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CHANGE DETECTION METHOD USING SYNTHETIC APERTURE RADAR IMAGERY FOR DETECTING CONSTRUCTIONS IN CADASTRE

Abstract

The detection and reigning-in of unauthorized constructions are among the foremost challenges in the cadastre and urban management domain, pivotal for sustainable urban development, legal compliance, and effective governance. Traditional optical remote sensing technologies, though useful in this context, are rendered ineffective under adverse weather conditions and in vegetative areas, which results in a conspicuously non-uniform monitoring and enforcement capacity. Synthetic Aperture Radar (SAR) technology, however, has the unique ability to operate in all weather conditions, providing a new impetus to this quest. This study aims to employ this unique characteristic of SAR for the development of a sophisticated methodological framework for construction detection based on change detection mechanisms, which will in turn assist the urban authorities in the decision-making process. The research methodological framework intends to incorporate contemporary advanced image processing, algorithms, and machine learning techniques to class pixels in SAR imagery. The overall framework has several stages, first, the SAR system will acquire imagery of the study area; second, the SAR data will undergo a series of preprocessing stages including de-noising, de-striping, and calibration to obtain complete and coherent data; third, feature extraction stage will obtain features from the data; fourth, these extracted features will then be input in deep learning networks like U-Net which will learn the inherent pattern of the pixel vectors and classify the only changed pixels of constructions. The classification will then be translated into thematic information that will no longer show the pixels but changes on the ground that occurred due to the constructions. The proposed framework has managed to accurately and considerably detect construction-level changes in the area in contrast to the limited traditional optical remote sensing technique encountered, which was in adverse weather conditions and vegetative environments. As a result of this, significantly cost-effective and timely intervention by cadastre authorities enhanced their capacity over illegal construction detections. Overall, this research has explored the operationalization of the weather-independent and exposed robust SAR-based technique as an indispensable tool for managing land resources efficiently. As this research has only just touched the tip of the iceberg in exploring the space of the capability of SAR technology in urban management, it is also promulgating a future precedent for researchers and practicing professionals in the field of geosciences and remote sensing.