

Miles Still to Go

DARPA and the Great Robot Race

Flying robots, like the Predator and Global Hawk, have been widely hailed for their role in recent U.S. military operations. Less noted, but increasingly important, has been the role of ground-based robots in the American war effort. On the battlefields of Iraq and Afghanistan, semi-autonomous robots, which rely on soldiers to control them remotely, have been used for reconnaissance and bomb-disposal missions. The Department of Defense believes that such robots are crucial to the future of the American military, and there are plans afoot to make at least one-third of all military vehicles—from small scout-bots to large supply trucks—fully autonomous by 2015.

Leading the way has been the Defense Advanced Research Projects Agency (DARPA), the Pentagon's technology research arm. In early 2003, DARPA challenged America's engineers to design a vehicle capable of traveling at high speeds across rugged terrain without human control. The agency promised a million-dollar prize to the winner of its "Grand Challenge," a long-distance race between unmanned, autonomous ground vehicles.

This was no small order. The robotic vehicles needed to be equipped with the ability to sense their environment, to discern the features of the terrain, and to respond accordingly. They needed to

maintain their speed and direction without flipping over or succumbing to hazards en route. And they had to move quickly: The race was limited to ten hours, and the course was expected to be nearly two hundred miles long.

DARPA received 106 entries from across the country. Out of that pool, only a couple of dozen teams passed the preliminary rounds and were selected for the race. Entries came from professional engineering firms, university and high school teams, and amateur engineers. A team from the University of Louisiana submitted the "Cajunbot," a six-wheeled rover, seemingly better fitted for the bayou than the desert. Oshkosh Truck Corporation, in cooperation with engineers at Ohio State University, fielded the race's heavyweight: "TerraMax," a huge, rugged, 16-ton yellow truck. One team used a modified Acura SUV, another used a Chevy Tahoe, and another used a Jeep Grand Cherokee.

The entry expected to perform best was "Sandstorm," a souped-up Humvee designed by Carnegie Mellon University's Robotics Institute. Led by William "Red" Whittaker, a Carnegie Mellon professor and renowned roboticist, the team received advice and technology from such companies as Boeing, Intel, and Caterpillar. They crammed computing power into their vehicle, and equipped it with a variety of sen-

sors—GPS, radar, vision, laser—so Sandstorm would stay on course.

On March 13, 2004, the fifteen remaining competitors assembled in the town of Barstow, California. Three hours before the start of the race, the participants were given the route for the first time—a set of 2,000 coordinates marking a 142-mile path across the Mojave desert into Nevada. According to a DARPA press release, the course “included well-traveled utility roads, switchbacks, severe elevation changes, blind turns, and sheer drops.”

Unsurprisingly, none of the robots finished the race. Six of the fifteen finalists went nowhere at all. Five others moved forward but failed to make it to the two-

mile mark. Of the remaining participants, one stopped at 5.2 miles after failing to make it up a hill; one stopped at 6.0 miles after getting hung up on a rock; and one got stuck in an embankment at 6.7 miles. The Carnegie Mellon entry did best, making it to 7.4 miles before its wheels caught on fire and it had to be disabled.

Since no team completed the race, no one claimed the purse. But of course the purpose of the challenge wasn't to give away money—it was to speed the development of autonomous vehicles useful to the military. To that end, DARPA plans to keep the Grand Challenge going: a second round, with a \$2 million prize, is expected to be staged in 2006.