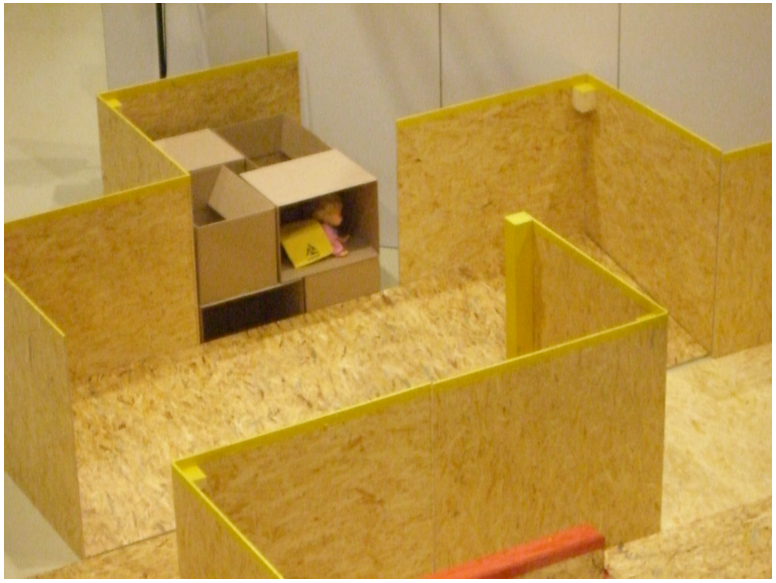
ORANGE STEPFIELDS

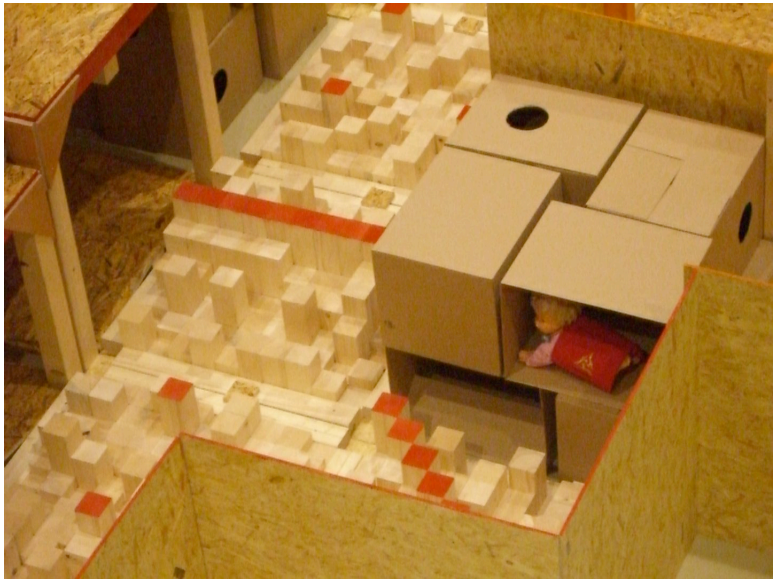

RED INCLINED PLANE


RED STEPFIELDS

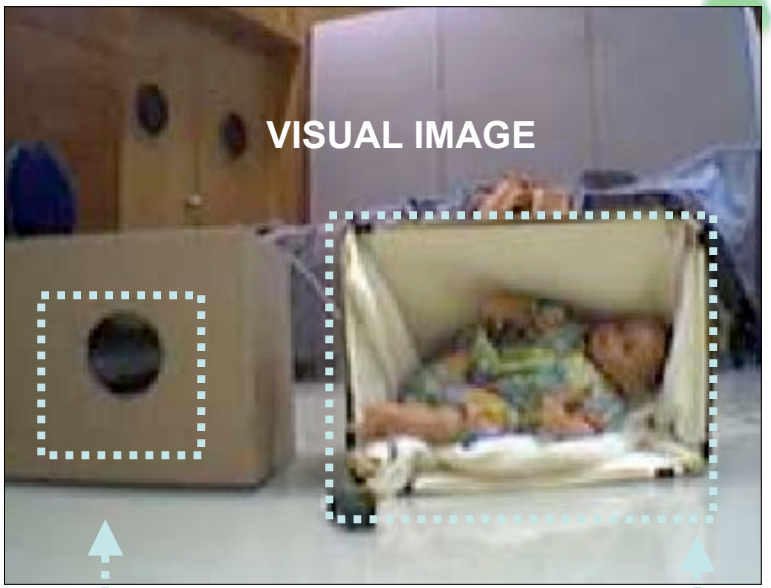
RoboCupRescue Robot League
Regional Qualifying Arena



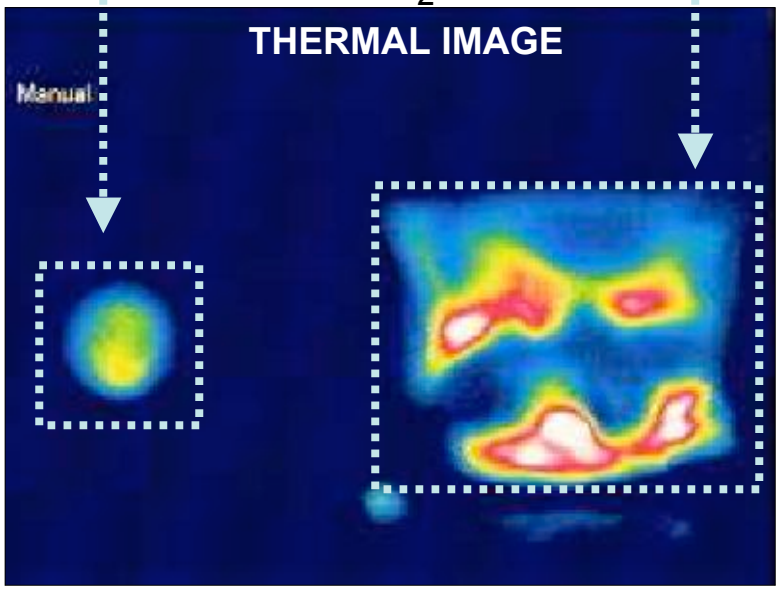




RoboCupRescue Robot League
Simulated Victims



Signs of life: form, motion, heat, sound, CO_2



RoboCupRescue Robot League
Arena Elements

Arena Elements Are Emerging

Standard Test Methods For

Urban Search & Rescue Robots

through

ASTM International

(Working Group E54.08)

RANDOM MAZES WITH DEAD ENDS

NON FLAT FLOORING THROUGHOUT

REMOTE OPERATOR STATION

VIDEO AND TRACKING DISPLAYS

RoboCupRescue Robot League
Rules at a Glance

New For 2007:

- Victim placements will be known to the operators and audience prior to missions, and changed each round to ensure complete arena coverage over multiple missions.
- Resets allow fixing/replacing the robot at the start point but loss of accumulated victims, maps, and time.
- GeoTIFF map formats will be used to allow comparison of maps to ground truth arena configurations.
- Best-In-Class awards for autonomy and mobility will be given to robots that find the most victims in the Yellow and Red arenas respectively over all missions.

Arena Features: Yellow, Orange, Red

- Random mazes with non-flat flooring
- Stepfield pallets (Orange: half-cubic, Red: full-cubic)
- Stairs (40°, 20cm riser, 25cm tread depth)
- Ramp (45° to test torque and center of gravity)
- Confined spaces (ceiling blocks under elevated floors)
- Visual acuity (tumbling E eye charts, hazmat labels)
- Directed perception boxes with victims/targets inside

Simulated Victims: 4 per arena, 12 total

- The chair will place victims in two high and two low boxes per arena, in different locations each round.
- Signs of life: form, heat, motion, sound, and/or CO2
- “Trapped” are in boxes open on top
- “Void” are in boxes open to side
- “Entombed” are in boxes with view holes
- Tumbling E’s and/or hazmat labels are victim tags

Missions:

- Teams queue at paddock entry prior to scheduled start.
- 15/20/25 minute missions include robot placement at the start point and operator station setup. Each team is responsible for making sure victims are functional (heat, batteries, tags) prior to their mission start.
- Teams are allowed one operator during missions.
- Start points will be in the Yellow arena with all robots facing the same direction (“north” on your map).
- Yellow arena victims can be scored only by robots with autonomous navigation and victim identification. Operators may take over control at any time to move into the Orange and Red arenas but must return to the start point to resume autonomous searches.
- Teleoperative robots can only score Orange or Red arena victims, which are placed on both sides of the Yellow arena to encourage complete mapping.
- Resets allow fixing/replacing the robot at the start point but loss of accumulated victims, maps, and time.
- Bumping penalties are assessed if the administrator must replace/fix arena elements prior to next mission.
- GeoTiff map formats get full scores for map quality and will be compared to ground truth for accuracy.
- Highest cumulative scores from 7-10 missions will be awarded 1st, 2nd, 3rd place awards.
- Best-In-Class awards will be given to **individual robots** that do the following during all missions:
  - Autonomy: Find the most Yellow arena victims
  - Mobility: Find the most Red arena victims

RoboCupRescue Robot League
Awardees

17 of 20 participating teams performed missions representing AUS, DEU, IRN, JPN, MEX, SWE, THA, USA.

