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SYNERGETICS FRAMEWORK FOR HYPERSPECTRAL IMAGE CLASSIFICATION

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Abstract. In this paper a new classification technique for hyperspectral data based on synergetics theory is presented. Synergetics – originally introduced by the physicist H. Haken – is an interdisciplinary theory to find general rules for pattern formation through selforganization and has been successfully applied in fields ranging from biology to ecology, chemistry, cosmology, and thermodynamics up to sociology. Although this theory describes general rules for pattern formation it was linked also to pattern recognition. Pattern recognition algorithms based on synergetics theory have been applied to images in the spatial domain with limited success in the past, given their dependence on the rotation, shifting, and scaling of the images. These drawbacks can be discarded if such methods are applied to data acquired by a hyperspectral sensor in the spectral domain, as each single spectrum, related to an image element in the hyperspectral scene, can be analysed independently. The classification scheme based on synergetics introduces also methods for spatial regularization to get rid of "salt and pepper" classification results and for iterative parameter tuning to optimize class weights. The paper reports an experiment on a benchmark data set frequently used for method comparisons. This data set consists of a hyperspectral scene acquired by the Airborne Visible Infrared Imaging Spectrometer AVIRIS sensor of the Jet Propulsion Laboratory acquired over the Salinas Valley in CA, USA, with 15 vegetation classes. The results are compared to state-of-the-art methodologies like Support Vector Machines (SVM), Spectral Information Divergence (SID), Neural Networks, Logistic Regression, Factor Graphs or Spectral Angle Mapper (SAM). The outcomes are promising and often outperform state-of-the-art classification methodologies.

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