SPHERICAL HARMONICS AS A SHAPE DESCRIPTOR FOR IDENTIFYING
STRUCTURES OF INTEREST IN MULTISPECTRAL/HYPERSONSPECTRAL IMAGES

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Abstract

Hyperspectral images have traditionally been analyzed by pixel based methods. Invariant methods that consider surface and shape geometry have not been used with these images. However, there is a need for such methods due to their spectral and spatial variability. In this work, spherical harmonics have been used for shape description of objects in hyperspectral images. Spherical harmonics have been used with 3D gray scale images for invariant object recognition under affine transformations such as rotation, scaling and translation. The goal is to identify structures of interest in hyperspectral images such as buildings and vehicles considering both their spectra and spatial structure or shape. A database of shape descriptors is created for man made structures present in real hyperspectral images. The hyperspectral image is preprocessed using graph cuts method to identify points of interest. Their spectral signatures are used to locate objects whose boundaries are then extracted. These objects can be rotated or translated in the image. The Euclidean similarity metric is used to match the shape descriptor of the objects found in the image with those in the database. The object is then identified as the one with which it has minimum distance in the database. Results are presented with real hyperspectral images.

Objective

Develop an algorithm to identify man made objects in multispectral/hyperspectral images. Utilizing shape priors or shape descriptors for invariant object recognition.

Algorithm

Hyperspectral Image (HSI)

Extract Boundary

Extract Spherical Harmonic Descriptor

X(x, y, z) \rightarrow Y(\phi, \rho) \rightarrow S(x, y, \Phi)

Discriminate Function Euclidean Distance

Process of spherical harmonic descriptor extraction

Original Image

Convert from cartesian coordinates to spherical coordinates

Extract the spherical harmonics

Convert from spherical coordinates to cartesian coordinates

Spherical Harmonic Descriptor (SHD)

Object database: has 115 hyper spectral images

Results: Percentage of Accuracy

Image Searched

Accuracy (%)

100 %

Results: Identification

Future Work

• Utilize appropriate filtering algorithms to subtract background.
• Test the method with complex multispectral and hyperspectral scenes.

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References


Experiments

Results:

Identify:

Results: