Mapping of Grass Species Using Airborne Hyperspectral Data

P. Burai[1], B. Deak[2], V. Orolya[2], Cs. Lenart[1]

[1]Institution A, Postal address
[1]Karoly Robert College, Research Institute of Remote Sensing and Rural Development, H-3200 Gyöngyös, Mátrai út 36, Hungary
Email: pburai@gmail.com

[2]MTA-DE Biodiversity and Ecosystem Services, Research Group, P.O. Box 71, H-4010 Debrecen, Hungary
Email: debalazs@gmail.com

1. Introduction

Vegetation mapping in such complex landscapes requires a huge amount of fieldwork, thus there is an increasing interest to test alternative methods for mapping these areas. Remote sensing techniques, such as application of hyperspectral data can be a promising tool to map the vegetation of these landscapes. In recent years, many studies explored using hyperspectral imagery for vegetation mapping (Boyd and Foody, 2011).

Pannonian alkali grasslands and marshes are high priority habitats for the European nature conservation and are included in the Natura 2000 system as Pannonic salt steppes and marshes. The vegetation types of alkali landscapes are dominated by a few monocot species (grasses, sedges, bulrushes or rushes), differing in traits such as biomass, physiology, canopy cover and phenology. Hyperspectral imaging is a remote sensing technique which is feasible to detect differences in these differences. Our goal was to classify alkali vegetation types based on the differences of their dominant monocot species in Pentezug using hyperspectral data. For the management and conservation of alkali landscapes, it is crucial to have reliable/up-to-date/high resolution vegetation maps of extended areas. This paper investigates whether the combination of airborne hyperspectral imagery and image classification methods using feature extraction can discriminate among species of grass.

2. Methods

2.1 Study area

The study area (~ 23 km^2) is located in the eastern part of Hungary, National Park of Hortobágy, Pentezug. Alkali landscapes are characterized by a mosaic of various vegetation types, including open alkali vegetation, shortgrass steppes, tallgrass meadows, sedge meadows, marshes and alkali reeds. During acquisition, vegetation types that can be found on the study area were located using a DGPS device.

2.2 Data collection

Hyperspectral images were acquired by a push-broom type AISA Eagle sensor over 126 bands with a spectral resolution of 4.6 nm. The sensor was mounted to Piper Aztec aircraft.

2.3 Image processing

Classification of hyperspectral images is a very challenging procedure due to the small number of training areas and large number of spectral bands. Several advanced feature extraction techniques have been developed to reduce the dimensionality of the data (Plaza et al. 2009). In order to explore the information content of the hyperspectral data sets considered Minimum Noise Fraction (MNF) were calculated (Green et al. 1988). Jeffries-Matusita (JM) values were calculated based on training pixels to select the training pairs with good separability. Random Forest (RF), Maximum Likelihood (MLC), and Support Vector Machine (SVM) supervised classification method were applied for vegetation mapping. Feature extraction methods and image analysis were performed with the ENVI+IDL 5.0.

3. Results

The primary outcome of this study was a comparison of image classification methods and training area to evaluate vegetation types of alkali landscapes. The image classification was applied on the original and transformed (MNF) dataset. Random samples were generated for each class to produced five different training samples (10-20-40 and 50 pixels).

A binary tree Support Vector Machine (SVM) classifier was developed in accordance withthe principle of SVM, based on the Jeffries-Matusita (JM) separability measure of selected classes. In particular we analysed the behavior of the accuracy of different image classification methods. The adaptive binary tree SVM on MNF-transformed dataset provided more accurate results than applied RF, MLC and multiclass SVM methods. In this paper, an adaptive binary tree SVM classifier (ABTSVM) is proposed to increase the accuracy of vegetation map.

Acknowledgements

This research was part of the INSPIRE project entitled “KEOP-7.3.1.3./09-2009-0012”.

References

Green AA, Berman M, Switzer P, and Craig MD, 1988, A transformation for ordering multispectral data in terms of image quality with implications for noise removal, *IEEE Transactions on Geoscience and Remote Sensing*, 26: 65−74.

Plaza, A, Benediktsson JA., Boardman JW, Brazile J, Bruzzone L., Camps-Valls, G., Chanussot J, Fauvel M, Gamba P, Gualtieri J, Marconcini M, Tilton JC, and Trianni G, Recent advances in techniques for hyperspectral image processing. *Remote Sensing of Environment*, 113: 110-122.

Boyd DS, Foody GM, 2011, An overview of recent remote sensing and GIS based research in ecological informatics Ecological Informatics 6: 25–36.