Contribution of textural information from Terrasar-X images for forest mapping


1 Université Paris-I Est, IGN/ISR, MATIS, Saint Mandé, France
2 TELECOM Bretagne, STICC Laboratory, France
3 CNIF International, France
4 ONF International, France
5 INRA, UMR 1391 ISPA, F-33140 Villenave d’Ornon, France
6 Bordeaux Sciences Agro, UMR 1391 ISPA, F-33170 Gradignan, France

Context
Since 2007, radar sensors like Radarsat-2 or Terrasar-X offer high spatial resolution acquisition (about 1m), well suited to the patchwork parcels of European landscape. Beyond giving complementary information to optical data, radar data are insensitive to cloud cover. Such resolution allows to access to textural information which was not possible with previous existing sensors such as ERS, ASAR with almost 25m of spatial resolutions. This work focuses on evaluating the potential of textural analysis of high spatial resolution radar images for forest mapping.

To complete studies that have already shown the interest of textural analysis for forest mapping [1], three textural analysis methods are compared: two methods based on frequency textural analysis: namely wavelet transform and Fourier transform, the third method is based on the characterization of the of the gray level co-occurrence matrix (denoted GLCM) by retrieving Haralick descriptors from it. The derived attributes of each method are evaluated by analyzing their performance from Random Forest classification.

Study Site and Data

Image characteristics:
- Wave length: λ=3cm (X-band)
- Polarization: HH
- Footprint: 5x7km
- Spatial resolution: 1m
- Pixel Size: 0.5

Because of the high variability of texture inside a mono-species plot, the definition of the classes to be used for the classification is based on both the textural information and thematic information. The textural information is based on the photo interpretation of the TerraSAR-X intensity image. 6 classes have been defined.

In situ data are provided by ONF International, Terrasar-X image was acquired in the frame of “PlanetAction” project.

Methods

Three textural analysis methods have been compared: Fourier transform, wavelet transform and Haralick textural attributes.

Fourier Transform Analysis (FOTO [2])

For each pixel:
- Amplitude Spectrum
- Local neighbour

Wavelet Transform Analysis [3]

Generalized Gaussian parameters estimation on a co-localized window

Haralick Analysis [4]

The 3 methods are compared using the overall accuracy of a supervised classification (Random Forest).

Result

Scale analysis sensitivity

Best classification results:
- Foto (OA: 86%).
- Wavelet (OA: 78%).
- Haralick (OA: 94%).

Incremental attributes selection (Greedy Forward)

The incremental attributes selection shows a strong dominance of the large scale analysis.

Attribute fusion

Further studies will be made over different study sites with an approach more related to the plot scale analysis.

+ Foto method may be improved by characterizing radial spectra by computing attributes to characterize their form.
+ Those attributes will be compared to bio-physical variables (tree height, plantation density...)

Perspectives

References