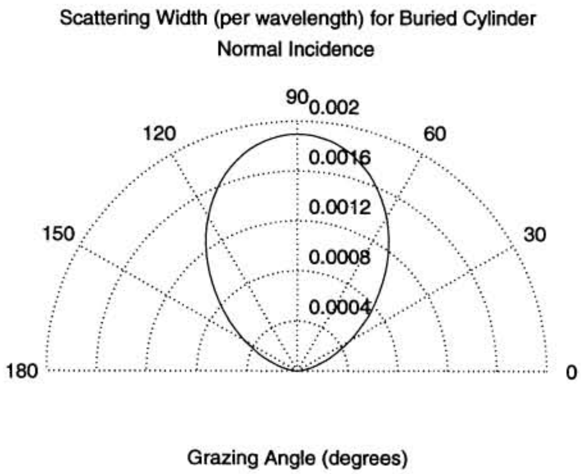
NUMERICAL SIMULATION OF SCATTERING FROM SMALL-SCALE SURFACE STRUCTURE; J.E. Baron, G.L. Tyler, and R.A. Simpson, Center for Radar Astronomy, Stanford University, Stanford, CA 94305-4055.

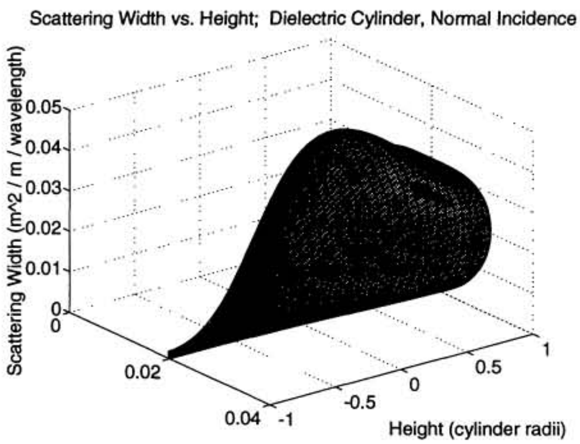
Processing of Magellan altimetry and SAR data has resulted in composite backscattering functions $\sigma_0(\theta)$ for a range of incidence angles $0^o \leq \theta \leq 45^o$ over much of the Venusian surface [1]. For smooth regions of Venus, simple theoretical models match the composite functions well over a small range of incidence angles near nadir, where the majority of the radar echo is due to quasi-specular scatter from suitably oriented surface facets. At more oblique incidence angles ($\theta > 30^o$), these models do not adequately describe the observed scattering behavior, in part due to the presence of small-scale structure and inhomogeneities in the regolith. A numerical method, based upon finite-difference time-domain (FD-TD) techniques, has been developed to study these diffuse scattering mechanisms. We anticipate that a combination of experimental data, theoretical models, and numerical simulations will provide a basis for improved geologic interpretation of radar backscatter observations.

Figure 1 depicts results from a two-dimensional numerical simulation, in which we study scattering from a circular dielectric cylinder (representing a small "rock") buried in a lossless dielectric half-space (representing a "surface"). The figure indicates that the radar echo from a rock buried just beneath the surface is roughly ten times less than that from a rock resting on the surface; peak backscatter occurs when the rock is partially buried. The numerical code can be modified easily to handle a variety of material and geometrical configurations.

Further numerical studies of pairwise coupling among wavelength-diameter "rocks" resting on the regolith demonstrate that, for center-to-center separations greater than approximately four wavelengths, the rocks can be considered independent scatterers. By extending these results to a surface with randomly separated rocks, it may be possible to determine a statistical distribution of small-scale structure on a gently undulating surface that accounts for the discrepancy between backscatter observations and theoretical backscatter predictions at oblique angles.



(1-a)



(1-b)

Figure 1. Scattering from a 0.175λ-diameter circular dielectric cylinder, relative permittivity $\epsilon_r = 4$, buried in a lossless half-space with $\epsilon_r = 2.56$, and subject to illumination at normal incidence. (a) Polar plot of normalized bistatic scattering width (the 2-D analog of radar cross section) when the cylinder is buried tangential to the surface. (b) 3-D representation of behavior of scattering pattern as the cylinder is raised until it rests on the surface; each cross-sectional "slice", for a given cylinder height, corresponds to a polar pattern of the type depicted in (a).

[1] Simpson R.A. *et al.* (1993) *LPSC XXIV*, 1311.