Extraction of bright & dark features of buildings from VHR SAR images & detecting them automatically & 2-D reconstruction of radar footprints

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Abstract—**The space borne synthetic aperture radar (SAR) systems Cosmo-Sky Med, Terra SAR X, and Tan DEM-X acquire imagery with very high spatial resolution (VHR), supporting various important application scenarios, such as damage assessment in urban areas after natural disasters. To ensure a reliable, consistent, and fast extraction of the information from the complex SAR scenes, automatic information extraction methods are essential. Focusing on the analysis of urban areas, we present an approach for the extraction of bright & dark linear features from single VHR SAR detecting them automatically and 2-D reconstruction of building radar footprints. The method is based on the extraction of a set of low-level features from the images and on their composition to more structured primitives using a production system. Then, the concept of semantic meaning of the primitives is introduced and used for both the generation of building candidates and the radar footprint reconstruction. The semantic meaning represents the probability that a primitive belongs to a certain scattering class and has been defined in order to compensate for the lack of detectable features in single images. Indeed, it allows the selection of the most reliable primitives and footprint hypotheses on the basis of fuzzy membership grades.**

Keywords—**Building detection, building reconstruction, synthetic aperture radar (SAR), very high spatial resolution (VHR).**

I. INTRODUCTION

In the last decade, very high spatial resolution (VHR) space borne remote sensing sensors (e.g., Quick Bird, Worldview-2, Cosmo-Sky Med) acquiring data with meter or sub meter resolutions became widely available. These data have the potential to be employed for various important application scenarios, such as the monitoring of changes in urban areas, the characterization of urban areas (e.g., slum mapping), the crisis management after natural disasters (e.g., earthquakes). But now, space borne VHR synthetic aperture radar (SAR) sensors, such as Cosmo- Sky Med and Terra SAR-X are of particular interest, due to their independence on the solar illumination and the relative insensitivity to the weather conditions. we propose a novel method for the detection and reconstruction of building radar footprints from detected VHR SAR images. Unlike most of the literature methods, it can be applied to single images. In this context, radar footprint refers to the characteristic scattering signature of buildings in SAR.

II. PROPOSED SYSTEM

The proposed technique for the extraction of bright & dark linear features of buildings from VHR SAR images & detecting them automatically & 2-D reconstruction of radar footprints. Buildings are assumed to be approximately regular parallel with rectangular base, or compositions of parallelepipeds. Fig. 1 shows a block scheme representing the proposed processing chain. In the following, we describe in detail each step.

A. Pre-processing and Feature Extraction

In the pre-processing, the input image VHR SAR is radio metrically calibrated. The basic features composing building radar footprints in VHR SAR images are extracted from the calibrated image. There are bright linear features with different thicknesses, and dark areas. The bright linear features are related to double bounce, roof , facade & dark linear features are related to building shadows.

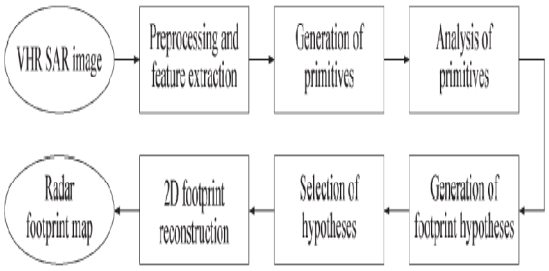


Fig.1.Block scheme of the processing chain of the proposed technique for the automatic detection and reconstruction of building radar footprints in single VHR SAR images.

B.Generation of Primitives

Staring from the set of simply extracted bright & dark features, the proposed method merges both features in order to make a big object which is given as input to the production system.

c. Analysis of Primitives

This step aims at calculating the semantic meaning of the bright & dark primitive. we use the term semantic meaning

to describe the membership grade which is calculated based on the membership functions. For bright primitives there are four primitives which depends on width, thick & thin linear features & dark depends on mean & coefficient of features.

D. Generation of Building Radar Footprint Hypotheses

The hypotheses are generated according to a set of rules and the process is performed by means of a production system.

A footprint hypothesis is generated when

1) Two bright primitives, or
2) Two bright primitives and one dark primitive, or
3) One bright primitive and one dark primitive are close each other.

E. Selection of Hypotheses

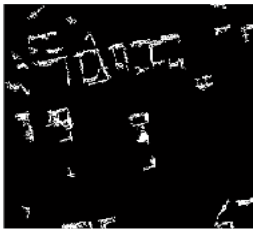
The algorithm selects only the most reliable hypotheses, which will be used in the next step as starting point for the 2-D radar footprint reconstruction. Therefore, the output of this step is a map containing the detected building radar footprints.

F. Two-Dimensional Radar Footprint Reconstruction

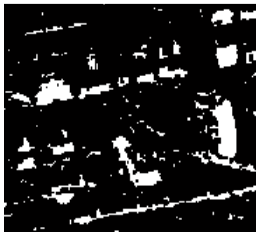
At this stage, it filters both the bright & dark primitives, in order to reduce the effect of false, merged, missed buildings coming from pre-processing & feature extraction.

III. SIMULATION RESULTS

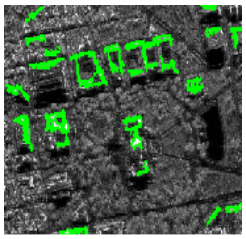
(a)



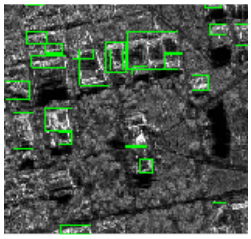
(b)



(c)



(d)



(e)

Fig 2:(a)original SAR image;(b)extraction of bright linear;(c)extraction of dark linear features;(d)actual buildings;(e)final reconstructed.

IV. CONCLUSION & FUTURE WORK

The method shows very high detection rates in the case of medium and large buildings, exhibiting. Also a good capability to reconstruct their radar footprints. The number of false alarms is limited, and these are mostly related to other man-made structures or trees which show radar Signatures similar to those of buildings. For small buildings, the proposed technique shows worse detection and reconstruction performance of radar footprints, and an increased number of False alarms. This is mainly due to the low number of features related to small buildings visible in single-meter-resolution SAR images. The proposed approach is automatic when the user set some of the parameter that is related to the area under investigation.As future developments, we plan to extend the proposed technique to both the analysis of multi-aspect acquisitions and the integration of interferometric height information in the steps of the processing chain.

ACKNOWLEDGMENT

It is a pleasure to recognize Mrs.Venkata Sumana.C.H (G.M.I.T Davangere) for all the technical guidance, encouragement and analysis of the data throughout this process.

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