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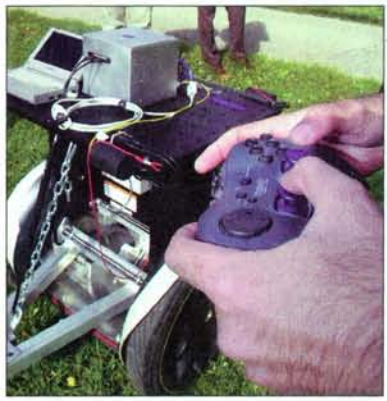


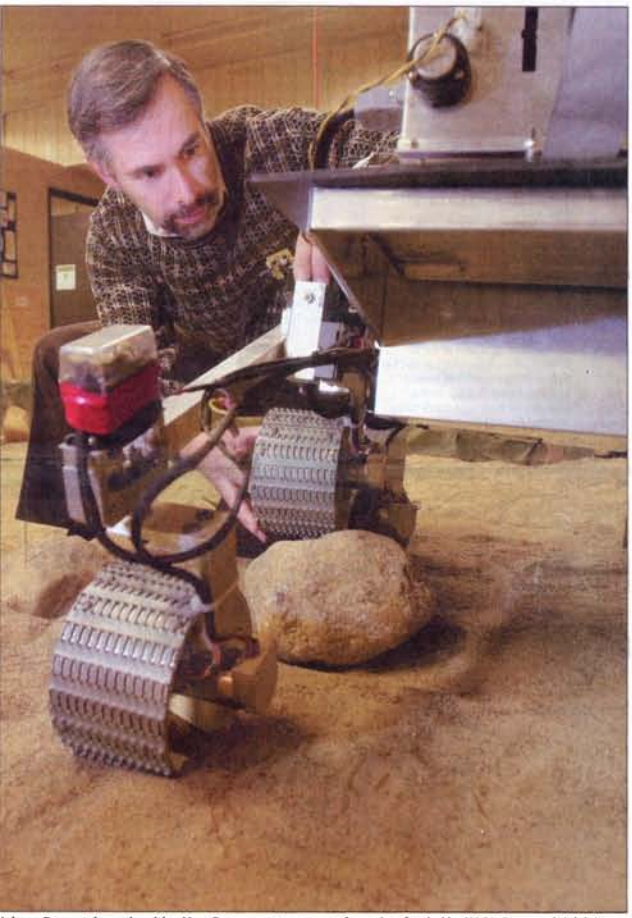
PHOTOS: ROBERT CHASE, THE ANN ARBOR NEWS

Researchers at the University of Michigan Advanced Technology Laboratory are trying to adapt a Segway to operate with its own electronic brain.

I think, therefore I am a humanoid

U-M researchers try to teach robots simple human tricks

BY ANNE RUETER
News Staff Reporter



Johann Borenstein works with a Mars Rover prototype, part of a project funded by NASA. Borenstein's lab is one of a several working on different position-estimating components for NASA's planned Mars mission in 2009.

Like athletes in training, a Mars rover prototype and a stripped-down Segway go through their paces regularly in Johann Borenstein's lab at the University of Michigan engineering college. To be real players in the slowly evolving world of useful robots, they've got to overcome being clumsy and dumb.

Robots have to get to first base before we can really rely on them for lots of routine jobs. But Borenstein, a robotics scientist, thinks that the day is not far off when mobile robots will be able to make predetermined rounds, guarding warehouses and even issuing parking tickets.

"I could imagine that 10 years from now, robotic Segways could deliver the mail," he says. To get there, robots first have to be able to 1.) avoid running into things, and 2.) know where they are. Intelligent robots can beat human chess masters, but engineers still struggle to give them these two simple skills a 2-year-old has largely mastered, says Borenstein, a senior research scientist at the University of Michigan Advanced Technology Laboratory.

"Nature has put millions of years into these skills, so that's why they're harder to replicate," he says.

