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A Review on Despeckling of the Earth's Surface Visuals Captured by Synthetic Aperture Radar

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Abstract

Today, processing pictures of the Earth's surface is frequently used for a variety of purposes. Given the increased need for this data, several sensors are presently being deployed for the accurate recording of remote sensing images. These sensors may be divided into two main categories: optical sensors and radar-based sensors. Radar-based sensors are widely used to acquire data for remote sensing because they have an advantage over optical sensors in that they can capture high-quality data even in the dark portions of the Earth's surface. One of the most used radar-based sensors is synthetic aperture radar (SAR). To rebuild the visual of the target region, these sensors leverage the synthetic nature of their aperture to record the reflected components of distinct bands of broadcasted highly polarized frequency waves. An undesired coating of granular patterns that covers the entire visual is intrinsically introduced by this phenomenon of receiving distant sensing visuals. This is a result of on-going positive and negative interference in the reflected frequencies before recording. These granular patterns, often referred to as speckles, cause the collected images to lose quality and become more challenging to understand. Thus, while preparing this data for processing, researchers are most concerned with the effective removal of these speckle components. The idea of removing undesirable speckle components from SAR data is known as SAR despeckling, and it has been studied for several decades. Since remote sensing visuals are collected across vast areas, the unintentional loss of any minute details during despeckling has a considerable negative impact on processing. As a result, it is difficult to handle the speckle pattern deftly while retaining even the most minute features captured by the data. Additionally, since the multiplicative nature of these speckle components depends on the intended data value, it makes despeckling more difficult. The goal of an effective SAR despeckling technique is to find the best and most stable solution while taking into account the trade-off between efficient speckle reduction and preservation of finer detail. The

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main objective of eliminating speckles without harming the finer features is partially achieved at an acceptable rate, thanks to the ongoing research and the introduction of several SAR despeckling models, but there is still plenty of room for improvement. This chapter offers a concise summary of the numerous SAR technology ideas, applications, inherent difficulties in processing SAR visuals, and the main reasons behind these difficulties. It also provides a thorough review of SAR geometry while demonstrating the principles of synthetic aperture and how it may be used to record remote sensing images. Additionally, it describes the issue of SAR despeckling and emphasizes how crucial it is when processing SAR images. The chapter also includes a thorough discussion of the many well-accepted techniques for each of the various technologies that have been continuously developed to despeckle SAR data and are documented in the literature. These techniques have the potential to significantly improve the results that are shown. Additionally, the main contributions of all feasible SAR despeckling models, along with their flaws, benefits, and drawbacks, are evaluated and assessed.