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Planetary radar data inversion techniques improvement

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The planetary radar (e.g. MARSIS) data inversion is based on the selection of groups of stationary frames, within the area under investigation, that shall be statistically analyzed after suitable correction. The selection step includes the recovery of bad/poor data and the estimation of the geometrical surface and subsurface features; these feature shall be utilized in order to obtain data that are only dependent by the material nature of the inclusion, within the layer, and of the interface. This paper is addressed to the techniques used for the frames selection, recovery and their geometric estimation content.

As first step, frames have been selected in Mars areas where the surface and subsurface have a physical optics behavior (i.e. quite flat); the surface flatness has been estimated according to a simulator based on MOLA (Mars Orbiter Laser Altimeter) data while the subsurface has been estimated taking into account the Doppler filters content (i.e. filter 0, +1, -1). Being the surface and subsurface quite flat only small geometric contribution have been estimated and used for correction of the received echoes. To perform this task surface and subsurface models have been developed, under the Kirchhoff approximation hypothesis, to be compared with the experimental data. A figure showing the different material nature of different areas of the Mars South Pole has been drawn.

The discovery of areas with an high dielectric constant led geologists to analyze those areas with other instrument to confirm the results obtained by MARSIS. This paper outlines also the way out for future works in order to analyze more complex surface and subsurface scenarios where conditions for geometric optics or fractal can be present. In this case, it will be mandatory to develop a clutter cancellation technique to avoid the presence of false subsurface echoes generated by surface and subsurface features not immediately below the nadir direction of observation. It will be also necessary to improve the access to the simulator for a quickly accomplishment of this task. In addition it is necessary a deeper analysis of the volumetric clutter including its distribution within the layer thickness. A fully automation of the frames selection will be set for a fast analysis of wide areas of Mars. Finally a data fusion with SHARAD data will improve the reliability and the validity of the obtained results.