Borenstein and his staff put in a lot of time these days working on the know-where-you-are part. They place their "position estimation" hardware and software aboard the Segway, given to the lab as part of research funded by the Defense Advanced Research Projects Agency, and test the Segway's smarts in knowing precisely where it is in different settings inside and outside the Advanced Technology Lab building. The idea is to adapt the Segway, developed as a smart vehicle for humans, to operate with its own electronic brain.

In what looks like a huge kid's sandbox in the middle of Borenstein's lab sits a prototype of a Mars Rover, part of another current project funded by NASA. The rover, built by students and volunteers, makes frequent runs around an obstacle course of boulders and sand.

This project, too, tests the accuracy of the U-M scientists' position estimation system. The rover runs its course three times, then reports where it thinks it is. It doesn't score perfectly yet, but the team is pleased with recent results. "The error is less than 1 percent of the distance traveled," Borenstein says.

Space, military applications and more

NASA needs such a position estimation system for situations where global positioning systems won't work – there are no GPS satellites circling Mars. Borenstein's lab is one of a number of labs working on different position-estimating components for NASA's planned Mars mission in 2009. After two years, he'll wrap up the work by February. NASA will decide later which approach it will proceed with.

On Earth, the military wants to be able to pinpoint locations in places soldiers might be, like inside buildings or in dense woods, in which GPS won't work.

Segway makes a good base

A robot could conceivably map a mine field, so soldiers could use the map to traverse a mine field safely.

Defense Advanced Research Projects Agency, the research and development arm for the U.S. Department of Defense, has given 15 Segway platforms to robotics research teams around the country. Borenstein says the agency has given few directives about how to use them. "If scientists are not told what to do, and people find it sexy enough, then things will come out of it," he says.

He's focusing on equipping the Segway so it will avoid obstacles and accurately sense its location as it patrols simulated routes. Borenstein says the Segway has a couple of basic advantages for robotics engineers: It has a stable base and can accommodate sensors up high where they can see well. It's also mass produced, so applications could happen more swiftly. It's got limitations too: It falls over easily when it leaves the smooth surfaces it's designed to navigate.

Jessy Grizzle, a U-M professor of electrical engineering and computer science, does research on bipedal robots that could someday be useful in emergency zones where human workers would be at risk. He agrees that the Segway has potential as a useful platform, though he has reservations about a robot on two wheels falling over if its power supply runs low.

He says safety and responsibility issues play roles in whether a product will be put out in the community.

"It's not just up to an engineer to determine," he says. Even if a mail carrier robot becomes feasible, "it may not be out on your sidewalk anytime soon."

Borenstein has no trouble imagining many ways the NASA and military-funded research can lead to civilian applications. For instance, the Department of Energy oversees inspections to check for leaking drums of nuclear waste in storage facilities around the country. It could find robot Segways cheaper and safer than the current expensive patrols by humans with sensors, says Borenstein. A visitor to Borenstein's lab can't help thinking it's a bit like a precocious 11-year-old's dream workshop. Borenstein's voice picks up as he shows a visitor a red and black plastic conglomeration of treads from a Fischertechnik toy construction set. In four hours, he says proudly, he came up with this prototype of a device he hopes to develop for urban rescue efforts. "It would have hypermobility to go through rubble," he says.

He has two patents pending on the device, which he calls Omni Tread. He started playing around with the Fischertechnik tread parts after an earlier centipede-like device, also intended to crawl through rough terrain, didn't work out.

Borenstein likes moving around, whether he's teaching aerobics six times a week or riding off-road motorcycles with his wife. So he jumped at the chance to ride a Segway in California not long ago. He likes the fact that "the body is part of the dynamics of the system."

"It's oodles of fun to ride one," he says. "I would long to have one. I wouldn't want to pay for one." Segways sell for around $5,000.

Borenstein hopes they're a commercial success. A mass-produced robot platform has turned out to be elusive. Many companies formed to produce robots have gone under. The Segway could prove critical if robots are to move out of labs and onto sidewalks and streets.

If robots can navigate a cityscape, they could be useful in homeland security work. "I could imagine the streets of New York being patrolled by bioagent-sniffing Segways," Borenstein says.

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