CHAMPIONSHIP AWARDS: MIXED INITIATIVE MISSIONS

Teams with the highest cumulative scores from 7-10 missions receive 1st, 2nd, 3rd place awards

- 1st: INDEPENDENT, KING MONGKUT'S INST. OF TECH. BANGKOK, THAILAND
- 2nd: PELICAN UNITED, CHIBA INSTITUTE OF TECH. & TOHOKU UNIV., JAPAN
- 3rd: CEO MISSION, UNIV. OF THE THAI CHAMBER OF COMMERCE, THAILAND

BEST-IN-CLASS: MOBILITY

Robots that found the most Red Arena victims throughout and scored the most points in mobility missions

- 1st: PELICAN UNITED, CHIBA INSTITUTE OF TECHNOLOGY, JAPAN
- 2nd: SHINOBI, THE UNIVERSITY OF ELECTRO-COMMUNICATIONS SGI, JAPAN
- 3rd: INDEPENDENT, KING MONGKUT'S INST. OF TECH. BANGKOK, THAILAND

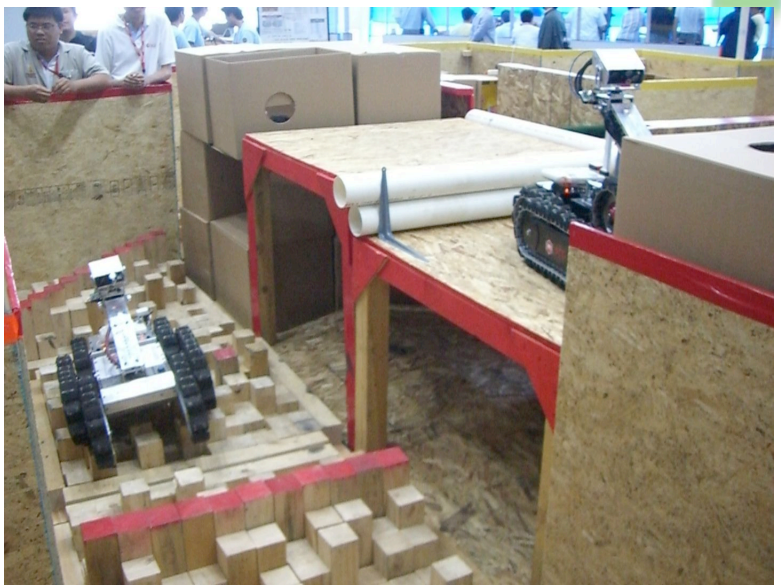
BEST-IN-CLASS: AUTONOMY

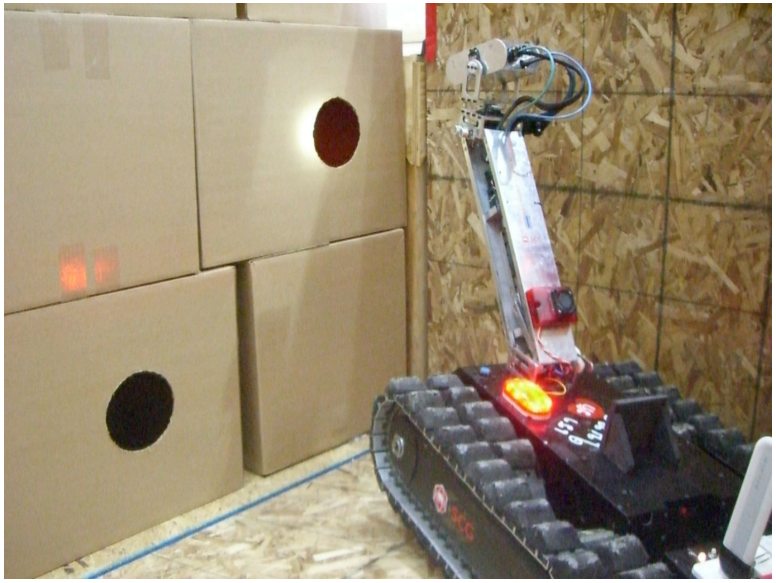
Robots that found the most Yellow Arena victims throughout and scored the most points in mapping missions

- 1st: RESKO, UNIVERSITAT KOBLENZ UND LANDAU, GERMANY
- 2nd: JACOBS RESCUE ROBOT, JACOBS UNIVERSITY BREMEN, GERMANY
- 3rd: RFC UPPSALA, UPPSALA UNIVERSITY, SWEDEN

Independent, KMITNB, Thailand

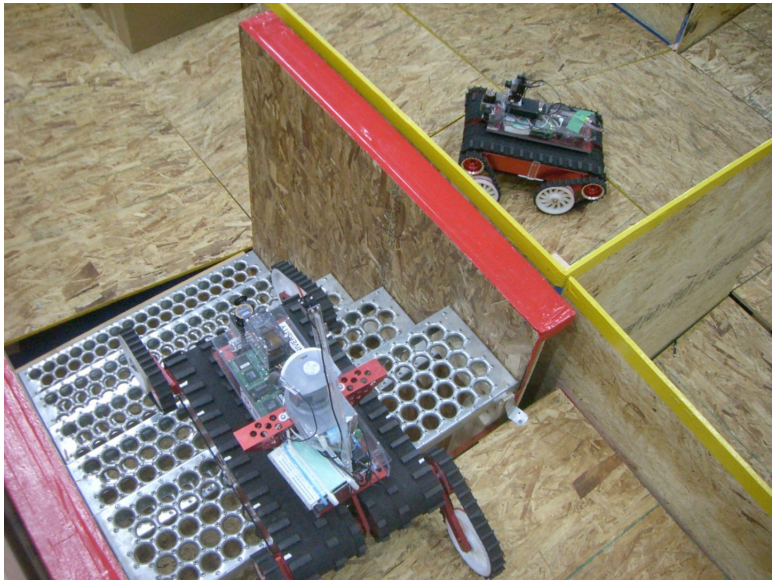
1st Place Award & 3rd Best-in-Class Mobility

