

# An Estimation method of Vegetation Fraction by Using Unit Vectorized Reflectance and the Nonlinear Spectral Mixture Model

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**Abstract:** In recent years, the problem of the Urban Heat Island (UHI) in a city is apparent. Increased green spaces (e.g. tree planting, roof or wall greening) have been possible to inhibit air temperature in the city, thus the acts of urban greening are promoted. The vegetation cover classification in a large area is one of the most important data in the analysis or monitoring of the UHI. Although high-resolution satellite images (a few meters per a pixel) are valuable data for analysis of the vegetation, we cannot obtain the images periodically for high costs. Moreover, it is difficult to analyze the high-resolution images since the images have the several noises (e.g. shades of buildings, small objects). Landsat-7/ETM+ images are free and accessible data from USGS, but the images is low resolution as 30 meters per a pixel. The aim of this paper is to estimate of the mixture ratios for the endmembers for the Landsat-7/ETM+ image in urban area. The number of the endmembers is two: "Vegetation" and "Non-vegetation". The Nonlinear Spectral Mixture Model (NSMM) had been proposed by Somers et al. 2009. The NSMM considers second-order interaction (e.g. second reflections) between endmembers. Oyamada et al. 2012 have proposed the topsoil ratio using the unit vectorized reflectance to reduce the difference of brightness (sunny or shade places). In this paper, we have analyzed if NSMM is represented as the influence of second reflections by using the unit vectorized reflectance, and also have analyzed the enhanced NSMM which we had proposed. As the result, Estimation of the vegetation fraction has been influenced by NSMM in a residential region which have several features. Therefore, we have suggested beneficial effect of NSMM for the second reflections.

Keyword: Landsat-7/ETM+, Vegetation fraction, NSMM, Unit vectorized reflectance, Mixed pixel