Polarimetry and Tomography

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Session:

6 presentations about polarimetric tomography of forested areas:

Pardini: TomSAR with simultaneous tandem-X pairs proposed as a tool to by-pass temporal decorrelation. Results from TDX data.

Ho Tong: P-Band TomSAR at 6 MHz proved feasible on tropical forests using 6 MHz data derived from the TropiSAR data-set.

Ferro-Famil: theoretical advancements about multi-baseline estimation theory with application to real data from the TropiSAR data-set.

Aguilera: accurate TomSAR reconstruction with few sparse baselines using compressive sensing wavelet-based estimation. Results from E-SAR data.

Schwaebisch: dual baseline airborne TomSAR proved effective for topography and vegetation height estimation. Results from real data by Intermap.

Lombardini: Differential TomSAR as a tool to model and understand temporal decorrelation. Results from BioSAR 2007 data.

Seed questions

1. Estimation performance

The forest vertical structure can be **imaged** using several baselines or **estimated** using a few, with all intermediate possibilities in between.
To what extent the performance of current estimation algorithms operating with few baselines can be compared to multibaseline imaging
(for example, forest height estimation is OK with 1 or two baselines, but what about radiometric accuracy, robustness to temporal decorrelation, other….) ?

2. Temporal decorrelation

Temporal decorrelation is crucial in repeat-pass scenarios (spaceborne).
Multiple baselines and physical modeling can be employed to counteract its effects for the retrieval of physical parameters.
In terms of theoretical developments, validation from real data, info about volume statistics, campaign requirements, etc. etc. what is now needed to make these methods established tools in forest analysis ?

Seed questions

3. Polarimetric modeling

For estimation purposes, a lot of physical modeling has been done about forest vertical structure, whereas ground and volume polarimetric signatures are not so well considered. To what extent would forest structure estimation be improved if we pushed on polarimetric modeling?

4. General methodological applications of polarimetric SAR tomography

Various polarimetric techniques (applicable to air/spaceborne data sets) have been developed to separate **volume/non volume** contributions based on arbitrary, and often hardly verifiable hypothesis. Estimation of important features (underlying ground characteristics, types of trees, ...) is generally conditioned by the choice of a decomposition method.

On the other hand PolTomSAR offers unique **3-D polarimetric imaging** possibilities, requires specific campaigns, and could be used to validate working hypothesis for large scale POLSAR applications.

Should we favor this type of cross-validation? Should we define a working group, specific sites and campaigns?

Recommendations

LIDAR measurements help interpretation of the results, but they should not be taken as the reference against which to compare TomSAR, since LIDAR and Radar vertical profiles are intrinsically different objects.

It is then recognized that:

- TomSAR products should be discussed based on the added-value associated with the applications
- TomSAR algorithms operating in practical conditions (few baselines, lower resolution, temporal decorrelation) should be tested against high resolution TomSAR products obtained in optimal conditions (many baselines acquired on the same day), rather than against LIDAR.

Accordingly, the audience expresses the need for dedicated airborne or ground based TomSAR campaigns, aimed at producing high resolution 3D reconstructions of forest scattering in selected areas where accurate in-situ measurements are available.

The recommendation is made to provide phase-calibrated data (i.e.: data free from interferometric phase residuals due to platform motion or processing artifacts), in order to enable the largest number of researchers, including non-SAR specialists, to carry out TomSAR analyses.

Recommendations

This would result in a fundamental tool to:

- improve our understanding of the connection between TomSAR and relevant forest parameters (not only height, but also structure, biomass, dynamics);
- increase collaboration with scientists from forestry and ecology
- develop estimation methods tailored to specific forest parameters
- develop and validate PolSAR and PolInSAR models
- validate the accuracy of TomSAR algorithms able to operate in spaceborne-like conditions and/or with data from few baseline airborne campaign

It is also recommended to further study theoretical modeling and performance bounds.