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Crop Leaf Area Index (LAI) Inversion and Scale Effect Analysis from Unmanned Aerial Vehicle (UAV)-Based Hyperspectral Data

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Abstract : Leaf Area Index (LAI) is a key structural characteristic of crops and plays a significant role in precision agricultural management and farmland ecosystem modeling. However, LAI retrieved from different resolution data contain a scaling bias due to the spatial heterogeneity and model non-linearity, that is, there is scale effect during multi-scale LAI estimate. In this article, a typical farmland in semi-arid regions of Chinese Inner Mongolia is taken as the study area, based on the combination of PROSPECT model and SAIL model, a multiple dimensional Look-Up-Table (LUT) is generated for multiple crops LAI estimation from unmanned aerial vehicle (UAV) hyperspectral data. Based on Taylor expansion method and computational geometry model, a scale transfer model considering both difference between inter- and intra-class is constructed for scale effect analysis of LAI inversion over inhomogeneous surface. The results indicate that, (1) the LUT method based on classification and parameter sensitive analysis is useful for LAI retrieval of corn, potato, sunflower and melon on the typical farmland, with correlation coefficient R2 of 0.82 and root mean square error RMSE of 0.43m2/m-2. (2) The scale effect of LAI is becoming obvious with the decrease of image resolution, and maximum scale bias is more than 45%. (3) The scale effect of inter-classes is higher than that of intra-class, which can be corrected efficiently by the scale transfer model established based Taylor expansion and Computational geometry. After corrected, the maximum scale bias can be reduced to 1.2%.

Keywords : leaf area index (LAI), scale effect, UAV-based hyperspectral data, look-up-table (LUT), remote sensing
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