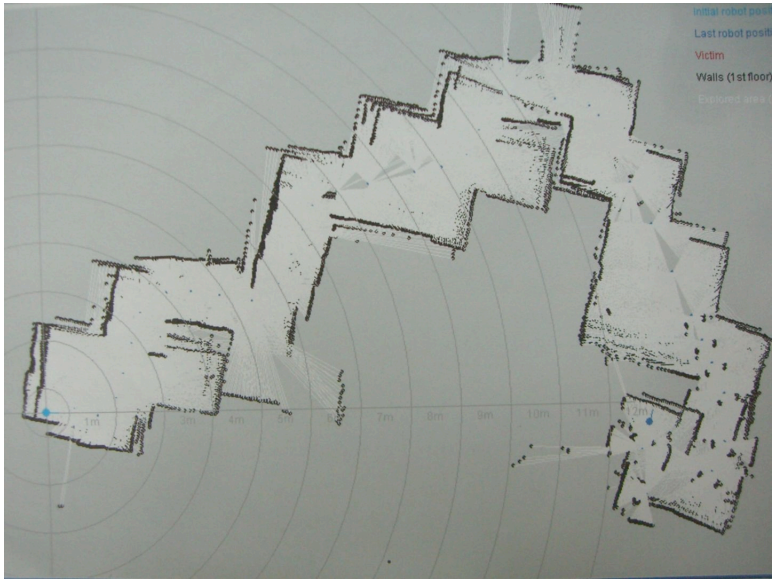


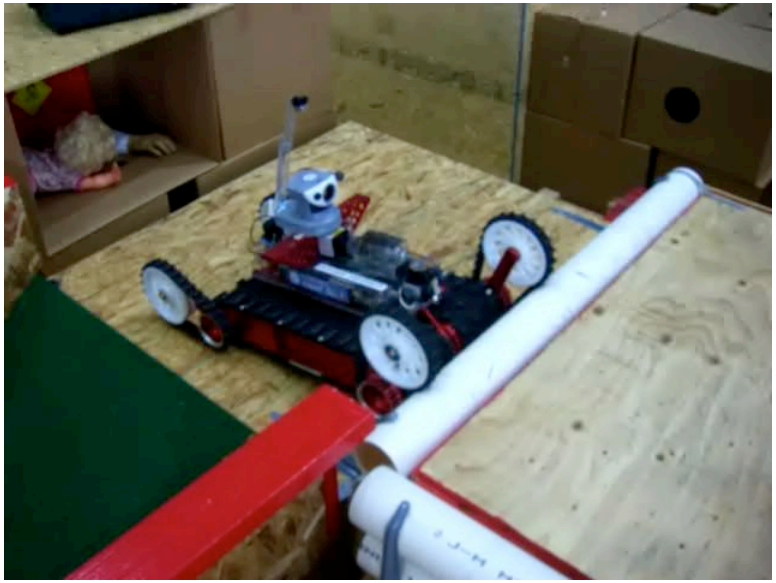


Pelican United, Chiba Inst and Tohoku Univ, Japan

2nd Place Award & 1st Best-in-Class Mobility

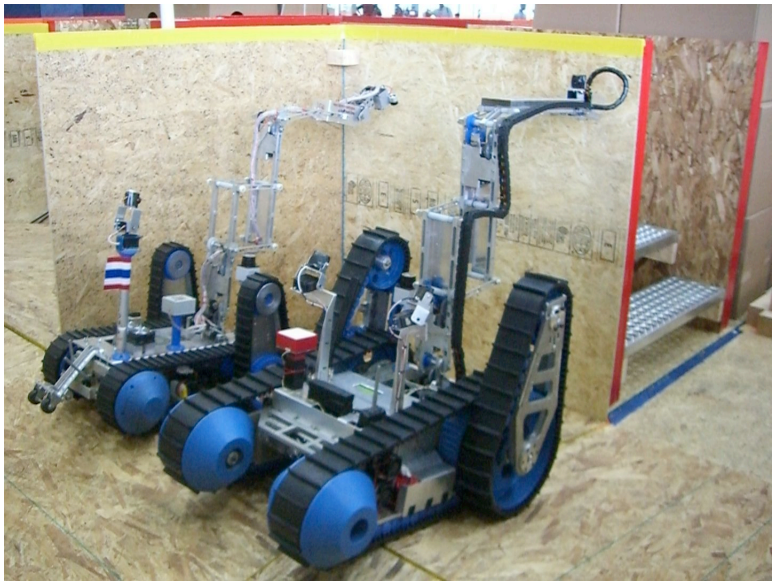


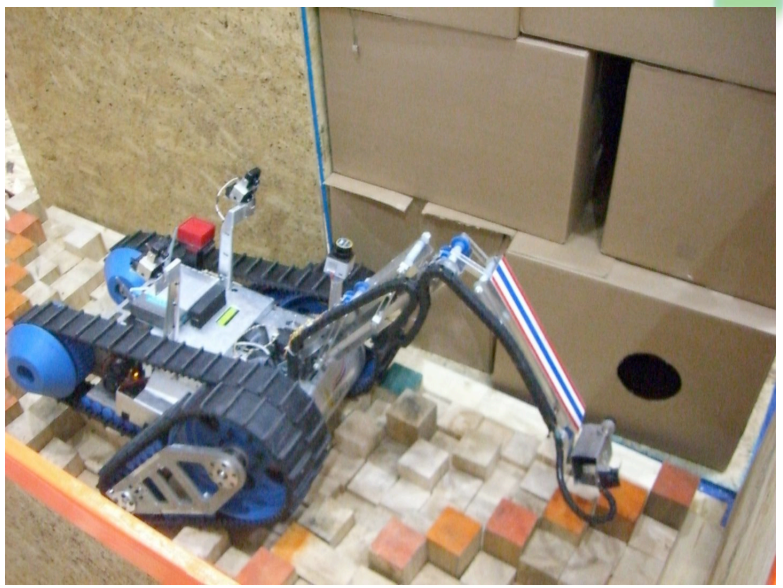


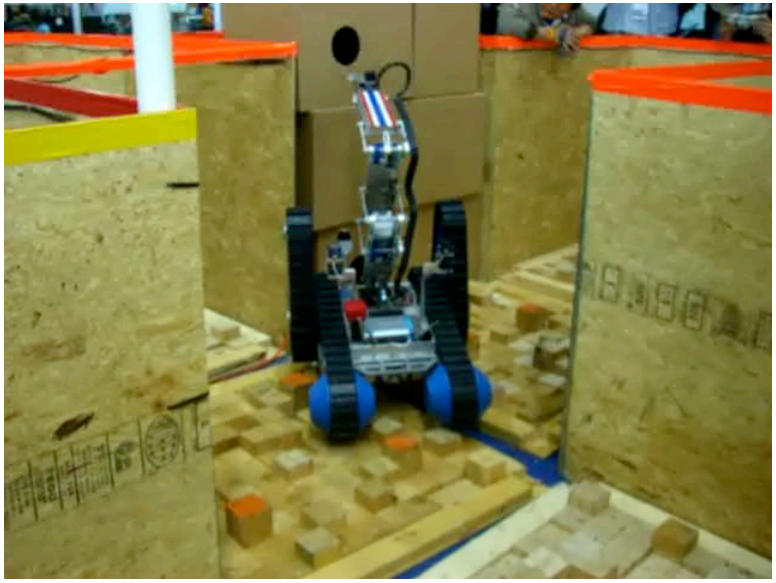


CEO Mission, Univ Thai Chamber of Commerce, Thailand

3rd Place Award

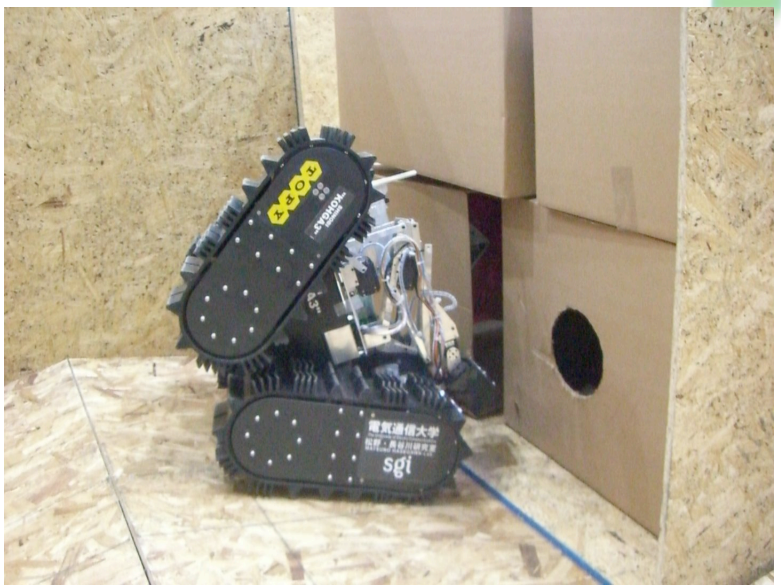


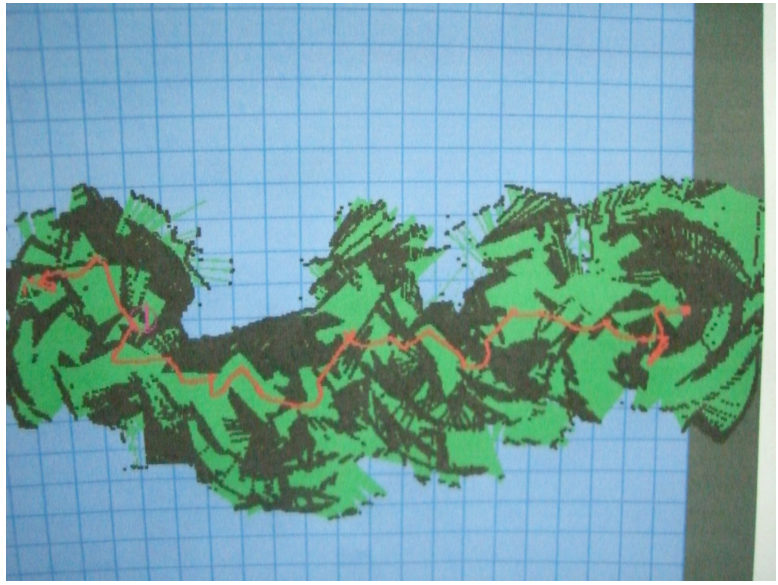


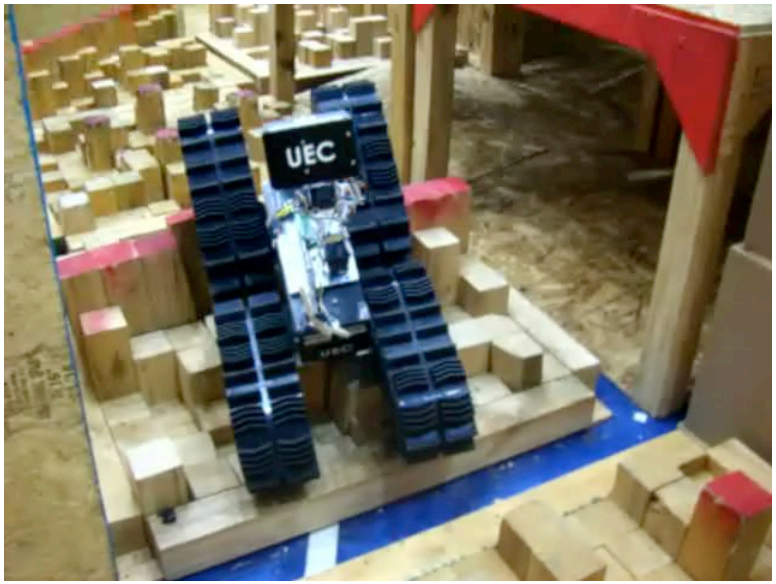


