Modeling the scattering contributions of soybean pods and corn cobs

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This paper reports on the contribution of fruit, such as soybean pods and corn cobs from an agricultural crop canopy, to the total L-Band radar backscatter. A typical model used for a crop canopy consists of a sparse layer of randomly discrete scatterers over a dielectric half-space, having either a flat or rough interface. For a simple, but reasonably accurate soybean canopy, the scatterers are represented by thin dielectric discs, used to model the leaves, having prescribed orientation statistics [1]. Stems can be added to the model by the use of thin dielectric cylinders. Scattering between the stems and leaves is assumed to be independent. Similarly for a corn canopy, thin elliptical dielectric discs are used with dielectric cylinders that can be either thin or thick, depending on the stage of growth and the operating radar frequency.

Few studies model a crop canopy when it reaches the reproductive stage and produces fruit, even though a significant amount of biomass can be attributed to the fruit itself, as shown in [2], [3]. Studies that do include the fruit contributions are typically modeled using simple canonical shapes such as a dielectric cylinder. A commercial numerical electromagnetic solver allows for more realistic and accurate modeling of the fruit's scattering cross-section. Differences in the scattering cross-section between the canonical dielectric cylinder and more complicated geometries used to model a soybean pod and corn cob will be presented.

These results are incorporated into the radar scatter model [4] and the polarimetric radar backscatter contributions from the fruit are calculated by using the Distorted Born Approximation. The new fruit models are validated by the in-situ field experiments which were made concurrently with radar backscatter measurements. The fields are located in Beltsville, MD and the measurements were conducted from June 1st, 2012 through October 24th, 2012 using the ComRad system [5]. Comparison results from the model and measurements will also be presented at the meeting.

References

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