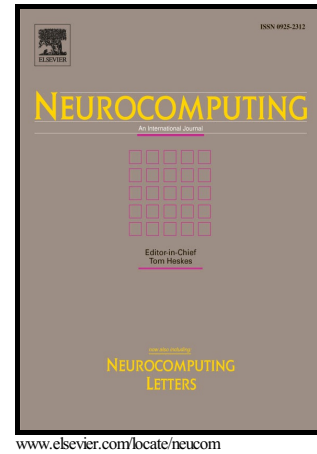


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Improved Weighted MRF Bayesian

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Multispectral Image Classification Based on Improved Weighted MRF Bayesian

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Abstract. This paper presents a novel nonparametric supervised spectral-spatial classification method for multispectral image. In multispectral images, if an unknown pixel shows similar digital number (DN) vectors as pixels in the training class, it will obtain higher posterior probability when assuming DN vectors of different classes follow a certain type of statistical distribution. According to statistical characteristics about DN vectors, the proposed method assumes the vectors follow a Gaussian mixture distribution in each class. Particularly, adaptively Bayesian nonparametric method is developed to estimate the optimal settings in distribution model appropriately. Then, we construct an anisotropic hierarchical logistic spatial prior to capture the spatial contextual information provided by multispectral image. Finally, optimized simulated annealing algorithm is conducted to estimate the maximum a posteriori. The proposed approach is compared with state-of-the-arts classification methods of multispectral images. The comparison results suggested that the proposed approach outperformed in overall accuracy and kappa coefficient.

Keywords: Bayesian nonparametric model, Gaussian mixture model, Markov random field, multispectral image classification.

1. Introduction

As well known, land cover can provide abundant information for understanding the nature of hydrological, geographical, agricultural, ecological and socioeconomic systems. It could impact and connect many aspects of human life with physical environments [1, 2]. Moreover, analyzing of land cover can characterize hydrologic response to land cover change, estimate ecosystem status and health, comprehend spatial patterns of biodiversity, and also develop management policies of land [2-4]. As the rapid development of spatial, spectral and temporal resolutions of remote sensing image over the past years, multispectral image classification has become one of the most common approaches to extract land cover information in remote sensing.

Focusing on multispectral image classification, the strategies proposed in literature generally are categorized as unsupervised and supervised schemes [3-5]. Unsupervised methods investigate data statistics by subdividing the image into clusters of pixels with similar characteristics, e.g., iterative self-organizing data analysis (ISODATA) [6] and K-means classification [7]. Wang et al. proposed a novel method named an improved ISODATA algorithm for hyperspectral image classification, which took into account the maximum and minimum spectrum of the image and determined the initial cluster center by the stepped construction of spectrum accurately [6]. Wu et al. proposed a new remote sensing image classification algorithm based on K-means using HSV color feature, which is implemented by extracting three color features (hue, saturation, value) for K-means clustering [7]. Unsupervised methods do not require labeled information provided by user, while the procedure may lose correlation between the clusters it found and classes user desired. For handling this problem, supervised techniques are characterized by finding explicit relationship between samples and classes. They have shown more promising accuracies in terms of image classification than unsupervised methods, e.g. the minimum distance classification (MinDC) [8], the Mahalanobis distance classification (MDC) [9], the maximum likelihood classification (MLC) [10], the multinomial logistic regression (MLR) [11] and the support vector machine classification (SVM) [12-14]. Duda et al. detailedly described the algorithm of minimum distance classification in Pattern Classification [8]. Richards et al. pointed out that the Mahalanobis distance classifier is relatively speaking one kind of fast classifier [9]. Sisodia et al. used

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