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The radar WISDOM for the ExoMars rover mission Interpretation of the polarimetric data and contribution to the operations

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Abstract

WISDOM (Water Ice Subsurface Deposits Observation on Mars) is a ground penetrating radar designed to characterize the shallow subsurface of Mars, it will be accommodated on the rover of the ExoMars mission and will provide global information about the landing site geological history as well as accurate descriptions of the buried structures that will be essential to collect the samples at depth. In this paper, we focus on the tools that have been developed to process the signal and the polarimetric data in order to achieve the technical and scientific objectives of WISDOM and contribute to the success of the rover mission. Experimental data acquired in natural environments will be shown and analyzed.

1. The WISDOM radar for ExoMars

WISDOM is a polarimetric radar, it can be operated in co/cross-polar mode, which is essential to characterize the shape of buried reflectors, estimate the roughness of the surface.

WISDOM will be accommodated on the rover of the ExoMars 2020 mission [1][2].

The main objectives of WISDOM are to:
- Give clues into the geological context of the investigated site by providing information about the structure of the subsurface (layers, blocks,...), constraining the composition of the detected units (porosity, composition) and mapping the distribution and state of the subsurface water
- Provide input for the identification of the most promising locations for sampling
- Provide guidance for the drilling operations

2. The experimental data set

We are leading a series of field tests in natural environments order to acquire experimental data in a variety of environments. These data are currently used to design the data processing pipeline and validate the algorithms. To assess the performances and limits of the tools, it is essential to operate on a number of interesting geological structures (outcrops, layered subsurface, sedimentary rocks …).

We use a prototype of the instrument representative of the flight model to perform the measurements. The WISDOM prototype is mounted on a cart inside a case and the antenna system is 40 cm above the surface as shown on Fig.1

Fig.1 : WISDOM prototype during a field test in South of France

3. Data Processing

For the purpose of the operations on Mars, as automatic as possible codes are developed. They allow to detect in limit time layers and buried blocks.

High resolution algorithms are used to accurately retrieve the surface topography. On smooth surfaces, the amplitude of surface echo provides a first estimate of the permittivity value which is used to convert the measured delays in distances. Entropy computation allows a local characterization of the heterogeneities. Image processing codes are developed to map the interfaces below the surface.

On-going work is done to optimize the processing of the data and a collaboration with the Ma-MISS team has recently be initiated to work on and optimize the necessary synergy with the other instruments.

Acknowledgements

References

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