**DARPA Robotics Challenge: Robotic Technology for Disaster Response**

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Mr. Jim Pippine is a technical consultant to the Defense Advanced Research Projects Agency (DARPA) and serves as Chief of Operations for the DARPA Robotics Challenge (DRC) program. Mr. Pippine has been involved with the program since its inception and was instrumental in the planning and execution of the DRC Trials in December 2013. He will present an overview of the DRC, including detailed results and lessons learned from the recent trials and initial plans for the 2015 DRC Finals.

The DARPA Robotics Challenge is a competition of robot systems and software teams vying to develop robots capable of assisting humans in responding to natural and man-made disasters. The program was designed to be extremely difficult in order to spur rapid innovation. Participating teams must collaborate and innovate on a very short timeline to develop the hardware, software, sensors, and human-machine control interfaces that will enable their robots to complete a series of challenge tasks selected by DARPA for their relevance to disaster response. Three sequential DRC events place equal emphasis on hardware and software:

- Virtual Robotics Challenge occurred online in June 2013 and tested software teams' ability to effectively guide a simulated robot through three sample tasks in a virtual environment
- DRC Trials occurred in December 2013 at the Homestead-Miami Speedway, where teams were tested to operate their robots through eight individual, physical tasks
- DRC Finals in 2015 will require robots to attempt a circuit of consecutive physical tasks. The winning team will receive a $2 million prize.

The primary technical goal of the DRC is to develop ground robots capable of executing complex tasks in dangerous, degraded, human-engineered environments. Competitors in the DRC are expected to focus on robots that can use standard tools and equipment commonly available in human environments ranging from hand tools to vehicles, with an emphasis on adaptability to tools with diverse specifications.

To achieve its goal, the DRC aims to advance the current state-of-the-art in the enabling technologies of supervised autonomy in perception and decision-making, mounted and dismounted mobility, dexterity, strength, and platform endurance. Success with supervised autonomy, in particular, could allow control of robots by non-expert operators, lower the operator's workload, and allow effective operation even with low-fidelity (low bandwidth, high latency, intermittent) communications.

The DRC consists of both robotics hardware and software development tasks and is structured to increase the diversity of innovative solutions by encouraging participation from around the world, including universities, small, medium and large businesses, and even individuals and groups with ideas on how to advance the field of robotics.

A secondary goal of the DRC is to make software and hardware development for ground-robot systems more accessible to interested contributors, thereby lowering the cost of acquisition while increasing capabilities. DARPA seeks to accomplish this by creating and providing government-furnished equipment

(GFE) to some DRC participants in the form of the Atlas robot. Availability of this platform will allow teams without hardware or hardware expertise to participate. Additionally, all teams will have access to a simulator created by DARPA and populated with models of robots, robot components and field environments. The simulator will be an open-source, real-time, operator-interactive virtual test bed, and the accuracy of the models used in it will be rigorously validated on a physical test bed. DARPA hopes the creation of a widely available, validated, affordable, and community supported and enhanced virtual test environment will play a catalytic role in the development of robotics technology.

On December 20-21, 2013, sixteen teams from the United States, China, Japan, and Korea participated in the DRC Trials at Florida's Homestead-Miami Speedway. The event tested several of the most advanced robots in the world, where they demonstrated their prototype robots' ability to perform a number of critical real-world disaster-response skills. DARPA constructed eight tasks to simulate what a robot might have to do to safely enter and effectively work inside a disaster zone, while its operator would remain out of harm's way. Many of the robots outperformed expectations and the top eight teams were identified for future funding to prepare for the DRC Finals.

DARPA and the teams are now looking ahead to the DRC Finals in 2015 which will build on the eight tasks from the Trials but must be attempted consecutively. The Finals will be an opportunity for the top eight teams as well as any other interested teams to vie for the chance to win the DRC Final's $2 million prize.