Radiometric and Geometric Correction Methods for Active Radar and SAR Imageries

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Abstract Radar imagery has become one of the most important data sources and efficient tools for terrain analysis and natural resource surveys since 1960s. With the development of technology in the field of radar remote sensing, new generation of radar sensors, i.e., Synthetic Aperture Radar (SAR) was born. Unique specifications of radar systems and images versus optical ones led to a whole new series of applications for radar imageries all over the world. However, the level of achievable accuracy from radar imageries is still a problem for their applications. Multiplicative noise such as speckle which is unavoidable part of coherent radar images, degrade radiometric quality and interpretability. Moreover, geometric distortions such as foreshortening, layover, shadow and other problems related to special imaging geometry of radar systems, decrease reliability of radar imageries. Thus, radiometric and geometric corrections and calibrations must be applied to the radar images before using them. This paper uses four filters with different window sizes to remove/reduce the speckle noise. These filters are Lee, Lee-Sigma, Gamma-MAP and Frost. It is shown that Gamma-MAP filter has a better performance than the other three filters, if the ratio of Mean/Std is used as a criterion. Moreover, geometric correction is done using three different methods including polynomial with five control points, geocoding with ephemeris, and orthorectification using ephemeris, DTM and control points. The results show that the last method which is called radargrammetric is more successful in removing the effects of foreshortening and layover. Besides, the accuracy of geometric correction using radargrammetry is better than the other two methods too.

KEY WORDS: SAR Images, Speckle Noise, Filter, Foreshortening, Layover, Shadow, Orthorectification

1. Introduction

According to Lillesand and Kiefer (2000) remote sensing is the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area, or phenomenon under investigation. Based on the wavelength in which the system works, remote sensing is categorized into two different groups, i.e., optical and microwave. Optical remote sensing uses visible and infrared waves while microwave remote sensing uses radio waves [1]. As a microwave remote sensing, RADAR (Radio Detection And Ranging) sends out pulses of microwave electromagnetic radiation and measures the strength as well as time between the transmitted and reflected pulses to determine both the type of reflector and its distance from the transmitter (Raney, 1998). Different pulse intervals, different wavelengths (which range between less than 1 mm to 1 m), different geometry and polarizations can all be used to determine the roughness, geometry and moisture content of the earth surface [2]. During the past two decades different satellitesusing RADAR sensors have been put into the orbit. SEASAT, SIR-A, SIR-B, SIR-C, ERS-1, ERS-2, ALMAZ, JERS-1, and RADARSAT are some of satellite missions which use RADAR technology.