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New spectral indices for detection of urban built-up surfaces and its sub-classes in AVIRIS-NG hyperspectral imagery

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ABSTRACT

The distribution of urban built-up surfaces is a key indicator of the level of urbanization, which originates from several ecological effects. In this study, three new spectral indices i.e. New Impervious Index (NII), Road Detection Index (RDI) and New Roof Extraction Index (NREI) have been developed for detection of built-up (Level-1), road and roof surfaces (Level-2), respectively, followed by a separability analysis between spectrally confused urban land cover classes. The entire analysis is carried out using AVIRIS-NG and ground hyperspectral data of the Udaipur, Rajasthan region of India. The results of the analysis depict that the proposed indices show an overall average accuracy of 96.12%, 92.24%, and 94.77%, respectively, which are higher than the outcomes of different existing built-up indices. Further, the separability analysis also confirms that the proposed indices can prove to be effective for separating built-up surfaces (Level-1 and 2) from the spectrally similar background.

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Urban remote sensing; hyperspectral imagery; built-up surface; road and roof surface; spectral index

1. Introduction

The urban environment in developing countries is transforming from rural to urban areas at a rapid pace. According to the report of the United Nations in year 2018, urbanization has increased all around the world, rising from 30% in 1950 to 47% in 2000, and it further increased to 55% in year 2018 and 68% of the population are projected to survive in the urban areas by 2050. The estimation for the developed countries is very much larger than the aforementioned figures, with 76% of their population residing in urban areas in 2018 and an estimated to be 90% by 2050 (https://www.un.org/development/desa/en/).

Urbanization brings economic and social benefits (e.g. economic prosperity and improved quality of life), it also causes many environmental effects such as it directly impacts surface runoff (Weng 2001), degradation in water quality (Praskievicz & Chang 2009), loss of biodiversity and urban heat island effect (Xu 2010), etc. Due to these major impacts, understanding the behaviour of the urban environment and their spatio-temporal analysis, become essential for local and regional planning and environmental management. This demands to develop some cost-efficient approaches to get urban sprawl

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