Performance evaluation and comparative assessment of Sentinel-2B, Landsat-8, and AVIRIS-NG sensor imageries for extraction of road and roof surfaces using different algorithms

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Abstract. Urbanization in India has been rapid over the past few decades, which results in a substantial replacement of the natural surfaces into built-up lands. We present a performance evaluation of Sentinel-2B, Landsat-8 multispectral, and AVIRIS-NG hyperspectral imagery for extraction of road and roof surfaces using proposed spectral index-based and other conventional algorithms. The new road extraction index (NREI) and new building extraction index (NBEI) are developed for extraction of road and roof surfaces, respectively. Moreover, existing spectral angle mapper (SAM), spectral information divergence (SID), matched filter (MF), and support vector machine (SVM) are utilized as angle, information, filtering, and machine learning-based algorithms, respectively, for detection of both the surfaces. The results of our study suggest that the performance of AVIRIS-NG sensor is the best in comparison to aforesaid multispectral sensors, whereas Sentinel-2B performs better in comparison to Landsat-8 for extraction of road and roof surfaces. The comparison of various algorithms suggests that proposed indices, MF, and SVM produce the best results for extraction of road and roof surfaces, while SAM and SID are superior algorithms for extraction of both the surfaces in AVIRIS-NG imagery. Further, NREI and MF performed well for extraction of roads followed by NBEI and SAM for roofs in Landsat-8. Finally, NREI, SAM, and SID are found to be efficient for extraction of roads subsequently NBEI, SAM, and SID for roofs in Sentinel-2B imagery. [DOI: 10.1117/1.JRS.14.034502]

Keywords: road surfaces; roof surfaces; airborne visible/infrared imaging spectrometer-next generation; Landsat-8; Sentinel-2B.

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1 Introduction

Urbanization has shown a rapid growth in the past few decades, affecting many dimensions of the today's world. The increasing trend is self-evident in the urbanized density and the spatial sprawl expansion of metropolitan areas, triggering the changes from nonbuilt-up to built-up surfaces. The spatial distribution and temporal dynamics of built-up surfaces play a significant role in the global environment and ecosystem services. Hence, there is an essential need to observe and assess the spatial distribution and sprawl pattern of urban area precisely.[1,2] Since remote sensing satellites rapidly increased in the late 1990s, this technology may be a powerful tool for the analysis of urban environment. As for urbanization, it is a primary requirement to derive land use land cover (LULC) maps from remote sensing imageries. In recent years, Landsat, Aster, Sentinel, and Hyperion imageries are frequently utilized for LULC mapping and for now, some research focuses on modeling of urban sprawl and its environmental impact, and stimulating the phenomenon of heat island. In general, there are three main indicators to describe the urban environment including the density of vegetation, biodiversity, and built-up surfaces. The

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