Shinobi, Univ of Electro-Communications, Japan

2nd Best-in-Class Mobility

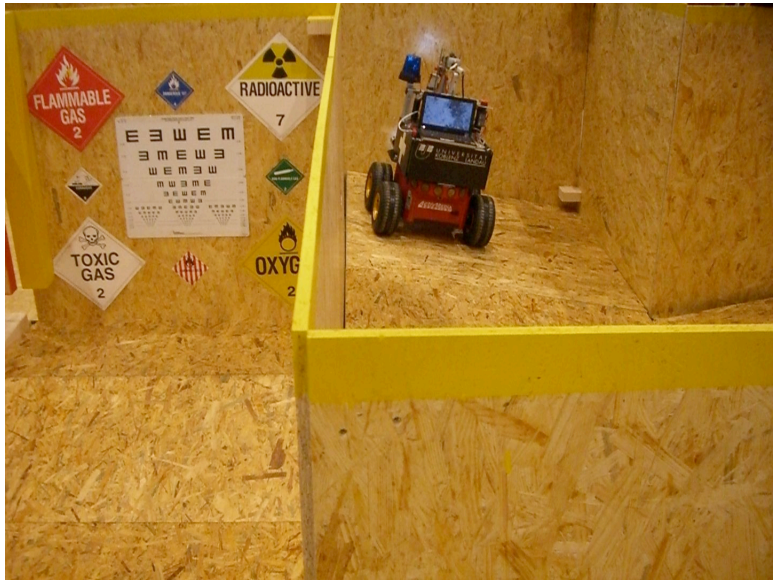


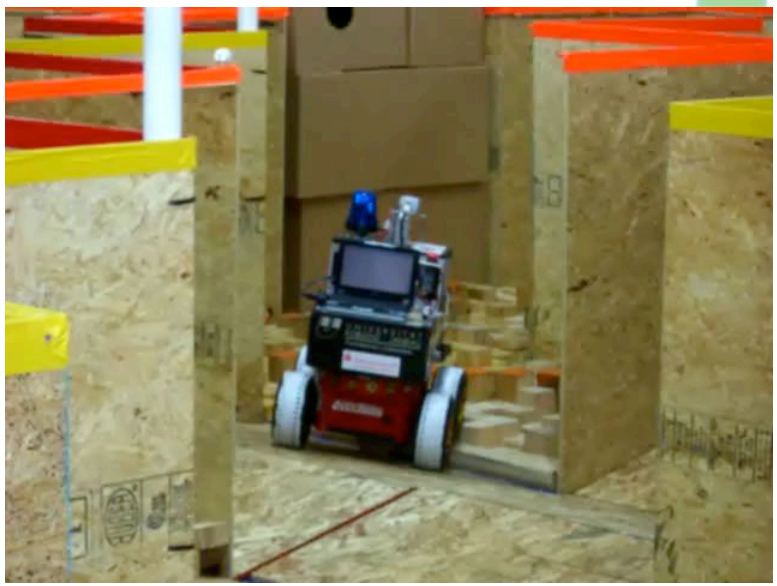




RESKO, Univ of Koblenz and Landau, Germany

1st Best-in-Class Autonomy/Mapping





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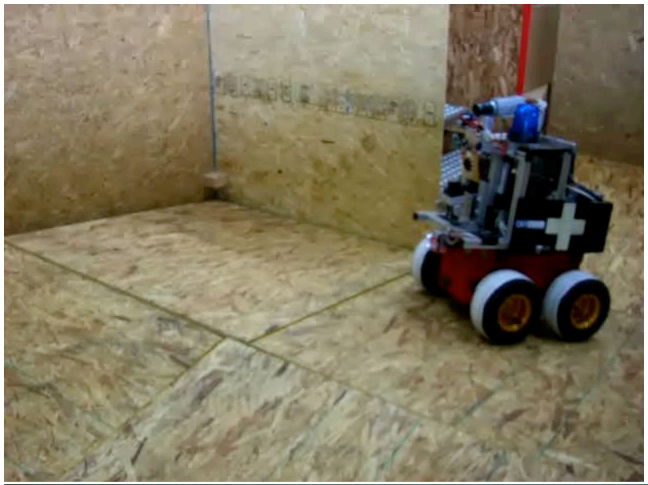
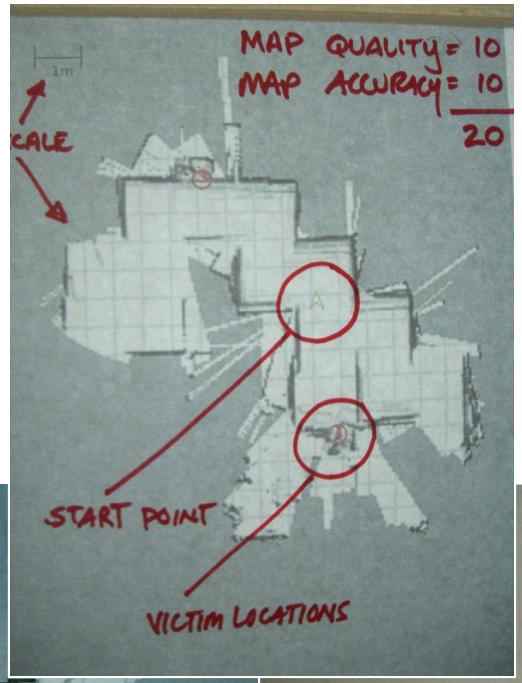
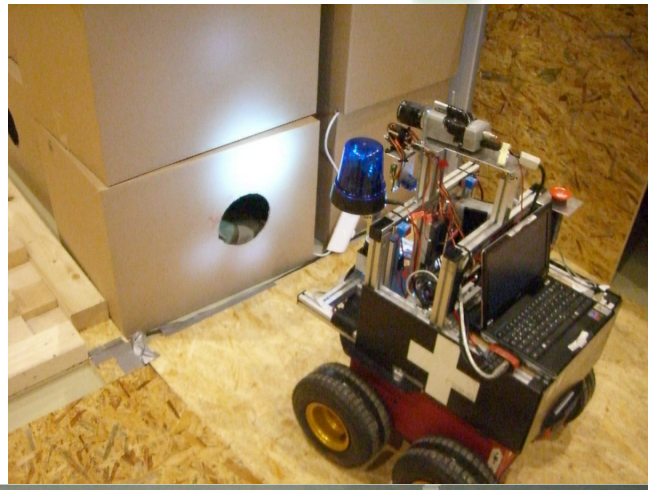
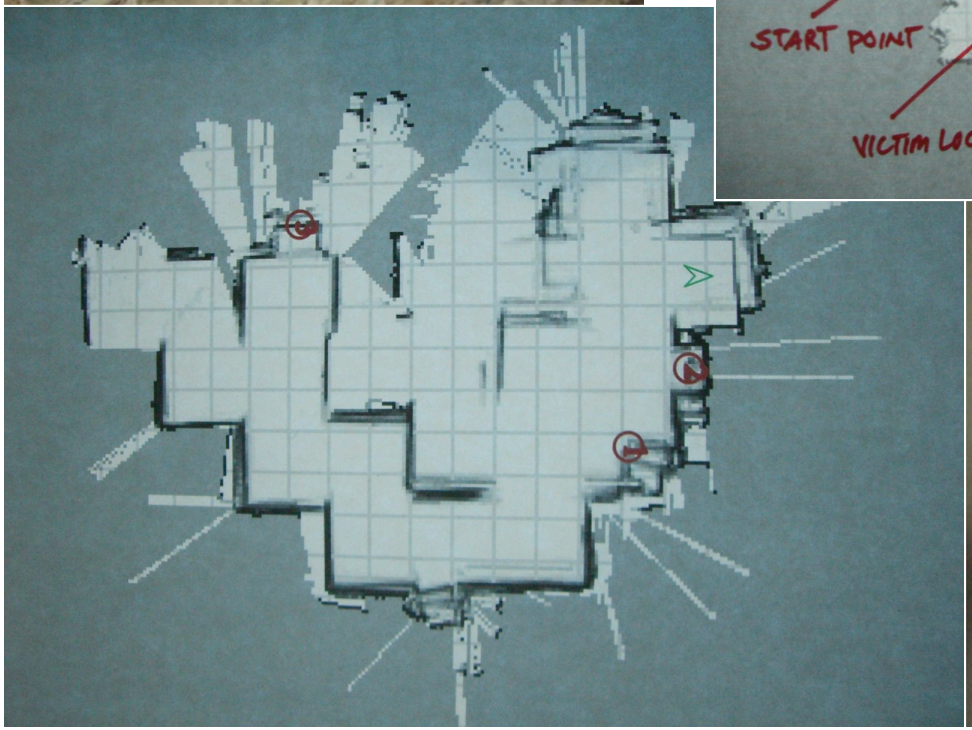
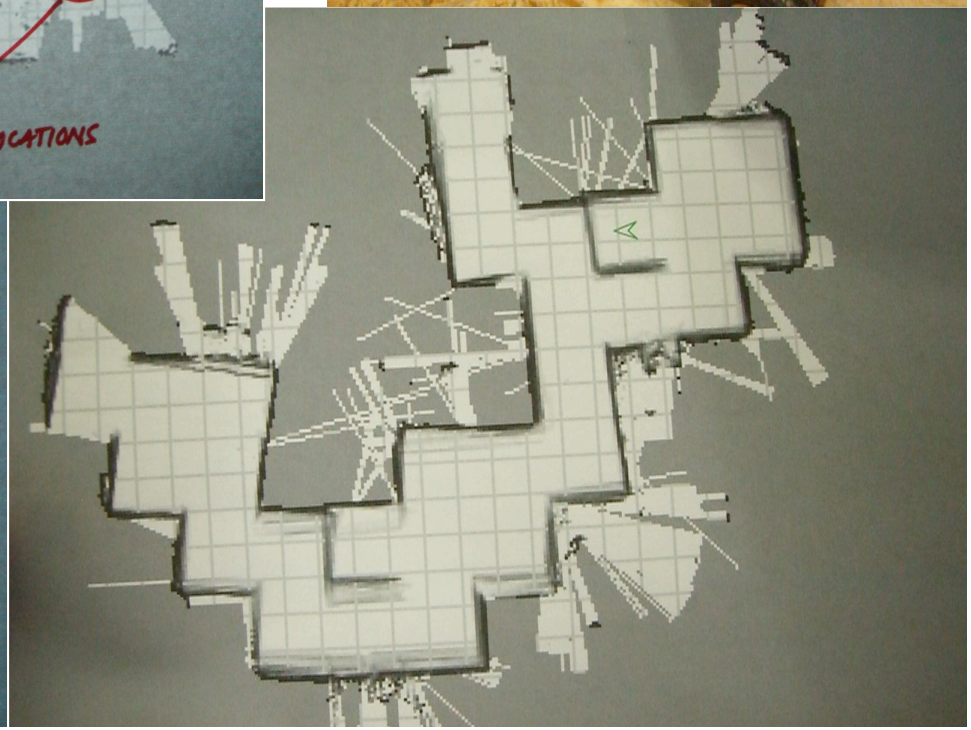




