陈　丽,张晓丽,焦志敏.基于混合像元分解模型的森林叶面积指数反演[J].农业工程学报,2013,29(13):124-129

基于混合像元分解模型的森林叶面积指数反演

Reversion of leaf area index in forest based on linear mixture model

投稿时间： 2013-01-16 最后修改时间： 2013-05-20

中文关键词：遥感,森林,估算,叶面积指数,混和像元分解模型,多次散射

英文关键词:remote sensing forestry estimation leaf area index (LAI) spectral mixture analysis multiple scattering

基金项目:国家"863"计划课题"数字化森林资源监测关键技术研究"（2012AA102001）

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中文摘要:

在叶面积指数（LAI）遥感估算中，常用的基于统计的遥感反演方法难以处理"同物异谱，同谱异物"的难题，该文从研究地物组分物理结构着手，采用像元分解的方法建立LAI的遥感反演模型，不仅能很好的解决这个难题，而且反演方法简便可行、具有普适性。该研究先对TM数据做最小噪声分离（MNF）并基于影像本身选择端元，经混合像元分解得到研究区植被覆盖度，再根据植被覆盖度与LAI的关系，用多次散射过程冠层模型求解迭代的方法逐步逼近准确的LAI值。最终选择植被、土壤、水体和水泥建筑4个端元，采用非限制性线性混合像元分解模型来分解影像，4个端元分解影像的平均误差为0.0028，端元质量好，分解效果较好。结果证明：混合像元分解模型和多次散射过程冠层模型相结合来反演森林叶面积指数的方法，能很好的预测森林LAI；研究区样点实测值与预测值的拟合度R2为0.8219，均方根误差RMSE为0.368，两者存在很强的相关性。该研究可为森林资源遥感定量估算提供技术支撑，为森林资源空间配置的优化调整与辅助解决方案的提出提供参考。

英文摘要:

Abstract: Leaf area index (LAI) is not only an important parameter of biomass estimation, but also one of the most important structural parameters for the quantitative analysis of the land ecological system's energy exchange. This paper was designed to find a method to estimate LAI, which was accurate, rapid, large scale, and not damaging. In the remote sensing estimation of leaf area index (LAI), the most commonly used methods were based on the statistics. However, it has significant limitations and had difficulty dealing with the problem of "the same thing with different spectrum, and the same spectrum but different thing" for those models. Based on the physical structure of the ground component, this study developed the linear mixture model for forest LAI estimation. It can not only deal with the difficulty of spectral discrimination, but also was simple, feasible, and general. The minimum noise fraction (MNF) method, which can eliminate the correlation between the bands of TM images and increase the quality of endmembers, was employed to convert the TM image into its principal components. After that, endmenbers were obtained from the image itself and the endmembers were regarded as the extremes in the triangles of an image scattergram. An unconstrained least-squares solution was used to un-mix the spectral image into fractions, and the vegetation cover percent was obtained from it. Then, according to the relationship between vegetation cover percent and the LAI, we were able to extract LAI from the remote sensing imagery successfully. Moreover, the canopy model of multiple scattering was applied to estimate the accurate LAI. Finally, four endmembers (green vegetation, soil, water, and non-photosynthetic vegetation) were selected, and an unconstrained least-squares solution was used to un-mix the spectral image into fractions. The average error was 0.0028, and the quality of fraction images was better. The results shows that the method that combined the linear mixture model with the canopy model could estimate the forest LAI accurately. In the study area, there was a strong correlation between the observed value and the predicted value. The coincidence degree of the model was 82.19%, and the RMSE was 0.368.

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