WISDOM Calibration and Data Processing Pipeline for the ExoMars 2020 Mission

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The WISDOM instrument is part of the 2020 ESA-Roscosmos ExoMars Rosalind-Franklin rover payload. It is a fully-polarimetric ground penetrating RADAR (GPR) operating as a stepped-frequency continuous-wave radar at frequencies between 500 MHz and 3 GHz yielding a centimetric resolution and a penetration depth of about 3 m in Martian soil. WISDOMs primary scientific objective is the detailed characterization the material distribution of the Martian subsurface as a contribution to the search for evidence of present and past life.

WISDOM works by transmitting electromagnetic waves in the observable zone of the subsurface below the antenna. The transfer function of the observed zone is then recovered from the received signal. The processing of the WISDOM data involves several calibration steps, where environment and temperature as well as instrument influences are compensated in order to obtain interpretable results. The data processing involves several filters that are designed to extract and quantify features of interest w.r.t. the surface and subsurface. Calibration and processing are implemented in the WISDOM Data Processing Framework (WDPF). It can be operated manually (via GUI integration) as well as automatically as part of the ROCC processing pipeline yielding comparable and reproducible results from automatic and manual processing of WISDOM data. The capabilities of WDPF are validated on laboratory and field measurements performed with the WISDOM instrument.