Radar Range Echoes from Mars Cratered Rough Surface/Subsurface and Inversions of Layering Parameters

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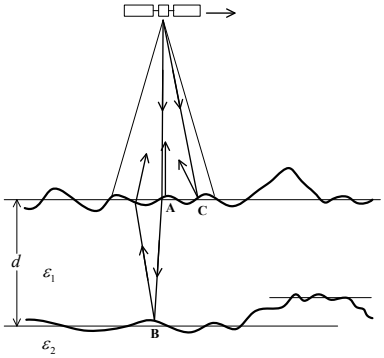
Imaging simulation of radar sounder echoes from Mars cratered rough surface/ subsurface, and physical parameter inversion, e.g. layering thickness and dielectric properties, are developed. Subsurface detection is utilized based on the nadir echoes time delay and intensity difference from the media interfaces (see Fig. 1).



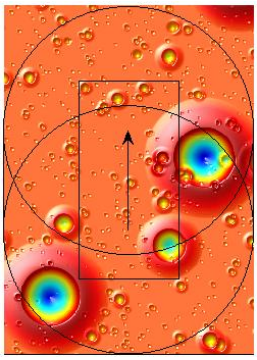
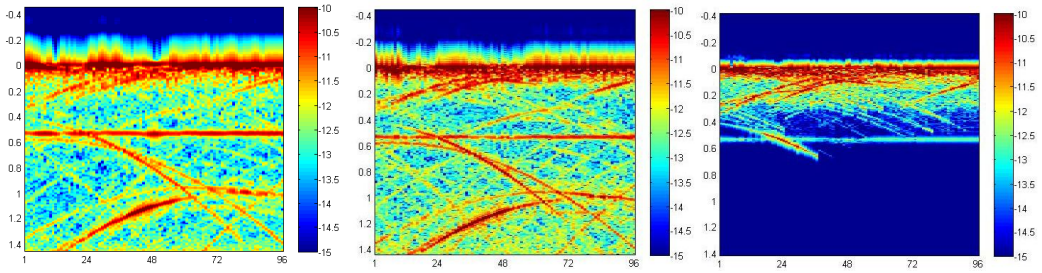


Fig. 1 Radar souder echoes from surface/subsurface Fig. 2 Simulation of Mars Surface DEM

According to Mars surface features, the cratered topography is numerically generated (Fig. 2), and the triangulated network is employed to make digital elevations of the whole surface. Based on the Kirchhoff approximation (KA) of rough surface scattering and the ray tracing of geometric optics, radar range echoes at 5~50 MHz from layering structure is numerically simulated (Figs. 3a-c).



(a) 5 MHz (b) 20 MHz (c) 50 MHz

Fig.3 Simulations of radar range echoes from rough surface/subsurface

Based on the theory of rough surface scattering in the KA approach, we derived that the received echo at nadir direction preserves the functional dependence of the surface reflectivity. It leads to inversion of the surface dielectric permittivity ε_1 . Then, the layer thickness d and subsurface dielectric permittivity ε_2 can be inverted. Real Mars DEM is also employed for imaging simulation, inversion and validation.