Detection of Man Made Structures in the Schirmacher Oasis Region of Antarctica from RADARSAT Satellite Images

Abhai Mishra

DEAL, Min. of Defense Raipur Road
Dehradun, India

Abstract

Images gathered from the active sensor of a remote sensing satellite, are rich in textural information. The wavelength of the sensor of active satellite is large in comparison to optical one. In the case of RADARSAT satellite the sensors wavelength is 5.6 cm. In this paper we have presented a scheme to detect anthropogenic features from the remotely sensed images of Schirmacher oasis, Antarctica, taken by RADARSAT satellite. This is achieved with the help of Weibull density distribution. We have tried to classify the SAR image in man-made and non man-made regions. Results are also shown and discussed at the end.

Introduction

Mapping of Antarctica region with the help of remote sensing satellites had always been a difficult proposition. The main reason for this is its geographical location and long polar nights. Passive satellites find it difficult to map it due to the absence of sunlight. Active satellites can very well map such areas. Their sensors are able to acquire images in night also. At present all the available active satellites are right looking. That is why they are unable to map the South Pole regionf When RADARSAT-1 was launched into orbit, it was operated in left looking mode during its initial phase. Its SAR (Synthetic Aperture Radar) sensor was able to map the Antarctica region successfully. This is very well known as Antarctic Mapping Mission (AMM). Later its sensor was changed to right looking mode. The clutter statistics of Synthetic Aperture Radar indicates the material present on the ground. Our method detects the man made features using the probability density of the clutter. We model the clutter statistics with the help of a family of probability density functions and select that density which best describes the local statistics.

Method

The family of Weibull density distribution is represented by the following equation.

$$P_\alpha(x) = \frac{\alpha}{x_m}\left(\frac{x}{x_m}\right)^{\alpha-1} \exp\left[-\left(\frac{x}{x_m}\right)^{\alpha}\right] \qquad \ldots (1)$$

Here **a** is the weibull parameter which is related to the skewness of the distribution while x_m is the distribution mean. By the changing the value of weibull parameter we obtain different distributions. For $\alpha=2$ we get Rayleigh distribution and for a=1 we get exponential distribution. In between it approximates log-normal distribution. With the help of weibull distribution we can model the clutter statistics using a single parameter model. For different values of **a** we can demarcate clutter into man made and natural features.
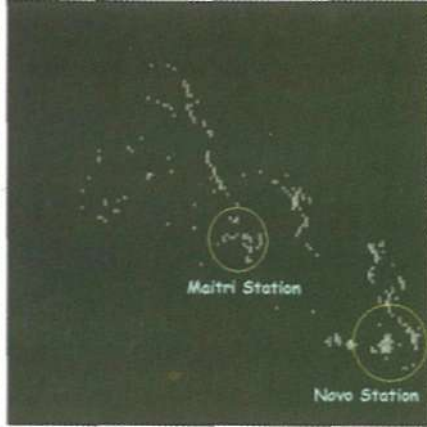
The SAR image is first divided into non overlapping regions X={x(i,j)}. The histogram of each region represents its local density. For median of each region we generate a family of weibull distributions for different **a** with the help of equation (1). We compare these distributions with the previously calculated distribution of that region. The **a** of that distribution, which best matches the local histogram is allocated to that particular region. Like wise we calculate **a** values for all regions. With the help of **a** we segment the image in man-made and natural features.

Results and Discussion

We have evaluated our methodology over the RADARSAT image of Schirmacher oasis region of Antarctica having resolution of 8 meters and area of 8 km x 8 km. For natural features the value of **a** was found to be high. For man-made features the value of *a* was found to be less than 2.7. Figure 1 (a) shows the RADARSAT image of the Schirmacher region of Antarctica. In Figure 1 (b) white patches depicts the man-made features. The Indian Antarctic station "Maitri" and Russian station "Novo" are encircled in the image. It has been verified by the ground truth collected by the author during the XXI Indian Scientific expedition to Antarctica.

Fig. 1: (a) RADARSAT image of   *Fig. 1: (b) Detected man-made*
Schirmacher region, Antarctica   *objects*

References

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