Performance of Various Speckle Reduction Filters on Synthetic Aperture Radar Image

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Abstract—**Synthetic Aperture Radar (SAR) image with its advantages, becoming popular than the optical image. However, the speckle in causes difficulties in the interpretation and analysis during image processing. Thus, before the SAR images are used, speckle noise reduction is necessary. The ideal speckle filter has the main goal of reducing speckle noise without losing the information, content, and preserve the edges and features. Various noise filters have been designed for different purposes and different capacities. In this study, we discuss four filters, namely Lee, Frost, Median and Mean filter. We are analyzing quality parameter and comparing statistic performance of Lee, Frost, Mean and Median filters for SAR sample data. The results show MSE, PSNR, SNR, and AD value that generate by Frost filter performs better than the other filter. And from visual interpretation of the de-speckle image that filtered with Frost filter, show sharpen edge and preserved texture.**

Keywords—synthetic aperture radar (SAR); speckle noise; despeckle; image filter; image processing

I. INTRODUCTION

Synthetic Aperture Radar (SAR) is one type of sensor for observation and characterization Earth's surface [1]. SAR sensor has several advantages such as, the ability to produce high spatial resolution images, observe in day and night and in all-weather condition [2]. SAR is categorized as an active sensor. As an active sensor, SAR sending electromagnetic waves toward the target surface and by coherently processing the returned backscattered signals from multiple distributed targets [3].

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, analyzing, detection and classification process of SAR image. [2], [4].

Original image with free of noise is required for better analysis of image. It is used to restore an original image from a noisy image by improving the visual qualities of the image. [5] Therefore, speckle reduction is become a commonly used routine pre-processing in (SAR) image. The objective of using a speckle reduction filter is to smooth homogeneous regions while preserving texture information and edges. Various researches have been conducted to reduce the speckle (despeckling). Several methods have been proposed with their own strength and limitation [6].

In this paper, we use commonly adaptive spatial-domain filters for speckle reduction namely Lee filter [7]–[9], Frost filter [9]–[11], Mean filter [9], [12] and Median filter [9], [12]. The performance of these filters on 3x3 size of the moving window. The evaluation of filter performance includes several criteria such as, preservation of the mean, reduction of the standard deviation, preservation of the edges and texture preservation. And the main objective of the work presented is to perform an analysis and a comparison filters in ALOS-PALSAR data.

II. SPECKLE NOISE

Speckle noise in SAR images will degrades their quality and this is an undesired effect. This multiplicative noise is generated in the process of creating the image with coherent radiation [13]. SAR images also have statistical property, and most of the statistical models evolved from multiplicative noise model. That is the noise varies more quickly in the regions those image gray changes faster, and the speckle is more