# CHANGE DETECTION FOR URBAN AREAS IN HIGH RESOLUTION SAR IAMGES USING SECOND KIND STATISTICS BASED G0 DISTRIBUTION

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## ABSTRACT

It is very popular to monitor the changes of urban areas via synthetic aperture radar data, which is rarely influenced by weather conditions or imaging time. However, change detection using multi-temporal SAR data may confront with difficulties, due to the highly speckled noise generated by the coherent imaging mechanism. Thus SAR images change detection algorithms mainly contains three steps: (i)modeling the SAR image RCS as well as clutters by some proper statistical methods; (ii)generating a change map by computing a certain similarity measure based on the former model; (iii)masking the change map via proper thresholding techniques to obtain the final change areas.

Quite a few researches have been carried out for SAR images change detection. Considering the multiplicative speckle noise of SAR images, the most common change detection algorithm is the ratio or log ratio method [1].The Kullback-Leibler divergence based algorithm [2], using the Pearson Distribution Family to approximate the SAR clutter within the neighborhood of each pixel in the image, distinguishes a volcano influenced areas between two 10 m resolution Radarsat images acquired before and after the eruption of the volcano. A generalized Gaussian model based change detection algorithm is performed after a noise reduction preprocessing step between chips from two multi-temporal ERS2 images of a city area via a reformed version of Kittler-Illingworth threshold selection criterion [3].

Before proposing a change detection method, one has to carefully examine the statistical models and choose the most appropriate one for the problem at hand. The well known Gaussian model [4] of fully developed speckle and many models derived from it are on the basis of a large amount of random reflectors per resolution cell hypothesis. However, with the increasing of the image resolution, the RCS and clutter of urban areas may deviate from the Gaussian model, especially when the area is man made or the resolution cell is about the size of the objects. Many non-Gaussian models(K, Weibull, Log-normal, Nakagami-Rice etc) are

proposed to fit with the scattering statistics, but none of them is flexible enough to model the surface of urban areas.

In this paper we choose the G0 distribution [5] to model the RCS and clutters of urban areas considering its capacity of approximating extremely heterogeneous clutters. After choosing a certain statistical model, the change detection problem turns into the problem of parameter estimation. The most typical parameter estimation method for G0 distribution, proposed by Freitas [6], is deduced from its first and second order of moments. Unfortunately, this moment based method takes the equivalent number of looks of the image as a priori knowledge, which results in the impossibility of parameter estimation over the whole range. That is to say, the moment based method of G0 distribution can not approximate the extremely heterogeneous areas (such as urban areas) well. We proposed a second kind statistics based parameter estimation method via Mellin transform. The method can perform a whole range estimation as well as a better approximate to urban areas than the moment based method. We analyze the adaptability of the second kind statistics based estimation method compared with the previous models(K, Weibull, Log-normal, Nakagami-Rice) and propose the following novel high resolution SAR images change detection method.

Step 1: Registering two multi-temporal SAR images of urban areas.

Step2: Estimating the three parameters of G0 distribution within the neighborhood of each pixel via the second kind statistics based method.

Step 3: Generating the change map by computing the Kullback-Leibler divergence of each pixel.

Step 4: Thresholding the change map according to the minimum error principle to obtain a mask representing the changed areas.

Experiments indicate that the second kind based G0 distribution model outperforms the previous ones and can help achieve a satisfactory change detection result.

***Index Terms***--- second kind statistics, G0 distribution, urban area,

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