

A Model for Backscattering from Quasi Periodic Corn Canopies at L-Band

In this study, a model for backscattering at L-band from a corn canopy is proposed. The canopy consists of a quasi-periodic distribution of stalks and a random distribution of leaves. The Distorted Born Approximation (DBA) is employed to calculate the single scattered return from the corn field. The new feature of the method is that the coherence of the stalks in the row direction is incorporated in the model in a systematic fashion. Since the wavelength is on the order of the distance between corn stalks in a row, grating lobe behavior is observed at certain azimuth angles of incidence. The results are compared with experimental values measured in Huntsville, Alabama in 1998.

The mean field and the effective dielectric constant of the canopy are obtained by using the Foldy approximation. The stalks are placed in the effective medium in a two dimensional lattice to simulate the row structure of a corn field. In order to mimic a real corn field, a quasi-periodic stalk distribution is assumed where the stalks are given small random perturbations about their lattice locations. Corn leaves are also embedded in the effective medium and the backscattered field from the stalks and the leaves is computed. The backscattering coefficient is calculated and averaged over successive stalk position perturbations. It is assumed that soil erosion has smoothed the soil sufficiently so that it can be assumed flat.

Corn field backscatter data was collected from cornfields during the Huntsville '98 experimental campaign held at Alabama A&M University Research Station, Huntsville, Alabama in 1998 using the NASA/GW truck mounted radar. Extensive ground truth data was collected. This included soil moisture measurements and corn plant architectural data to be used in the model. In particular, the distances between the stalks in a single row have been measured. The L-band radar backscatter data was collected for both H and V polarizations and for look angles of 15° and 45° over a two week period under varying soil moisture conditions. These measured backscattering values will be compared with the model backscattering values and a discussion of the results will be presented.