

# Clustering and Classification of Infrared Hyperspectral Aerial images

Alfred Ultsch<sup>1,3</sup> and Andrew McGrath<sup>2</sup>

<sup>1</sup> Databionics Research Group, University of Marburg, Marburg, Germany,  
ultsch@informatik.uni-marburg.de

<sup>2</sup> Flinders University - Airborne Research Australia  
andrew.mcgrath@airborneresearch.com.au

<sup>3</sup> Science Division, Academic Fyling (AKAlfieg), University of Frankfurt,  
Frankfurt, Germany.

High resolution aerial images of the hyperspectral infrared bands promise important advances in environmental and ecological research [1]. In 2012 and 2013, an experiment was conducted in Australia to determine the impact of continual sub-surface release of carbon dioxide on the growth of agricultural crops. Airborne hyperspectral imagery was one of the techniques employed to detect the effects of the CO<sub>2</sub>. However, standard hyperspectral analysis techniques and indices were unable to distinguish between plants affected by the CO<sub>2</sub> and those stressed by other factors [1]. The hyperspectral data of the test plot are in 488 bands from 400 to 2500nm [2]. They are georeferenced and resampled onto a 0.5m resolution grid [1]. Here we report an application of Data Mining techniques [3] for a deeper analysis of the data to seek for a hyperspectral signature able to identify the CO<sub>2</sub>-stressed vegetation specifically. A careful preprocessing allowed a data reduction by a factor of ca. 10. The remaining spectral bands were clustered using an emergent self-organizing map (ESOM) [4]. The clusters obtained could be related to the location of the healthy and stressed plants. This work shows the suitability and efficacy of modern Data Mining and Knowledge Discovery techniques for hyperspectral images.

- [1] Guan, H., McGrath, A., Bennett, J., Zhu, C., Clay, R., Ewenz, C. Comparison of high-resolution aerial thermal imagery with air temperature in Adelaide, In: International Workshop on Urban Weather and Climate: Observation and Modeling, International Workshop on Urban Weather and Climate: Observation and Modeling, Beijing, 2011.
- [2] Grahn, H, Geladi,P. Techniques and Applications of Hyperspectral Image Analysis, Wiley, Chichester, 2007.
- [3] Hand, D., Mannila,H., Smyth,P. Principles of Data Mining, MIT Press, Cambridge MA, 2001.
- [4] Ultsch, A. Maps for the Visualization of high-dimensional Data Spaces, In Proceedings Workshop on Self-Organizing Maps (WSOM 2003), Kyushu, Japan, pp, 225-230, 2003.