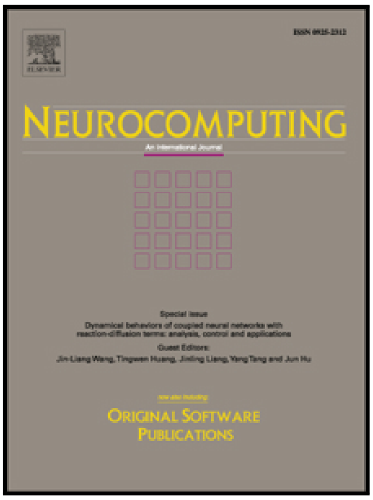

Attribute Profile Based Target Detection Using Collaborative and Sparse Representation

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Attribute Profile Based Target Detection Using Collaborative and Sparse Representation

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Abstract —Two hyperspectral target detection methods are introduced in this paper. The proposed methods use the spatial information contained in attribute profiles (APs) in addition to the original spectral information. The first detector is AP based collaborative representation (AP-CR) and the second one is AP based sparse representation (AP-SR). Since the thinning operators extract the details of image, the spatial features extracted by them are used to compose the target subspace. In contrast, since the thickening operators conduct the image details to be similar to the surrounding background, they are used for extraction of spatial features composing the background subspace. The proposed AP-CR and AP-SR methods, by generating two appropriate spectral-spatial subspaces, individually considered for target and background dictionaries, show a superior performance in several popular hyperspectral data from the detection probability and the running time point of views.

Index Terms: spectral-spatial features, target detection, attribute profile, collaborative representation, sparse representation, hyperspectral.

I. Introduction

A three dimensional hypercube with two dimensional spatial images and spectral information in the third dimension can be acquired by hyperspectral imaging sensors [1]-[3]. Each pixel of a hyperspectral image is a vector containing the radiance or reflectance value at hundreds of narrow spectral bands. These spectral values acquired in different wavelengths compose the spectral signature of the pixel. This spectral signature plays the role of a fingerprint for identification of pixel class. Each material on the ground has its unique spectral characteristics, and so, different materials can be discriminated by analyzing the hyperspectral image acquired from the scene. Assigning pixels to the predetermined classes is a classification problem [4]-[9]. In many applications, the aim is to recognize the special target pixels of interest. This problem is known as target detection that is actually a binary classification problem [10]-[14]. Hyperspectral target detection has many real-world applications such as detection of man-made objects, detection of oil and minerals, surveillance, public safety, and so on. The changes of Earth surface can be also detected through assessment of particular objects or special targets in time interval. A land cover semi-supervised change detection method using multi-temporal hyperspectral images has been introduced in [15]. It benefits the advantages of distance metric leaning for detection of change areas under noise conditions.