DARPA Robotics Challenge:

Jim Pippine - Golden Knight Technologies
DRC - Chief of Operations
Overview

- *Will not discuss Autonomy*
- There will be no equations used in this talk
- We were not trying to determine the “best” robot
- I am not a DARPA Employee*
DARPA Robotics Challenge

• International competition to develop robot systems for disaster response

• Why a challenge?
  • Historical examples – Napoleon's Food Challenge - 1800's
  • DARPA
    • Grand Challenge 1 – 2004
    • Grand Challenge 2 – 2005
    • Urban Challenge - 2007
Focus: Human Compatibility

1. **Environments**, even degraded, has been engineered for humans

2. No shortage of human **tools**

3. No **training**: Human-like robot capabilities are easier for domain experts to use without requiring training.
# DRC Program Structure + Funding

<table>
<thead>
<tr>
<th>CY 2012</th>
<th>CY 2013</th>
<th>CY 2014-15</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PHASE 1</strong></td>
<td><strong>PHASE 2</strong></td>
<td></td>
</tr>
<tr>
<td><strong>TRACK A SYSTEM</strong></td>
<td><strong>6 Teams $1.2M each</strong></td>
<td><strong>10 Teams ≤$1.5M each</strong></td>
</tr>
<tr>
<td>7 Teams $1.8M each</td>
<td><strong>CRITICAL DESIGN REVIEW</strong></td>
<td>10 Teams ≤$1.5M each</td>
</tr>
<tr>
<td><strong>TRACK B SOFTWARE</strong></td>
<td><strong>VIRTUAL ROBOTICS CHALLENGE</strong></td>
<td></td>
</tr>
<tr>
<td>11 Teams ≤$375k each</td>
<td>6 Teams ≤$750k each + Atlas Robot</td>
<td></td>
</tr>
<tr>
<td><strong>TRACK C SOFTWARE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>115 Teams Self-funded</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TRACK D SYSTEM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Teams Self-funded from Industry, academia</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Months</td>
<td>6 Months</td>
<td>18 Months</td>
</tr>
<tr>
<td>October 2012 DRC Kickoff</td>
<td>June 2013 DRC Trials Homestead, FL</td>
<td>December 2013</td>
</tr>
</tbody>
</table>
The story of the DARPA Robotics Challenge (DRC) begins on March 12, 2011, the day after the Tohoku, Japan earthquake and tsunami struck the Fukushima-Daiichi nuclear power plant. On that day, a team of plant workers set out to enter the darkened reactor buildings and manually vent accumulated hydrogen to the atmosphere. Unfortunately, the vent team soon encountered the maximum level of radiation allowed for humans and had to turn back. In the days that followed, with the vents still closed, hydrogen built up in each of three reactor buildings, fueling explosions that extensively damaged the facility, contaminated the environment and drastically complicated stabilization and remediation of the site.

At Fukushima, having a robot with the ability to open valves to vent the reactor buildings might have made all the difference. But to open a valve, a robot first has to be able to get to it. The DRC tasks test some of the mobility, dexterity, manipulation and perception skills a robot needs to be effective in disaster response.
THE DARPA ROBOTICS CHALLENGE FINALS
AN INTERNATIONAL COMPETITION

United States
Team Tartan Rescue
Team DRC-Hubo
Team Grit
Team IHMC Robotics
Team MIT
Team RoboSimian
Team THOR
Team TRACLabs
Team Trooper
Team VALOR
Team ViGIR
Team WPI-CMU

South Korea
Team KAIST
Team ROBOTIS
Team SNU

Japan
Team Aero
Team AIST-NEDO
Team HRP2-Tokyo
Team NEDO-Hydra
Team NEDO-JSK

European Union
GERMANY
Team Hector
Team Nimbo Rescue

ITALY
Team WALK-MAN

Hong Kong
Team HKU
Wide array of Platforms
DRC Finals
# DRC FINALS TEAM STANDINGS

<table>
<thead>
<tr>
<th>TEAM</th>
<th>SCORE</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEAM KAIST</td>
<td>8</td>
<td>44:28</td>
</tr>
<tr>
<td>TEAM IHMC ROBOTICS</td>
<td>8</td>
<td>50:26</td>
</tr>
<tr>
<td>TARTAN RESCUE</td>
<td>8</td>
<td>55:15</td>
</tr>
<tr>
<td>TEAM NIMBRO RESCUE</td>
<td>7</td>
<td>34:00</td>
</tr>
<tr>
<td>TEAM ROBOSIMIAN</td>
<td>7</td>
<td>47:59</td>
</tr>
<tr>
<td>TEAM MIT</td>
<td>7</td>
<td>50:25</td>
</tr>
<tr>
<td>TEAM WPI-CMU</td>
<td>7</td>
<td>56:06</td>
</tr>
<tr>
<td>TEAM DRC-HUBO AT UNLV</td>
<td>6</td>
<td>57:41</td>
</tr>
<tr>
<td>TEAM TRAC LABS</td>
<td>5</td>
<td>49:00</td>
</tr>
<tr>
<td>TEAM AIST-NEDO</td>
<td>5</td>
<td>52:30</td>
</tr>
</tbody>
</table>

- TEAM NEDO-JSK
- TEAM SNU
- TEAM THOR
- TEAM HRP2-TOKYO
- TEAM ROBOTIS
- TEAM VIGIR
- TEAM WALK-MAN
- TEAM TROOPER
- TEAM HECTOR
- TEAM VALOR
- TEAM AERO
- TEAM GRIT
- TEAM HKU
Questions