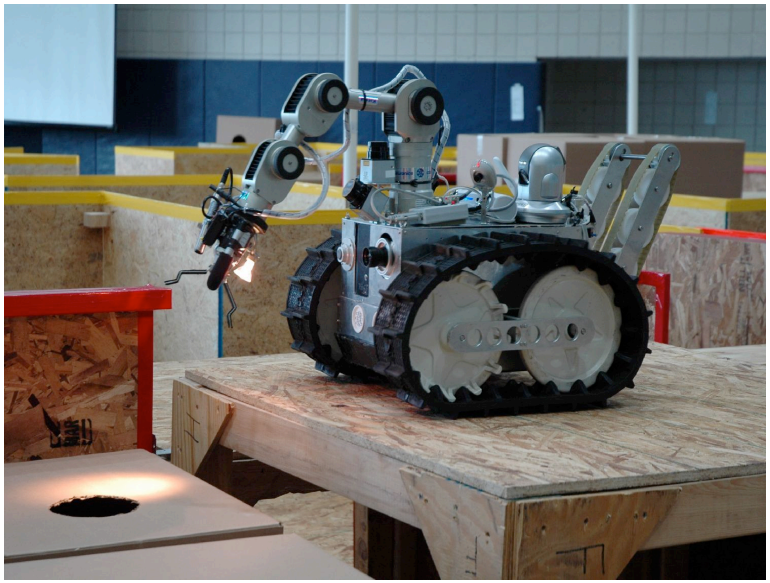






Jacobs Rescue Robot, Jacobs Univ Bremen, Germany

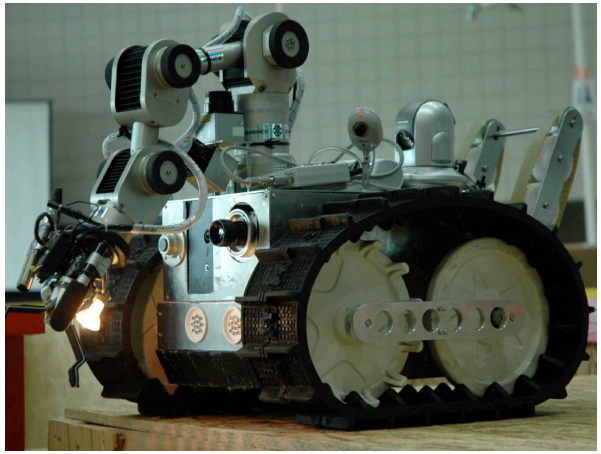
2nd Best-in-Class Autonomy/Mapping

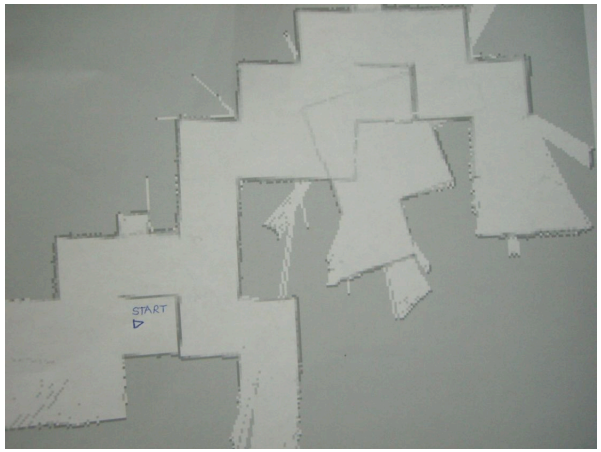


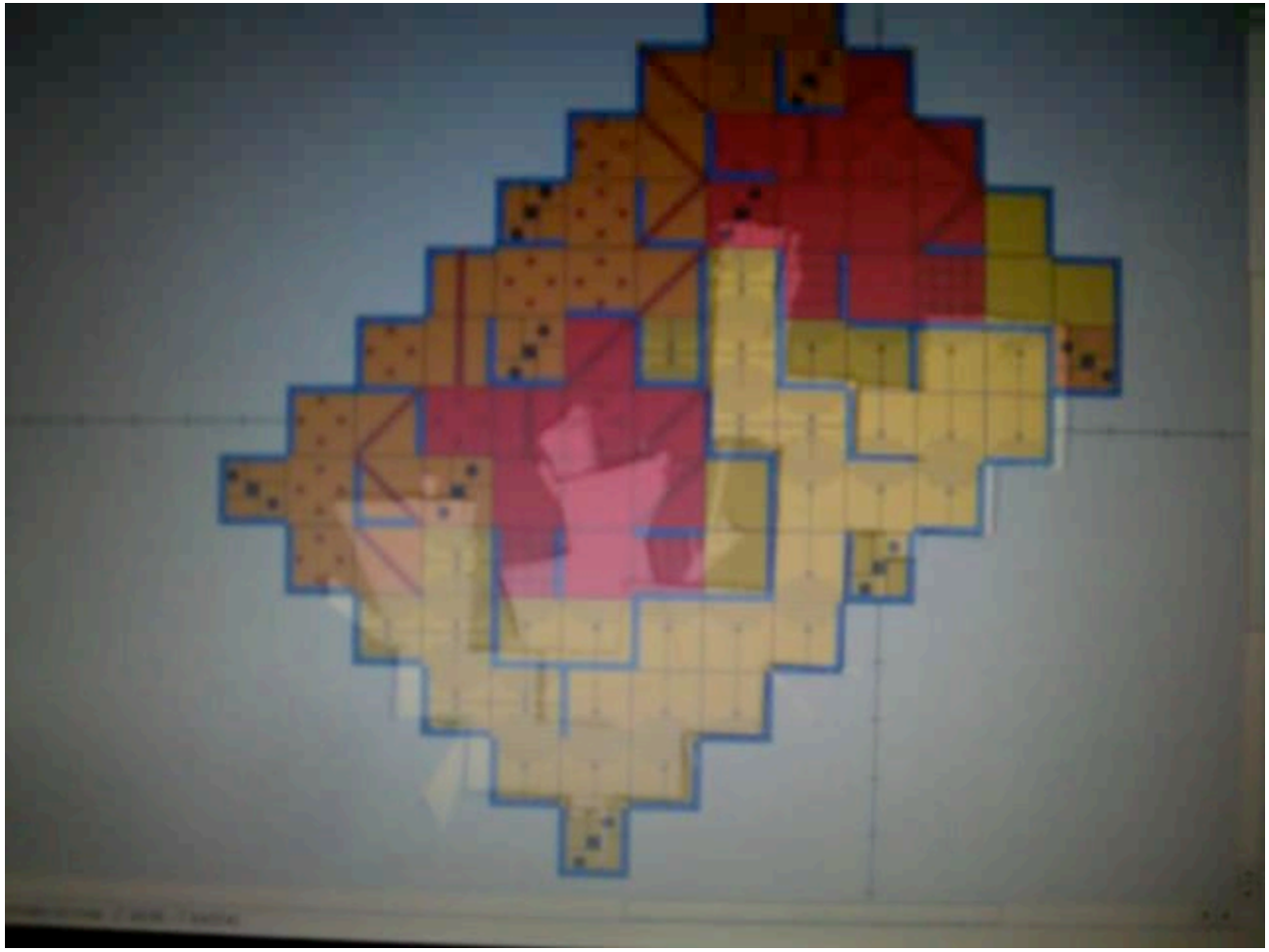
Jacobs Rescue Robot, Jacobs Univ Bremen, Germany

