Synthetic Aperture Radar and Signature Management of Ground Targets: Numerical Approach

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Synthetic Aperture Radar (SAR) is an airborne or satellite based remote sensing tool utilizing radio frequencies (RF) to form an image of the land or sea area under investigation. SAR typically operates in frequencies ranging from UHF/VHF bands up to millimeter wavelengths, and it is therefore not affected by weather or daylight conditions. SAR images are formed by combining returns of multiple pulses emitted from different directions. The radar track in air or in space during the data collection forms a synthetic aperture. The image resolution may vary from centimeters to hundreds of meters, depending on the radar bandwidth and the integration angle which is formed between the synthetic aperture and the target area. The image area width may typically vary from hundreds of meters to tens of kilometers.

In addition to many civil applications, SAR is a powerful tool in military imaging intelligence (IMINT). In military applications, SAR can be fitted to drones, aircrafts or satellites.

Camouflage is the most common countermeasure against IMINT and it is traditionally applied in the visual and thermal infrared spectral bands but in the case of SAR intelligence, RF reflectance and absorption properties need to be considered as well. Military targets are usually relatively large, mostly metallic objects which generate strong radar signatures, or large radar cross sections. The ultimate aim is to manipulate the radar return in such a way that the object blends perfectly in the background clutter so that it cannot be distinguished or detected from the surrounding area. In order to achieve this ambitious goal, special materials must be developed. In this presentation, a numerical approach is used to simulate various camouflage alternatives for the radar signature management of ground targets.

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