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RIMFAX: PLANETARY IN-SITU EXPLORATION WITH GROUND PENETRATING RADAR ON
PERSEVERANCE

Abstract

The RIMFAX ground penetrating radar (GPR) has been continuously sounding the subsurface of Mars since the Perseverance Rover landed in February 2021. This marks the first time that GPR has been used on a NASA Mars rover, providing insights into the stratigraphic succession of the major units in Jezero Crater, particularly the onlap of the deltaic fan onto the crater floor.

This study focuses on the local rock properties within the upper 10 meters, specifically the radar wave propagation velocity, measured with the RIMFAX GPR. The parameter allows to constrain the subsurface material and enhances further subsurface imaging. We use hyperbolic pattern detection to retrieve the velocity, adapting a well-known technique to the planetary setting with Rover-mounted antennas. Since hyperbolic patterns are naturally weak compared to continuous subsurface layer reflections, a wavefront-attribute based pattern enhancement scheme is utilized. This scheme is based on an unsupervised physics-informed template matching technique initially developed for seismic exploration.

As a result, the sounded crater floor subsurface under the Rover is classified as primarily igneous and dense bedrock. Additionally, potential cavities are detected within the Jezero Crater lava flow regimes. These cavities can help to determine the lava-flow emplacement history and serve as potential sheltering spaces for future human exploration.