

By Vijaysree Venkatraman

# The space roboticist

**T**he first motorized vehicle that Vandi Verma ever operated was a tractor. “I must’ve been 11 years old at the time,” she told *Science*. During school vacations, she visited her grandparents, who lived in a village in central India. At their farm, her uncle let her take a few turns behind the tractor wheel. Later, when she was a teenager, her father, who was a pilot with the Indian Air Force, taught her how to drive a car. That was unusual in India at that time, where those who could afford a car hired a driver.

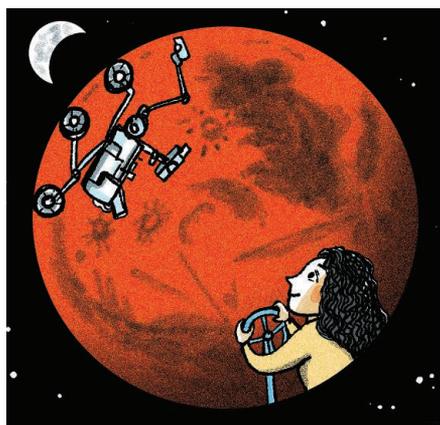
Today, Verma is one of the few people in the world who is qualified to drive a vehicle on Mars.

Verma majored in electrical engineering in India and came to the United States to study artificial intelligence. She was captivated by the landing of the Sojourner Mars rover in 1997 and decided to apply her engineering skill to space exploration. She pursued a Ph.D. in robotics at Carnegie Mellon University and did internships with NASA’s Ames Research Center. She also got her first taste of robotic exploration here on Earth by field testing a rover that surveyed South America’s Atacama Desert for signs of life.

After graduating, in 2005, Verma joined the intelligent systems division at Ames Research Center as a research scientist. Later, she moved to NASA’s Jet Propulsion Lab (JPL), the command center for the Mars rover missions. There, her robotics expertise and experience with field testing rovers won her a chance to drive the Opportunity rover. Verma drove Opportunity for 3 years before graduating to the nuclear-powered Curiosity rover, which is now prowling Mars, examining its rocks to see whether it is, or was ever, a suitable habitat for life.

Each day, before the rover shuts down for the frigid martian night, it calls home, Verma says. Besides relaying scientific data and images it gathered during the day, it sends its precise coordinates. They are downloaded into simulation software Verma helped write. The software helps drivers plan the rover’s route for the next day, simulating tricky maneuvers. Operators may even perform a dry run with a duplicate rover on a sandy replica of the planet’s surface in JPL’s Mars Yard. Then the full day’s itinerary is beamed to the rover so that it can set off purposefully each dawn.

For the first 3 months after landing, from 5 August to 5 November 2012, the team was working on Mars time. “I loved that we didn’t have to wait long after we uplinked our



*“I am happy to be ... pushing the envelope on space exploration.”*

behind. One of Verma’s key research goals has been to give rovers greater autonomy to decide on a course of action. She is now working on a software upgrade that will let Curiosity be true to its name. It will allow the rover to autonomously select interesting rocks, stopping in the middle of a long drive to take high-resolution images or analyze a rock with its laser, without any prompting from Earth.

Originally designed for a 2-year mission, Curiosity is still going strong and has already made many scientifically significant finds. “With every drive, we get to explore new terrain that no human has seen in this kind of detail,” Verma says.

Although human spacefaring has stalled, Verma says the spirit of exploration is alive and well in space robots. “I am happy to be working in robotics, pushing the envelope on space exploration,” she says. “We have reached Mars, our neighboring planet. We have only just begun.” ■

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commands to see the results from Curiosity, and every sol (a martian day), we were doing something we’d never done before,” Verma says.

Curiosity can scoop dirt, drill rock, and hand off samples to the onboard lab. While a sample is being analyzed, Curiosity is already on its way to the next site. Verma helped write the code that lets Curiosity juggle these tasks. “We have to drive on to find newer things for the slew of instruments to analyze without compromising the rover hardware or the sample,” she says.

She loves her day-to-day responsibility for the machine. “You definitely don’t want to be the one who drove the rover off a cliff! But I find it energizing rather than stressful. You’re completely focused.”

But she has not left research behind.

# Science

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