The NetStation GPR: Lander-Based 3-D Investigations of Subsurface Structure, Stratigraphy, and Volatile Distribution in Planetary Environments

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The NetStation GPR (Ground Penetrating Radar) is a stationary, impulse, multiband HF GPR, designed to conduct geologic and volatile-related investigations of planetary environments in both the near- and deep subsurface (~10-103 m), whether employed as a single-station investigation or as part of a geophysical network on the Moon, Mars, Europa, or other planetary bodies.

An evolutionary refinement of the low-frequency GPRs developed for the original Mars NetLander and ExoMars missions, the NetStation GPR's enhancements include: (1) operation over a broader range of frequencies (~1.8-25 MHz, overlapping the range of the MARSIS and SHARAD orbital sounder); (2) improved polarimetric and volume/3-D imaging capabilities; (3) measurement of surface permittivity and conductivity; (4) the potential for both monostatic and bistatic operation; and (5) the ability to stack up to 2^{31} coherent measurements (in monostatic operation), making it the most sensitive GPR ever built.

In its monostatic mode, the instrument offers the ability to investigate the electromagnetic properties of the subsurface, at moderate (~100 m) to high (~10 m) spatial resolution, in a broad cone-shaped region extending from ~10 m beneath the Lander to a potential maximum depth of ~1-2 km. When operated bistaticly, in conjunction with an orbital radar sounder operating at the same frequency, the region of potential investigation can be expanded to a radial distance of up to ~1 km around the Lander.

With an extensive heritage from two prior low-frequency GPRs (the NetLander GPR and ExoMars EISS), the NetStation GPR has the ability to address a wide range of scientific objectives, many of which have already been demonstrated in the field.

These include the 3-D characterization of local geology (structure and stratigraphy), the identification of transient near-surface or persistent deep-subsurface liquid water, and characterization of the electromagnetic activity of the atmosphere (including the frequency and intensity of electrical discharges, variations in the electron density profile and other properties of the ionosphere, and the ambient RF background noise).