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# Preliminary study for the long wavelength planetary SAR sensor design and applications

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The SAR observation over planetary surface has been conducted mainly in two ways. The first case is the subsurface monitoring of planetary surface, for examples Mars Advanced Radar for Subsurface and Ionosphere Sounding (MARSIS) and Shallow Surface Radar (SHARAD). In which the long wavelength electromagnetic wave for ground penetration was applied although the functionality for mining spatial distribution of subsurface substances was limited. Imaging SAR sensors using burst mode design, which is another case, have been employed to acquire planet/satellite's surface observations mostly with the presences thick atmosphere such as Venus and Titan's cases. However, the drawbacks of burst mode SAR for the extraction of topographic information of planet/satellite was obvious as shown in the CASSSINI and Magellan SAR missions, where the interferometric capability was absence in existing burst mode planetary SAR and the quality of radargrammetry is largely limited due to the insufficient resolution and the signal-to-noise ratio of acquired images.

Therefore, in this study, we proposed the exploitation of the long wavelength SAR system capable of extracting topographic information through both InSAR and radargrammetry techniques and monitoring shallow subsurface with the spatial resolving power. Although imaging SAR sensor has limited penetration depth compared with GPR such as MASIS and SHARAD, P and/or L band SARs will be certainly useful to observe a few meters depth subsurface which includes the most interesting layers in planet/satellite such as permafrost in Mars, underlying regolith of Moon, beneath of resurfacing topography of Venus, inner crust of ice satellite and bathymetry of Titan lakes. Meanwhile, those data can be used not only for the detailed surface imaging but also for the extraction of precise 3D topography reconstruction by either InSAR or stereo radargrammetry in the condition that sufficient orbital tracking accuracy is available.

Based on the ideas described above, we designed the system specifications of P and L band planetary imaging SAR for the most interesting planetary/satellite surfaces and evaluate the required power consumption, estimated weight and resolutions which can reach up to 2-3 meters in the case of Martian L band SAR. On the other hand, we investigated the possibility for the P/L dual band sensor and very high resolution short wavelength SAR which can be used for the fine resolution topographic monitoring including surface deformation detection. The technical concepts in this study can be used as in important bases for any future solid plant/satellite mission.