MODEL ACCURACY COMPARISON FOR HIGH RESOLUTION INSAR COHERENCE STATISTICS OVER URBAN AREAS

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Commission VII, WG VII/7

KEY WORDS: Interferometric Synthetic Aperture Radar (InSAR), Coherence Statistics, Model Accuracy, Urban Areas

ABSTRACT:

The interferometric coherence map derived from the cross-correlation of two complex registered synthetic aperture radar (SAR) images is the reflection of imaged targets. In many applications, it can act as an independent information source, or give additional information complementary to the intensity image. Specially, the statistical properties of the coherence are of great importance in land cover classification, segmentation and change detection. However, compared to the amount of work on the statistical characters of SAR intensity, there are quite fewer researches on interferometric SAR (InSAR) coherence statistics. And to our knowledge, all of the existing work that focuses on InSAR coherence statistics, models the coherence with Gaussian distribution with no discrimination on data resolutions or scene types. But the properties of coherence may be different for different data resolutions and scene types. In this paper, we investigate on the coherence statistics for high resolution data over urban areas, by making a comparison of the accuracy of several typical statistical models. Four typical land classes including buildings, trees, shadow and roads are selected as the representatives of urban areas. Firstly, several regions are selected from the coherence map manually and labelled with their corresponding classes respectively. Then we try to model the statistics of the pixel coherence for each type of region, with different models including Gaussian, Rayleigh, Weibull, Beta and Nakagami. Finally, we evaluate the model accuracy for each type of region. The experiments on TanDEM-X data show that the Beta model has a better performance than other distributions.

1. INTRODUCTION

Due to its independence on the solar illumination and all weather capability, synthetic aperture radar (SAR) has become a key remote sensing technique in the last decades. In the context of SAR data analysis, an important issue is the development of accurate models for the statistics of the data (Gabriele, 2006). There is a lot of work on the statistics of SAR intensity data and many different statistical models are proposed in the literature. For example, Beta distribution is adopted to model the probability density function (pdf) of SAR intensity in (A. Lopès, 1990), the accuracy of Weibull distribution for modelling the intensity pdf is explored in (Menon, 1963; C. Oliver, 1993) and it is found that the Weibull distribution is dedicated only to low heterogeneities. In (Tison, 2004), the Fisher distribution is proposed and it is proved to be a very good model to represent high resolution SAR intensity.

The interferometric coherence map derived from the cross-correlation of two complex registered synthetic aperture radar (SAR) images is the output of interferometric SAR (InSAR) processing, and it can reflect the characters of the targets within the image. And the coherence can act as an independent information source, or give additional information complementary to the intensity image in many applications. Specially, the statistical properties of the coherence are of great importance in land cover classification, segmentation and change detection. However, compared to the much work on the statistical characters of SAR intensity, less attention has been paid to InSAR coherence statistics. And to our knowledge, all of the existing model-based work that focuses on the InSAR coherence statistics models the coherence with Gaussian distribution for data in all resolutions and of all types of scenes. For example, (Abdelfattah, 2010) proposes a segmentation procedure of the InSAR coherence map in 10m resolution based on a Gaussian mixture model of the coherence histogram. (Abdelfattah, 2006) presents an application of the InSAR coherence in 10m resolution for land use classification. The proposed method is based on the InSAR coherence analysis, and the pdf of the coherence is modelled with Gaussian distribution. The experiments in (Abdelfattah, 2006) show that the Gaussian model hypothesis is not satisfactory in the case of urban area. Recently, (Zhang, Y et al, 2015) utilizes the coherence statistical properties in the reconstruction of buildings from high resolution InSAR data. They estimate the pdf of coherence through a kernel based non-model technique. But the non-model technique is very time consuming and sensitive to noise.

Nowadays more and more SAR systems are able to work in InSAR mode (such as TanDEM-X) and provide us with high resolution InSAR data. Therefore, it is very important to make a further research on the statistical characterisation of InSAR coherence.

In this paper, we make an investigation on the coherence statistics for high resolution data over urban areas and evaluate the accuracy of several typical statistical models. Four typical land classes including buildings, trees, shadow and roads are selected as the representatives of urban areas. At the beginning, we select several regions from the coherence map manually and

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