# DETECTION AND ANALYSIS OF URBAN AREAS USING ALOS PALSAR POLARIMETRIC DATA.

*Laurent Ferro-Famil*

University of Rennes 1, IETR, SAPHIR Team
Campus de Beaulieu, Bât 11.D
CS 74205, 35042 Rennes Cedex, France
Laurent.Ferro-Famil@univ-rennes1.fr

*Marco Lavalle*

Tor Vergata University
Via del Politecnico 1, 00133 Rome, Italy
marco.lavalle@gmail.com

## 1. INTRODUCTION

Due to their large scale of observation and their relatively high revisiting frequency, spaceborne SAR systems offer interesting possibilities for the systematic monitoring of urban areas. Several techniques have been developed to analyze urban areas from single-polarization spaceborne SAR data, based on the statistical properties of the reflectivity of such complex media and its spatial variations (texture). The reduced resolution of the data, compared to the airborne SAR case, is a particularly limiting factor. Polarization diversity offers an interesting and powerful alternative mean to detect and characterize urban areas. In this paper, we propose to use polarimetric SAR acquired by the ALOS sensor at L band, to monitor urban areas. The proposed technique uses three complementary approaches to discriminate urban structures using detectors adapted to the complex polarimetric features of this medium, to isolate specific coherent responses from a Time-Frequency analysis of the coherent SAR signal, and finally to charcaterize built-up areas from the coherence and phase properties of their Polarimetric and Interferometric SAR (POL-inSAR) response.

## 2. POLARIMETRIC STATISTICAL DISCRIMINATION OF URBAN AREAS

Polarimetric analysis techniques, based on a decomposition onto an orthogonal basis [1] [2] , on a parametric modeling of the response of environments [3] [4] or on specific indicators [5], have been applied to the case or urban monitoring. These approaches are used in this section to determine the general intrinsic structure and properties of POLSAR second order representations. This information is then used to build statistical detectors which discriminate specific polarimetric behaviors [6] applied here to separate built-up environments from natural areas. The design of the proposed detectors is driven by physical considerations and, specific precautions are taken in order to ensure a sufficient robustness of the detection process with respect to particular configurations linked to the level of reflectivity of to the rank of the POLSAR coherency matrix.

## 3. TIME-FREQUENCY ANALYSIS OF THE COHERENT RESPONSE OF URBAN STRUCTURES

Conventional scattering analysis and geophysical parameter retrieval techniques from strip-map SAR data generally assume that scenes are observed in the direction perpendicular to the flight track and at a fixed frequency, equal to the emitted signal carrier frequency. These assumptions may lead to erroneous interpretations over complex targets and particularly urban areas, characterized by anisotropic geometrical structures, showing varying electromagnetic behavior as they are illuminated from different positions and at different frequency components during the SAR integration. In this paper, a T-F analysis of coherent POLSAR data is lead in both azimuth and range directions in order to characterize the spectral content of responses of built-up areas. Given the reduced transmitted bandwidth and processed azimuth angular for spaceborne SAR systems, the analysis differs from the airborne one, lead in [7]. It is nevertheless shown that the concept of polarimetric T-F coherence remains valid and can be efficiently used to detect man-made structures having a coherent behavior. Moreover, the classification of T-F scattering behaviors, as well as the determination of polarimetric coherent scattering mechanisms permit to obtain an enhanced description of the different parts of a complex urban area.

## 4. POL-INSAR CHARACTERIZATION OF BUILT-UP AREAS

The last point of this study concerns the fusion of the results obtained in the former section with indicators derived from POL-inSAR data sets. The large temporal baseline of the ALOS sensor induces a significant interferometric decorrelation over vegetated areas, whereas some parts of cities remain coherent. The polarimetric sensitivity of the degree of coherence is used to further discriminate volumetric media for buildings and the resulting map is merged with the results obtained from the POLSAR statistical and T-F analysis.

## 5. REFERENCES


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