2nd Best-in-Class Autonomy/Mapping

GEOTIFF map format allowed direct comparison to ground truth arena layout!
This will be REQUIRED for all team maps in 2008.

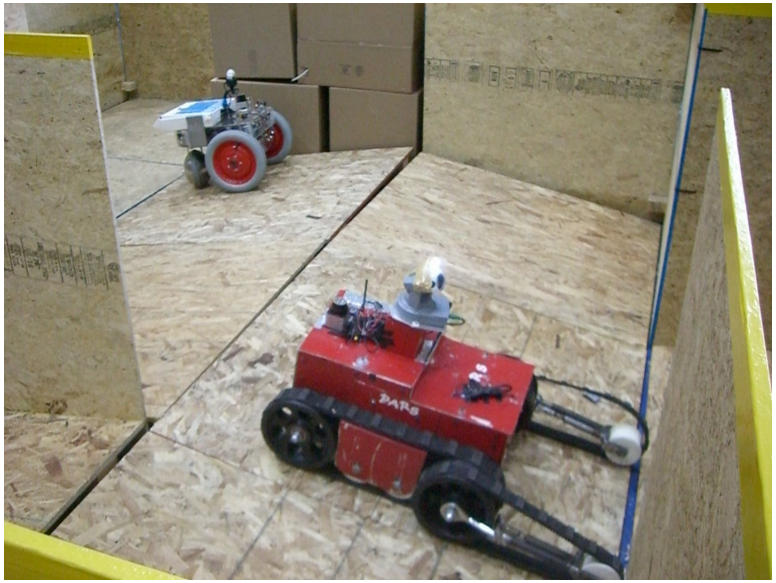


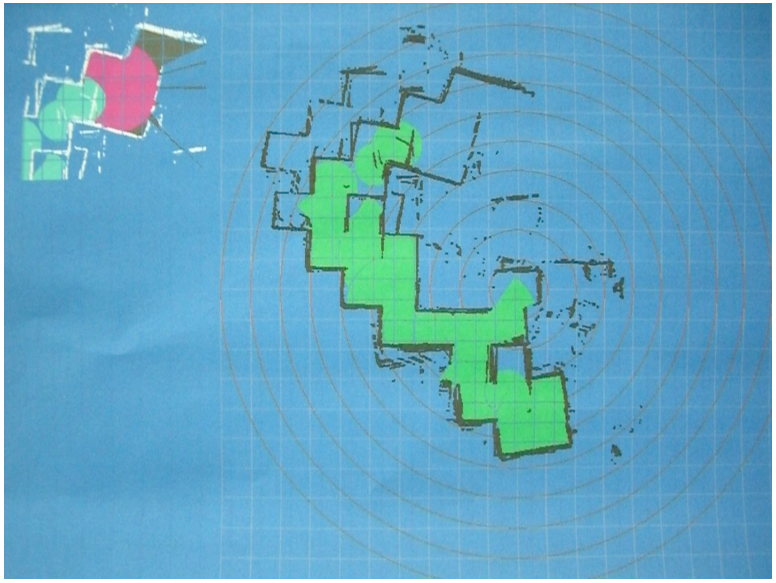


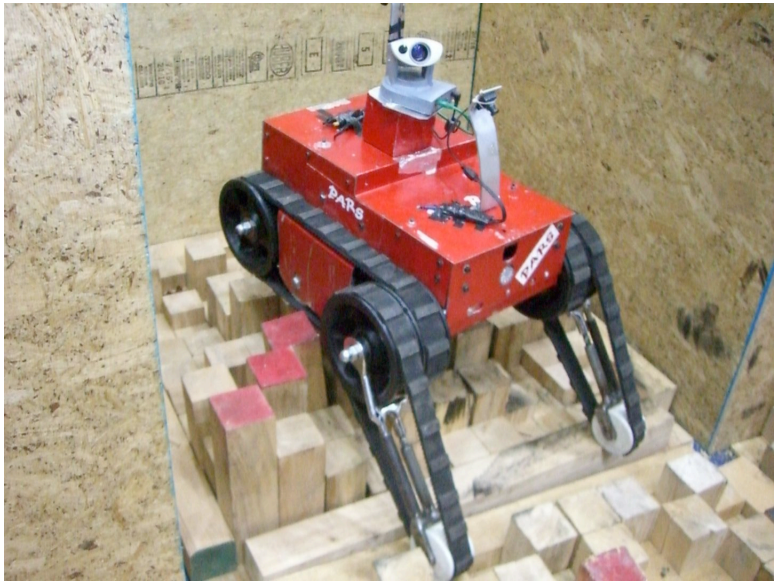


RFC Uppsala University, Sweden (shown with PARS, Iran)

