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WISDOM/ExoMars 2022: Fantastic Martian subsurface reflectors and where to find them

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The mission of the ExoMars 2022 Martian rover, Rosalind Franklin, will be to find traces of past or present life in the shallow subsurface of Oxia Planum. To assure such traces were shielded from radiations and oxydation, the rover will be equiped with an instrumented drill, able to collect samples down to 2 m in the Martian subsurface. Samples will be analyzed in-situ, by instruments located in the rover body.

Only a limited amount of drilling operations are planned for the nominal mission, and the integrity of the drill must be preserved at all cost. For these reasons, the drilling sites must be selected carefully. The WISDOM Ground Penetrating Radar, one of the 9 instruments onboard Rosalind Franklin, is designed to give insights on the structure and dielectric properties of the subsurface prior to any drilling operation, with radar images known as radargrams.

An underground subsurface reflector, such as a buried boulder which could harm the rover drill, would appear as a hyperbolic shape in a classic GPR radargram. An the shape of this hyperbola gives an estimation of the dielectric constant of the surrounding subsurface (allowing the estimation of the reflector depth).

However, due to engineering constraints, the WISDOM radar antennas are 38 cm above the Martian surface, and the signals sent and received by WISDOM are therefore refracted. Thus the shape corresponding to a reflector in WISDOM radargrams is no longer a hyperbola.

In order to correctly detect these signatures of underground reflectors, and to accurately estimate the dielectric constant of the subsurface, an automated detector software has been developed, and tested on both synthetic and experimental WISDOM radargrams.

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Field

Instrumentation

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