



Ionospheric plasma irregularities: impact on the space-borne ultra wide band ground penetrating radar sounding.

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Ground penetrating radar (GPR) is the promising technique to explore planetary interiors, successfully applied in the Mars research program[1].

In the present work, HF GPR sounding from the orbiting spacecraft through the ionosphere has been simulated numerically. Phase distortion of the ultra wide band (UWB) chirp signal, introduced by the regular layered ionosphere and the effect of scattering of the radio waves by the random small scale ionospheric plasma irregularities are both incorporated in the numerical model. The role of effects of wave diffraction caused by the small-scale structures in the ionospheric plasma has been studied. Influence of the anisotropy of the correlation function of the plasma density is discussed.

It has been shown that the density fluctuations of the ionospheric plasma introduce significant distortions in the chirp signal. On the other hand, correction algorithms for compensating of the phase distortions in the regular ionosphere are relatively stable with respect to the small scale irregularities, at least for not so large density fluctuations, typically occurring in the terrestrial atmosphere. Thus, the conclusion can be made is that the regular phase distortions and the scattering on the small scale structures contribute independently in the degradation of the radar chirp signal.

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[1] Picardi, G., et al. Radar soundings of the subsurface of Mars. *Science*, 310:1925, 2005.