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A fuzzy approach for speckle noise reduction in SAR images

Ardhi W Santoso [1, 2, *], Luhur Bayuaji [2, 3], Dwi Pebrianti [4], Suryanti Awang [2], Lim Tien Sze [5], Habibah Lateh [6], Jasni Mohamad Zain [2]

[1]*Department of Electronics and Informatics, Sekolah Vokasi, Universitas Gadjah Mada, Yogyakarta, Indonesia*
[2]*Faculty of Computer System and Software Engineering, Universiti Malaysia Pahang, Pahang, Malaysia*
[3]*IBM Center of Excellence, Universiti Malaysia Pahang, Pahang, Malaysia*
[4]*Faculty of Electrical and Electronic Engineering, Universiti Malaysia Pahang, Pahang, Malaysia*
[5]*Faculty of Engineering and Technology, Multimedia University, Melaka, Malaysia*
[6]*School of Distance Education, Universiti Sains Malaysia, Penang, Malaysia*

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ABSTRACT

The Synthetic Aperture Radar (SAR) image has a high resolution and not influenced by weather conditions either day or night. SAR image with its advantages, is becoming popular than the optical image in earth observation using the remote-sensing techniques. However, the speckle noise that occurs in the SAR image causes difficulties in image interpretation. Thus, speckle noise reduction needs as prepossessing procedure prior to the use of the SAR images. The ideal speckle filter has the capability of reducing speckle noise without losing the information and preserving texture. Fuzzy approach has a good performance to reduce speckle noise in a medical image, which is occurred on a SAR image. It proposed a filter which is a combination of fuzzy with qualified existing filter that applied to SAR image, aimed at eliminating speckle noise while maintaining texture. The results showed that the proposed filter has better performance than commonly used filters such as the Mean, Median, Kuan, Lee, and Frost filters. The experiments conducted in a homogeneous area; forests, plantations and oceans from ALOS-PALSAR image in the area of Kuantan, Pahang, Malaysia.

1. Introduction

Geographical information can indicate natural resources and spatial phenomena on earth. Geographical Information Systems (GIS) is an implementation of information technology in the field of geography, that collecting, structuring, processing and analysis of spatial data to obtain spatial information to solve problems on Earth (Kennedy, 2009). Chandra et al. (2006) describes, Remote Sensing (RS) is one of the technologies used to collect GIS spatial data. According to Lillesand et al. (2004), RS is a science to obtain and analyze information about the object or phenomenon from a distance, by detects the characteristics of the electromagnetic radiation reflected/emitted by the earth's surface.

Based on the sensors used to produce images, RS systems can be divided into two, passive sensors that produce optical images and active sensors that produce radar imagery. Optical imaging system (passive sensors) requires day lighting while imaging radar (active sensor) using an active lighting system. In the process of image formation, the antenna mounted in an aircraft or spacecraft transmits the radar signals in the side view in the direction of the earth's surface. (ESA, 2004)

Synthetic Aperture Radar (SAR) is a type of sensor used for observation and characterization of Earth's surface (Foucher and Lopez-Martinez, 2014). SAR sensor has several advantages such as the ability to produce high spatial resolution images, capable to observe in day and night and all-weather condition (Bamler, 2000). SAR is categorized as an active sensor. As an active sensor, SAR sends electromagnetic waves towards the target surface and coherently processes the returned back scattered signals from multiple distributed targets (Kuttikkad et al., 2000).

Unfortunately, the SAR image suffers from additive and multiplicative noise. The additive noise comes from the receiver thermal noise. However, the image is mostly affected by multiplicative noise compared to additive noise. This multiplicative noise is also known as speckle noise. The speckle noise causes difficulties on interpretation and analyzing process of SAR image (Bamler, 2000). Speckle noise in SAR images will degrade their quality, and this is an undesired effect. This multiplicative noise is

* Corresponding Author.
Email Address: ardhi.wicaksono@ymail.com (A. Santoso)