SAR MONITORING OF SUBURBAN AREAS BASED ON AN ELECTROMAGNETIC SCATTERING MODEL

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Abstract

Inhabited areas and their neighborhoods need persistent surveillance, especially where natural conditions and disasters may threaten the safety of life. In any weather condition, Synthetic Aperture Radars (SAR) ensure a good compromise of coverage and resolution thus letting to properly observe the phenomenon or area of interest.

When we speak about monitoring urban areas we usually think of monitoring buildings whose shape, in most cases, is that of a parallelepiped. In this paper, instead, our attention is given to big tanks, often present in the closest neighborhoods of urban centers, whose shape is that of a classical cylinder or that of a cylinder with a conic-shaped roof.

The interest for this kind of man-made structures arose for different reasons. Above all, the content of these tanks is often dangerous being easily flammable (fuel, hydrogen, other kind of gases). Hence the need of their surveillance especially in areas, like the African territories, where climate or vegetated areas make the propagation of fires easy. Moreover, differently from buildings which can greatly vary in terms of dimensions, shapes and materials from country to country and, sometimes, even from city to city in the same country, this kind of structure is everywhere the same: for safety and logistic reasons, the best way to store gases is in cylindrical tanks and these structures are everywhere adopted.

In this paper we are interested in investigating how the radar signal interacts with this kind of structures and how they appear in the SAR images. The aim is not only speculative but strongly applicative for the reasons above.

Up to now this kind of structures did not receive much consideration and nothing can be found in literature about it since the attention of scientific community was mostly devoted to understand and retrieve building structures in SAR images.

The approach we adopt to study these structures is based on the following consideration. Their shape can be, under certain circumstances, discretized and the cylinder reduced to a polyhedron. This possibility is interesting since the signal return from lateral surfaces may be treated and written like that backscattered from the building wall and ground modeled as a dihedral in [1]. Being the approach in [1] parametric and deterministic, its adaption for the case at issue will be too, and many applications may be derived, like the retrieval of features of interest for change detection, in the same way they have been derived for parallelepiped-like structures [2-4]. For example, some of these tanks present a floating roof whose height change with the volume content: in these cases, then, monitoring changes in the roof height means monitoring changes in the volume content.

In this paper, how the approach developed in [1-4] may be adapted to cylindrical structures will be detailed. The theory will be followed by an example of application, like the retrieval of cylinder height, that will be tested on TerraSAR-X images [5]. Where possible, the cylinder height will be retrieved exploiting the information content of double reflection contributions like in [3-4] but with obvious modifications in the extraction procedure (no more a line but a curve has to be extracted) and in the calibration procedure (the average operations are to be performed on a smaller number of points). Details will be given at the conference.

A first area of study is in Algeria and a TerraSAR-X image acquired in the stripmap mode (~3m of resolution) is analyzed. As a further test, a similar scene crowded with tanks in the area of Naples (Italy) is studied too but in this case a high resolution TerraSAR-X image, acquired in the spotlight mode (~1m of resolution) is considered. Retrieval results for both sites will be compared and discussed.

References

[1] G.Franceschetti, A.Iodice, D.Riccio, "A canonical problem in electromagnetic backscattering from buildings", *IEEE Trans. Geosc. Remote Sensing*, vol.40, pp.1787-1801, 2002.

[2] G.Franceschetti, R.Guida, A.Iodice, D.Riccio, "Extraction of Building Parameters from Single High Resolution SAR Images", *IEEE Trans. Geosc. Remote Sensing,* submitted.

[3] R.Guida, G.Franceschetti, A.Iodice, D.Riccio, G.Ruello, U.Stilla, "Building Feature Extraction via a Deterministic Approach: Application to Real High Resolution SAR Images", *Proc. Geosc. Rem. Sens. Symp.*, pp.2681-2684, Barcelona (Spain), 2007.

[4] R. Guida, A. Iodice, D. Riccio, U. Stilla, "Model-Based Interpretation of High-Resolution SAR Images of Buildings", *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol.1, no.2, pp.107-119, June 2008.

[5] T. Fritz, M. Eineder, J. Mittermayer, B. Schättler, W. Balzer, S. Buckreuß, R. Werninghaus, "TerraSAR-X Ground Segment - Basic Product Specification Document", http://www.dlr.de/tsx/documentation, 2008.