3rd Best-in-Class Autonomy/Mapping



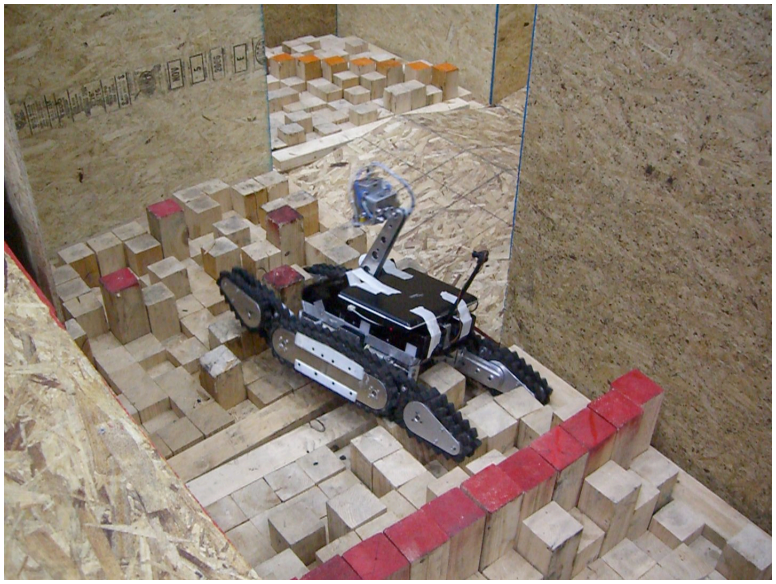


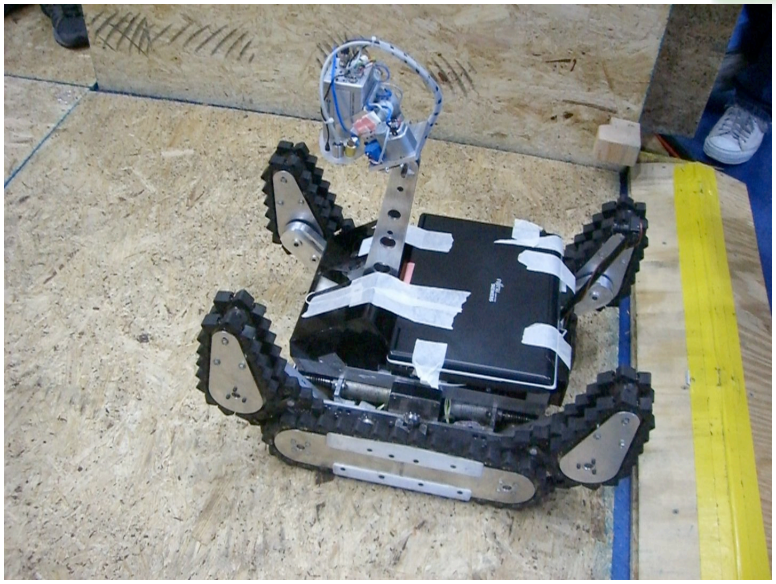


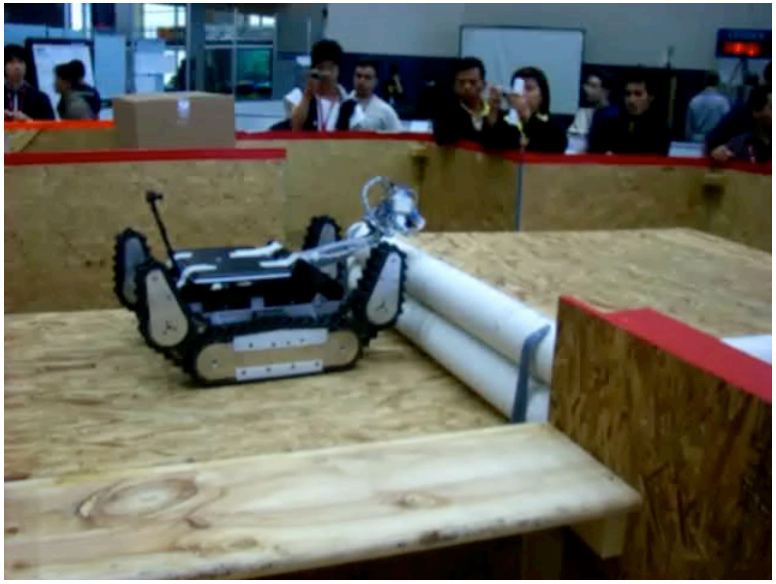
Resquake, K.N. Toosi Univ of Technology, Iran

Innovative Operator Interfaces

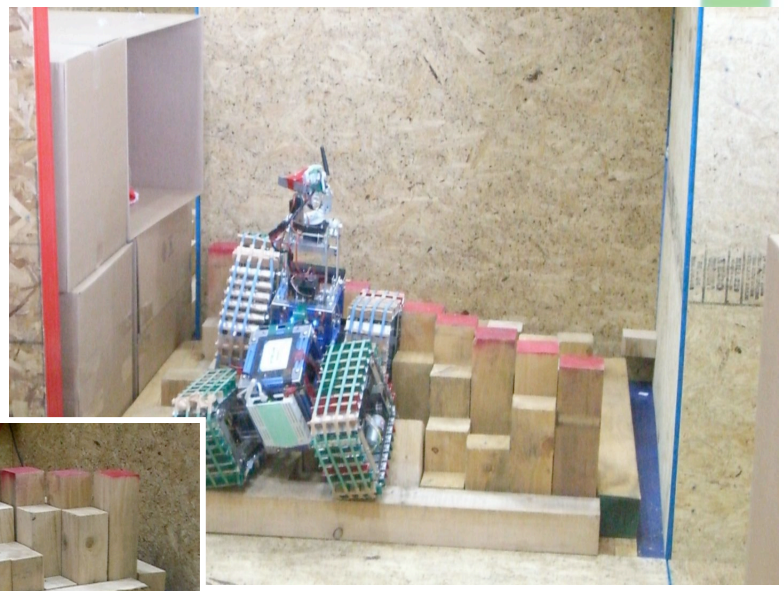
(steering wheel, camera mast joystick, voice commands for preset flipper positions)

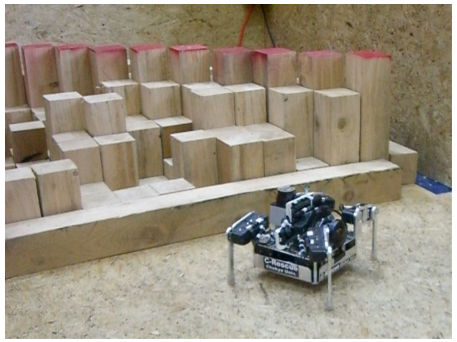


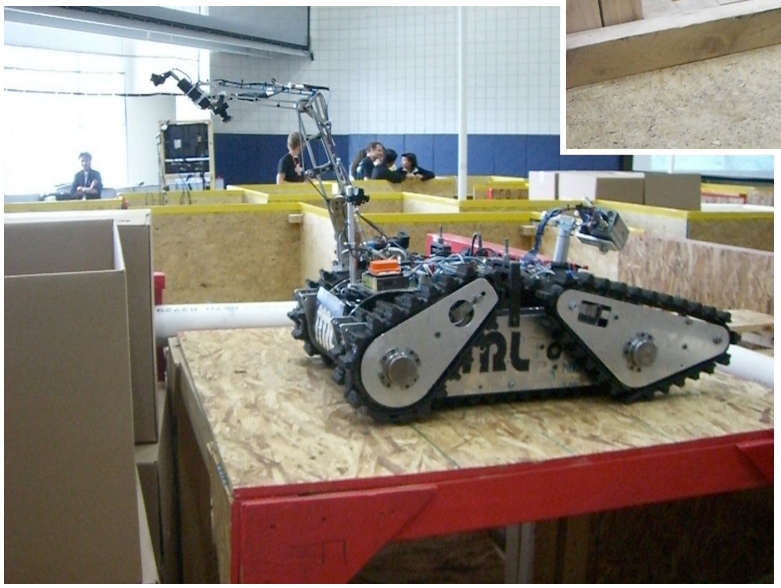




Ideal, NIIT Blue, MRL, Casualty, C-Rescue
Innovative Mobility, Sensors, and Interfaces

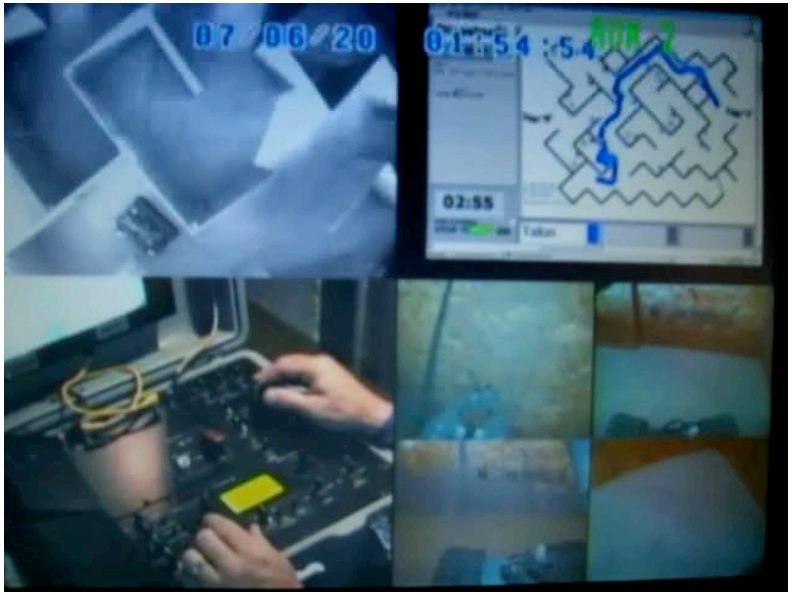






RoboCupRescue Robot League Accomplishments This Year

- Leverage of emerging standard test methods for response robots
- Non-flat flooring throughout the arenas challenging autonomy and mapping
- 2D GeoTiff maps with ground truth comparison (next year for scoring)
- Ultra wideband tracking of robot position within arena
- Quad-screen performance capture
  - Tracking position
  - Operator interface
  - Operator actions
  - Robot situation
- Capture and dissemination of sensor data sets
  - 3D range imagers
  - 3D rotating line scans
  - Thermal sensors
  - Stereo vision

