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CalTech: Intelligent space robots will explore universe by 2020

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July 24, 2008 (Computerworld) Before the year 2020, scientists are expected to launch intelligent space robots that will venture out to explore the universe for us.

Researchers are working on creating autonomous spacecrafts that will be able to analyze data about points of interest as it passes and then make quick decisions about what needs to be investigated, according to Wolfgang Fink, a physicist and senior researcher at the California Institute of Technology.

"Robotic exploration probably will always be the trailblazer for human exploration of far space," said Fink. "We haven't yet landed a human being on Mars, but we have a robot there now. In that sense, it's much easier to send a robotic explorer. When you can take the human out of the loop, that is becoming very exciting."

NASA and the Jet Propulsion Laboratory are using a robotic arm onboard the Mars Lander that's been working on the Martian north pole for more than a month and a half now. Programmers send up daily instruction code to the arm, telling it to dig trenches in the soil or scoop up ice scrapings and deposit them in one of the analysis tools onboard.

Fink said that's a great start, but he's looking forward to the day when the robots can make at least some of the decisions for themselves.

"The arms are the tools, but it's about the intent to move the arms," he added. "That's what we're after. To [have the robot] know that something there is interesting and that's where it needs to go and then to go get a sample from it. That's what we've after. You want to get rid of the joystick, in other words. You want the system to take control of itself and then basically use its own tools to explore."

The physicist said he envisions a time when humans send out intelligent probes to explore the far reaches of the universe and send information back to Earth -- without having to send people on excruciatingly long and dangerous space missions.

"In the old *Star Wars* movies, especially in *The Empire Strikes Back*, the empire was sending out probes or floating robots," said Fink. "Those were ideal robotic explorers because they floated over planets and had sensors and communication capabilities. Once you venture out to other planets, you need something that

can operate on its own. You can't monitor and supervise every single step. You want to deploy something that, on its own, can start a reconnaissance of the area and report back."

What will make the spacecraft or space robot intelligent is its ability to recognize something of interest -- say, a crater on a planet or an asteroid -- and then decide to go investigate. And giving a machine that complex ability will be no easy task, but CalTech scientists already have begun working on it.

According to Fink, CalTech is working with scientists at the University of Arizona to develop software packages that use camera images to enable machines to distinguish colors, shapes, textures and obstacles. With the ability to pick out these features, the software can begin to calculate what is anomalous -- much like the children's game of "which one of these things does not belong?"

Researchers have hooked the software up to a rover and soon will be linking it to the rover's navigation functions.

The researchers are also working on a wish list of sorts for the spacecraft. The list would include things that NASA and university scientists would like the robot to investigate. "It's very difficult to teach a spacecraft," said Fink. "When a geologist goes into the field, they can tell you if they see something that sparks their interest. Based on that interest, it triggers more refined research. But the problem is if you encounter something that scientists had not foreseen, then you run the risk of not detecting it. We'll equip it with a database and a wish list, along with the ability to flag an anomaly."

Fink said NASA has shown some interest in their work. And that makes sense since NASA is planning an unmanned mission to Titan, Saturn's largest moon, around 2017. The CalTech physicist explained that an orbiter would most likely release a balloon-type vehicle that would float above the surface of the moon and send its findings back to Earth.

"It takes more than hour to send communications back and forth to a space probe at Saturn or Titan," said Fink. "It is not a problem so much if you are dealing with a Lander, which is immobile, or when you're dealing with a rover which is not moving too fast. It becomes a significant problem if you deploy a balloon or air ship on Titan, let's say. They are floating so you need a much quicker reaction time. If there's a mountain or hill coming up, you need to make a decision right there and then to avoid it."