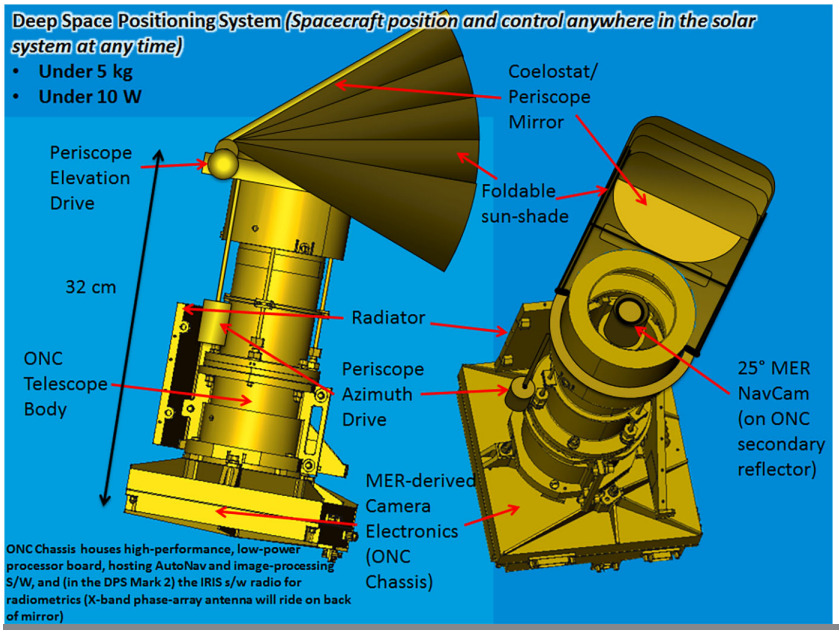

National Aeronautics and Space Administration

NASA

TECHNOLOGY SOLUTION

Communications

Deep-Space Positioning System (DPS)

A single device that provides a spacecraft's position and velocity in interplanetary space

NASA's Jet Propulsion Laboratory has developed a compact, low-power, self-contained instrument that provides the equivalent of GPS throughout the solar system without the aid of artificially provided infrastructure. The state-of-the-art X-ray navigation instrument is also able to determine the position of a spacecraft anywhere in the solar system, but it cannot provide this information relative to the Earth, the sun, or any other remote target body (i.e., the equivalent of GPS providing a user's position relative to a vehicle, a second user, or any other moving target). JPL's uniquely capable deep-space positioning system determines the position and the target-relative position of a spacecraft anywhere in the solar system using optical navigation, which makes it ideally suited for any spacecraft requiring deep-space navigation services.

BENEFITS

- DPS provides both deep-space navigation and target-relative navigation without the aid of artificially provided infrastructure
- Placement of the wide- and narrow-angle cameras guarantees co-boresighting through the coelostat
- Coelostat relieves the spacecraft pointing requirements with respect to navigation imaging and radiometric link closure

THE TECHNOLOGY

JPLs deep-space positioning system consists of narrow- and wide-angle cameras, a coelostat, an S- or X-band receiver and patch antenna, and a central processor that hosts the navigation computations and controls the coelostat. The DPS instrument determines the location of the hosting spacecraft via images of solar system objects and, optionally, via one-way radio to the Earth or another known object from which Doppler observables are extracted. To make the instrument as small and lightweight as possible, the pointability of the coelostat is combined with that of the antenna into a single mechanism. Additional mass and volume are saved through the placement of the wide-angle camera behind the secondary reflector of the narrow-angle camera such that the wide-angle camera shares the precise field of the narrow-angle camera and can provide accurate pointing information for the narrow-angle camera. The DPS is also advantageous because the coelostat can be used to relieve the pointing requirements of the host spacecraft with respect to navigation imaging and radiometric link closure. (Most missions require either a reorientation of the spacecraft or a cessation of science activities in order to obtain navigation data when the desired science and navigation targeting are different.)

APPLICATIONS

The technology has several potential applications:

- Deep-space navigation instruments
- Asteroid reconnaissance and mineral prospecting missions
- Human missions to Mars

PUBLICATIONS

Patent No: 9,382,020

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

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