SAR Polarimetry & Interferometry

RECENT ADVANCES IN RADAR POLARIMETRY AND POLARIMETRIC SAR INTERFEROMETRY

Prof. Wolfgang-Martin Boerner
UIC-ECE Communications, Sensing & Navigation Laboratory

Abstract The development of *Radar Polarimetry* and *Radar Interferometry* is advancing rapidly, and these novel radar technologies are revamping "*Synthetic Aperture Radar Imaging*" decisively. In this exposition the successive advancements are sketched; beginning with the fundamental formulations and high-lighting the salient points of these diverse remote sensing techniques. Whereas with *radar polarimetry* the textural fine-structure, target-orientation and shape, symmetries and material constituents can be recovered with considerable improvements above that of standard '*amplitude-only Polarization Radar'*; with *radar interferometry* the spatial (in depth) structure can be explored. In '*Polarimetric-Interferometric Synthetic Aperture Radar (POL-IN-SAR) Imaging'* it is possible to recover such co-registered textural plus spatial properties simultaneously. This includes the extraction of *'Digital* Elevation *Maps (DEM*)' from either '*fully Polarimetric (scattering matrix)'* or *'Interferometric (dual antenna) SAR image data takes'* with the additional benefit of obtaining co-registered three-dimensional *'POL-IN-DEM'* information. *Extra-Wide-Band POL-IN-SAR Imaging* - when applied to *'Repeat-Pass Image Overlay Interferometry'* - provides differential background validation and measurement, stress assessment, and environmental stress-change monitoring capabilities with hitherto unattained accuracy, which are essential tools for improved global biomass estimation. More recently, by applying multiple parallel repeat-pass EWB-POL-D(RP)-IN-SAR imaging along stacked (altitudinal) or displaced (horizontal) flight-lines will result in *'Tomographic (Multi-Interferometric) Polarimetric SAR Stereo-Imaging'*, including foliage and ground penetrating capabilities. It is shown that the accelerated advancement of these modern '*EWB-POL-D(RP)-IN-SAR'* imaging techniques is of direct relevance and of paramount priority to wide-area dynamic homeland security surveillance and local-to-global environmental ground-truth measurement and validation, stress assessment, and stress-change monitoring of the terrestrial and planetary covers.

In addition, various closely related topics of (i) acquiring additional and protecting existing spectral windows of the *"Natural Electromagnetic Spectrum (NES)"* pertinent to Remote Sensing*;* (ii) mitigating against common "*Radio Frequency Interference (RFI)"* and intentional "*Directive Jamming of Airborne & Space borne POL-IN-SAR Imaging Platforms"* are appraised.