ROBOTICS

Dante Goes Into the Volcano

Like a giant spider, an eight-legged, 10-foot-tall robot named Dante II crept more than 600 feet down into the inferno at the core of a smoldering Alaskan volcano—sometimes picking its own route and proving that big robots can boldly go where no humans have gone before. The descent into Mount Spurr, the robot's second try at a volcano crater and its first success, sets the stage for robotic explorers to traverse the terrain of distant planets.

As the robot inched down the steep, icy slopes of the volcano, trudged over deep snow and thick mud, and maneuvered around boulders the size of Volkswagens, its progress was visible to scientists in a control room in a trailer 80 miles away in Anchorage, who were delighted. "I'm on top of the world," said William L. "Red" Whittaker, head of the team that built the robot at the Robotics Institute at Carnegie Mellon University (CMU) in Pittsburgh. "We're in some fairly exotic terrain, but it's going better than I expected." The performance could be a forerunner of a future robot's mission to Mars or the moon, which might include components first tested on Dante.

The mission was also of intense interest to volcanologists, who hope to use information about the gases at the bottom of the crater to understand the volcano and, eventually, predict its activity. By the time Dante had reached a misty fumerole field on the crater floor on Monday, it was clear that the robot had proven its worth from a robotics perspective. In addition to unprecedented success at semi-autonomous navigation, the communications/telemetry system was working exceptionally well, making it possible for scientists as far away as Anchorage and the National Aeronautics and Space Administration (NASA) Ames Research Center in Mountain View, California, to operate the robot in real time. Dave Lavery, manager of the telerobotics program at NASA, chief sponsor of the $1.8-million Alaskan mission, called what Dante has achieved already a "significant leap forward in robotics technology....It's demonstrated the capability for a robot to explore planets with remote human control."

Dante's descent into Mount Spurr is a vast improvement over its performance on New Year's Day, 1993, when an earlier version of the robot tried to clamber down into the crater of Mount Erebus in Antarctica. The mission was called off after the robot had descended only 28 feet because a fiber-optic communications cable had broken.

After Erebus, the team of Carnegie Mellon scientists and students built "a whole new machine," says John Bares, Dante's project manager. Among other things, they strengthened the communications cable and winch, and designed the cable to lead to a satellite dish at the crater's rim, where the communications data were beamed by satellite to a control room (previously the cable tied the robot directly to the control room a few kilometers away). Then they tackled Mount Spurr.

BILL INGALLS/NASA

Mission to the Inferno. The robot Dante prepares for its descent into an active volcano.

After 39 years of quiet, the volcano had erupted three times in 1992—making it impossible for volcanologists to explore the crater. Dante II's eight video cameras and one digital high-resolution still-frame camera, however, make impressive remote sensors. The robot also took the temperature of the air and tested for two gases—hydrogen sulfide and sulfur dioxide—that have been indicators of volcanic activity. Neither gas was found.

While volcanologists were waiting for those measurements, scientists around the world were watching Dante II's progress in images broadcast over the Internet. The most dramatic, however, were not posted on the Internet: pictures of falling boulders as big as the robot, including one that slipped under its communications cable on Sunday.

What most impressed one observer—Rodney Brooks, associate director of the artificial intelligence lab at the Massachusetts Institute of Technology—was that Dante was operating autonomously (at least part of the time), selecting its own course as it created three-dimensional models of the surrounding terrain. Says Brooks: "I think they're doing a great job. Here's a vehicle that's able to navigate terrain that is pretty rough—and able to do large parts of that autonomously. That's going to be important for Mars." But for Dante's scientists, the success in Alaska was already out of this world.

–Ann Gibbons

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U.S. SCIENCE POLICY

White House Lauds Basic Research

For 18 months the academic research community has fretted that the Clinton Administration doesn't care about its issues. This week the Administration sought to soothe those bruised feelings, issuing a 31-page policy paper that glows with warmth toward basic research.

On 3 August, Vice President Al Gore unveiled "Science in the National Interest," a document that makes the case for the value of fundamental science and suggests that a $25-billion-a-year increase in the nation's investment in basic research (now hovering at $160 billion) may be needed to maintain the country's status as an international industrial power. Gore also urged scientists to "step up" to the challenge of increasing the country's level of technical literacy. Scientific leaders welcomed the Administration's therapeutic rhetoric, but many said they're still waiting for evidence—next year's proposed budget, for example—that the words will be backed by deeds.

Calling science the "fuel" that powers the economy's technological engine, the policy paper says the nation should boost spending on research by both the public and private sector to 3% of the country's gross domestic product, from a current level of 2.6%—an increase reflecting science's "growing importance to society." It also calls on Congress to provide sufficient funds for new buildings, state-of-the-art instruments, and human resources to help researchers in the lab and to develop a scientifically literate public. It pledges to keep the country strong in all major scientific fields, saying this is the best way

Five Goals for Science

In its new white paper on research, the Clinton Administration has set the following goals for its "stewardship of science":

- **Maintaining leadership across the frontiers of scientific knowledge;**
- **Enhancing connections between fundamental research and national goals;**
- **Stimulating partnerships that promote investments in fundamental science and engineering and effective use of physical, human, and financial resources;**
- **Producing the finest scientists and engineers for the 21st century; and**
- **Raising the level of scientific and technological literacy of all Americans.**