

NovAtel and the Mars Rovers

NovAtel antenna and GPS + INS technologies aid the Mars Rover missions here on earth

Rover History

Ames Research Center at Moffett Field, California plays a critical role in virtually all NASA missions in support of America's space and aeronautics programs. In 2002/2003 the initial prototyping for the first Mars rover was completed at Ames with NovAtel®'s DL-4 GPS receiver.

The DL-4, subsequently replaced by the DL-V3, comes with a removable Compact Flash (CF) card which provides combined storage for up to 2GB of logged data and the added convenience of data portability. The DL-V3 provides Bluetooth, for wireless connectivity, and Ethernet, for remote network-based receiver access, interfaces.

The Jet Propulsion Laboratory (JPL) in Pasadena, California also leads much of the Mars project work and utilizes NovAtel equipment.

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Rover Testing

The rugged terrain that NASA Ames uses for testing at Devon Island, Nunavut, Canada, mimics the alien terrain on Mars, see *Figure 2* on the right and *Figure 4* on *Page 2*. In 2007, two prototype Mars rovers, K-10 Black and K-10 Red, used NovAtel's 700-series antennas to explore the island's surface. K-10 Black, see *Figure 1*, detects different layers below the surface with ground penetrating radar or radio waves in a grid-like survey.

K-10 Red, see *Figure 4* on *Page 2*, creates

3-dimensional (3-D) maps of the terrain over ground with Laser Radar (LADAR) and works autonomously. During this two-week field test, the K-10 rovers drove more than 30 kilometers and collected more than 25 gigabytes of survey data.



Figure 1: K-10 Black rover uses its ground-penetrating radar in a polar desert Photo Credit: NASA Ames Research Center



Figure 2: Darlene Lim (NASA Ames Research Center) samples water from a lake on Devon Island Photo Credit: NASA Ames Research Center

Future Testing

Johns Hopkins University (JHU), from their facility in Virginia, is involved in the design, manufacture and control of the Mars mission, see *Figure 5* on *Page 2*. Their next project uses a NovAtel SPAN™ (GNSS + INS) system for the landing craft.

NovAtel's SPAN system is an Inertial Navigation System (INS) that provides continuous operation through short outages, or when less than four satellites are available, with accurate position and attitude measurements. *Figure 3* below shows SPAN components.

Tight coupling of inertial data, from an Inertial Measurement Unit (IMU) with GPS, also delivers faster satellite reacquisitions and faster RTK initializations after outages.



Figure 3: Possible components of NovAtel's (GNSS + INS) SPAN System
Photo Credit: NovAtel Inc.

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Figure 4: K-10 Red rover uses its 3-D scanning systems during field tests in the "frost rubble zone" of Earth
Photo Credit: NASA Ames Research Center

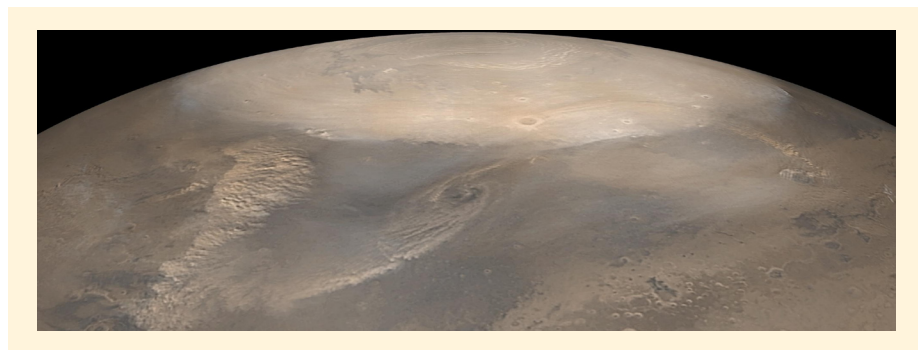


Figure 5: The choppy dust clouds of at least three dust storms are visible in this mosaic of images taken by the Mars Global Surveyor spacecraft in 2002. Currently, the Phoenix Mars Lander is exploring the Red Planet's northern region. For Phoenix's latest discoveries, visit www.nasa.gov/phoenix.
Image Credit: NASA/JPL/Malin Space Science Systems

Summary

From its early days, contributors to the Mars rover missions have implemented NovAtel GNSS receivers and antennas in their project work and testing applications.

NovAtel's GNSS navigation systems deliver high technical standards resulting from major investments in R&D and extensive field testing. Users of NovAtel's navigation GNSS products, such as NASA Ames, JPL and JHU, can be assured of solid performance, in-depth support, and reliable field operations. Each GNSS system also includes our innovative industry proven firmware.