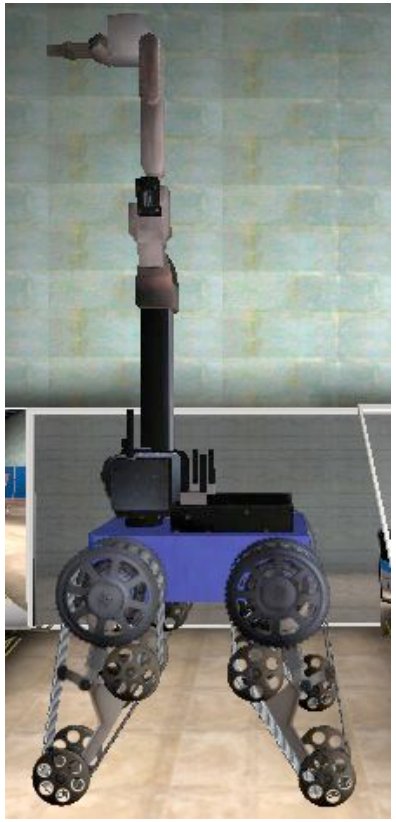
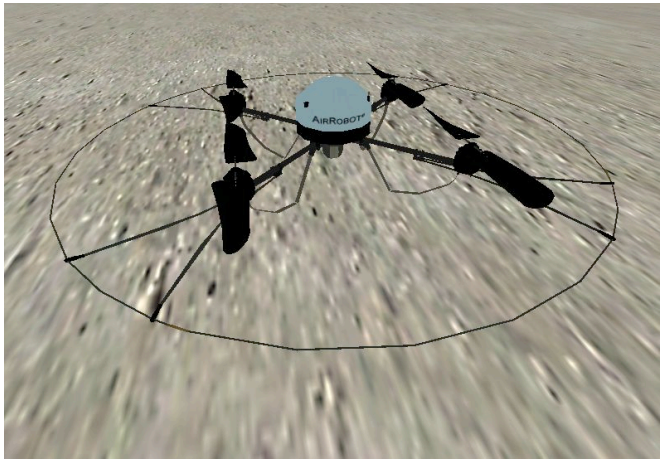
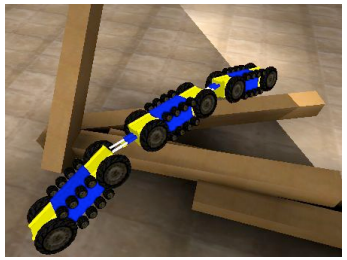
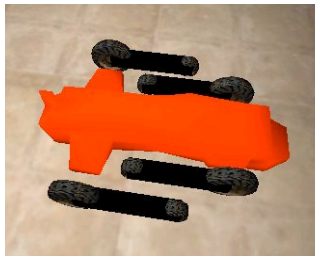


RoboCupRescue Robot League Roadmap

- Encourage autonomous behaviors on all robots (first victim in Orange and Red arenas)
- Manipulation tasks (last victim in each arena)
  - Door opening (push/pull, assorted knobs)
  - Placing items (radio, water)
  - Picking items (sample, ID badge)
- Continue integration with Virtual Robot Competition
  - GeoTiff mapping
  - Autonomous behaviors in complex environments
  - Robot design improvements
- Lighter weight operator stations (single operator deployment)
- A bracket of common robot platforms similar to legged league: Rhex, Volksbot, Kenaf, ???
- More regional opens supported by proliferation of practice arenas
- Disseminate best-in-class implementations at camp
- Centralize repository of data, algorithms, etc.
- Publish, publish, publish… especially best-in-class implementations

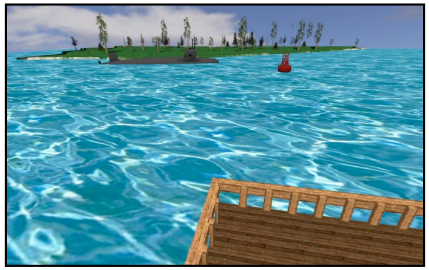
RoboCupRescue Virtual Robot Competition
Modeled Robots and Sensors

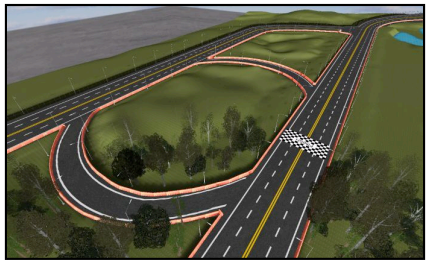
- Response robots
  - Talon
  - Telemax
  - AirRobot
- Research robots
  - Souryu
  - Tarantula
  - ATRV-Jr
- Sensors
  - Cameras (pan/tilt, illumination)
  - Lline scan laser
  - Flash lidar
  - Acoustic
  - Touch
  - Odometry
  - IMU
  - RFID
- Model your own…

RoboCupRescue Virtual Robot Competition
Modeled Environments

- Practice Environments
  - Emerging Standard Robot Test Methods (validated for friction)
  - Larger scenarios
  - Cooperative robot searches

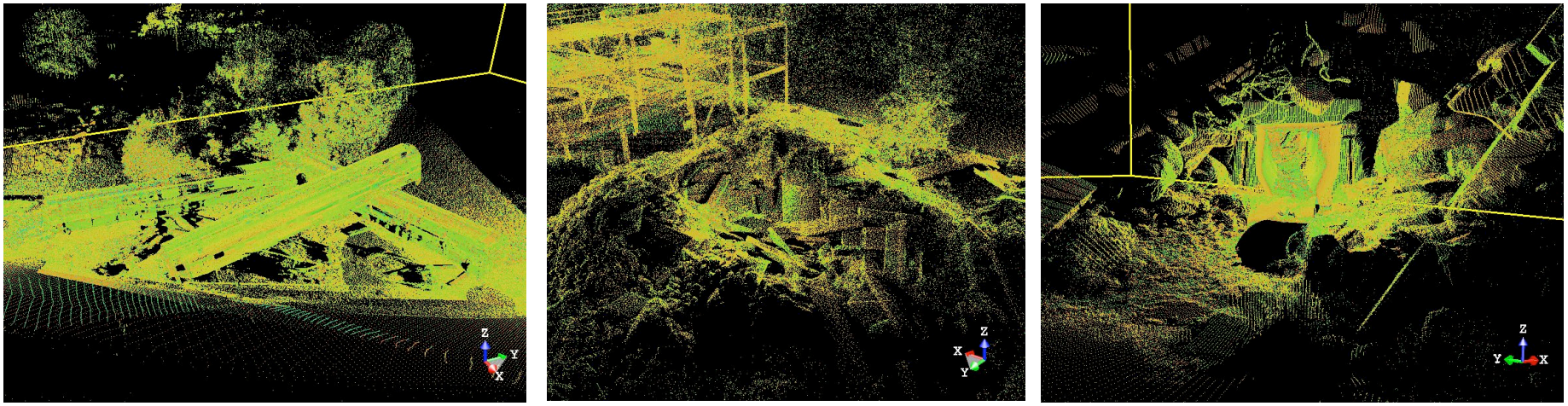




RoboCupRescue Virtual Robot Competition
Modeled Environments (future)

Working toward validation of laser scanned props from FEMA training sites

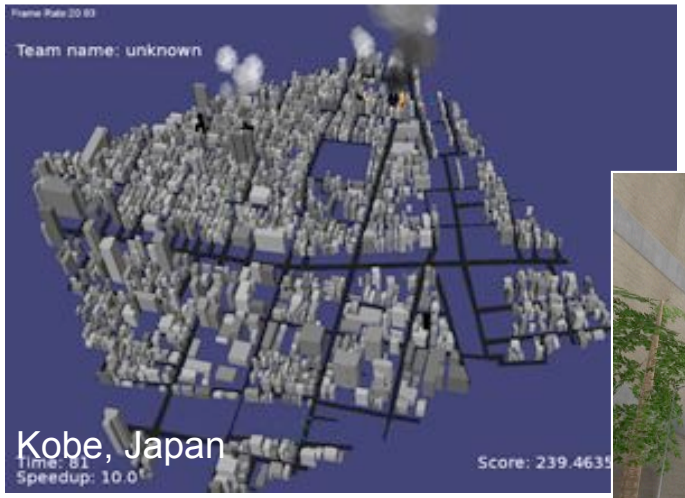
- Robot practice
- Responder practice
- Robot behavior development and assistive features



Three RoboCupRescue Competitions
Complimentary Development Initiatives

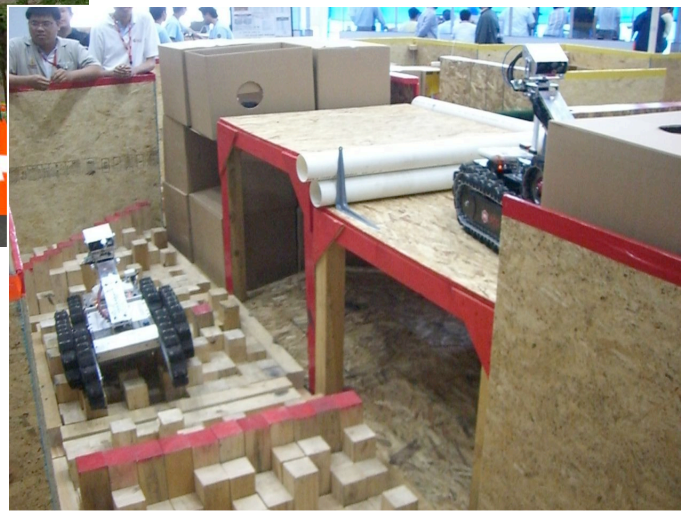
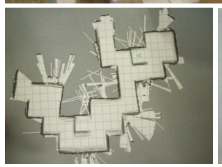
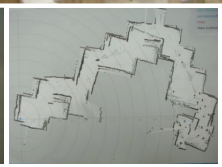
Simulation Competition

Citywide Logistics



Virtual Robot Competition

Multiple robots, larger scenarios

Real Robot Competition

Advanced mobility, mapping on terrains, assistive capabilities