Physical Models For Polarimetric SAR Signature and Identification

Yariv Shlivinski and Ehud Heyman*
School of Elect. Eng., Tel Aviv University, Tel Aviv 69978, Israel
heyman@eng.tau.ac.il

SAR is a powerful tool for the imaging and identification of complex targets. In the high frequency regime the scattered field from such targets can be described as a sum of contributions from isolated scattering centers ("hot-spots"). Composite targets an thus be identified by identifying the local scattering centers and their relative positions and orientations in the image domain. Such identification can be further supported by considering the polarimetric signatures of the localized scatterers.

With this strategy in mind, we derive analytic models for the polarimetric SAR images and for the image-domain Huynen's polarimetric signatures for classes of localized scatters that are commonly found in a composite targets. Specifically, we consider convex surfaces, curved and straight edges, and flat plates dihedrals. These models are then used to support the image-domain identification of localized scattering centers within the polarimetric SAR images of a composite target, and thus support the identification the such targets. In the derivation we use asymptotic techniques to construct the multi-frequency multi-aspect-angle scattered fields, then apply the SAR imaging analytically to calculate the polarimetric images near the corresponding hot spot regions, and then extract the local polarimetric features. Finally, we discuss identification based on these results. Specifically, we show that the polarimetric SAR images of the scatterers considered here involve rather intricate structure functions that depend on the target inclination relative to the scan trajectory. Yet we show that the localized polarimetric signatures in the SAR image domain, in rather large areas near the corresponding hot spots, are essentially the same as the conventional polarimetric signatures of each of these sub-scatterer in isolation.