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Analysis of Fully Polarimetric Laboratory Measurements Performed with the WISDOM Radar

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The Ground Penetrating Radar WISDOM (Water Ice Subsurface Deposit Observation on Mars) is one of the instruments selected to be part of the Pasteur payload of ESA's ExoMars Rover mission. The main scientific objectives of the Pasteur payload are to search for evidence of past and present life on Mars and to characterize the nature of the shallow subsurface. WISDOM is capable to obtain subsurface information along the rover path and to explore the first 3 meters of the soil with a vertical resolution of a few centimeters. WISDOM will help identify the location of sedimentary layers, where organic molecules are most likely to be found. By investigating geometry, location and properties of buried reflectors, WISDOM will contribute to the understanding of the 3D geological structure, electromagnetic nature, and, possibly, the state of water and ice in the shallow subsurface. WISDOM measurements will be performed 1) by conducting periodic soundings along the Rover traverse, which will provide a coarse, non-uniform, but positionally well-determined investigation of the landing site and 2) by selected high-resolution surveys of areas of strong scientific interest, which are identified for potential investigation and sampling by the Rover's drill. Such surveys will generally be conducted by acquiring a number of closely spaced parallel profiles. Supported by specific hardware features, like the arrangement of the fully polarimetric antenna system, an interpolated 3-D subsurface map of the local stratigraphy can be constructed from these radar measurements. Laboratory measurements are performed on a planar scanner in the anechoic chamber to simulate the closely spaced parallel profiles of selected high-resolution surveys. To characterize the performance of the radar and to be able to analyze the influence of radiation coupling effects between the rover and the antennas, the fully polarimetric WISDOM antenna system was mounted on a simple rover-like mockup. Calibration algorithms were applied to reduce the interference from radiation coupling and cross-talk between transmitting and receiving antenna. The analysis of the laboratory measurement will show features of the fully polarimetric radar system and quantify most of the important performance parameters. Synthetic aperture processing is implemented to increase the azimuth resolution of radar. The three dimensional reconstruction of the positioning of an arrangement of discrete objects will be shown.