Chapter 26
A Large Margin Learning Method for Matching Images of Natural Objects With Different Dimensions

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ABSTRACT

Imaging devices are of increasing use in environmental research requiring an urgent need to deal with such issues as image data, feature matching over different dimensions. Among them, matching hyperspectral image with other types of images is challenging due to the high dimensional nature of hyperspectral data. This chapter addresses this problem by investigating structured support vector machines to construct and learn a graph-based model for each type of image. The graph model incorporates both low-level features and stable correspondences within images. The inherent characteristics are depicted by using a graph matching algorithm on extracted weighted graph models. The effectiveness of this method is demonstrated through experiments on matching hyperspectral images to RGB images, and hyperspectral images with different dimensions on images of natural objects.

INTRODUCTION

Imaging plays a key role in Environmental Informatics in many different forms including grayscale, color, multispectral, hyperspectral, thermal, LIDAR and providing heterogeneous information of natural targets. Among them, hyperspectral imagery has attracted increasing interest as it not only characterizes the spatial distribution of object features, but also provides fine spectral reflectance information of object surfaces which is closely related to their material properties. Though traditionally mounted on space-borne or air-borne platforms, low cost close range hyperspectral imaging devices have become available in recent years thanks to the rapid development of imaging technology. New imagers based on liquid crystal tunable filter (LCTF) and acousto-optic tunable filter (AOTF) (Gat, 2000; Poger and Angelopoulou, 2001) have been adopted by many environment and computer vision labs.

A hyperspectral image consists of tens or hundreds of grayscale bands each of which covers a small range of the light wavelengths. When hyperspectral imager is used to capture data on a regular basis, large amount of data can be generated and stored in image database. As a consequence, image retrieval or matching images captured at different time becomes an important task for many applications. In remote sensing, though GPS can be used to provide georeferenced information of images, the accuracy of GPS and the way images are captured make the image matching difficult. This is especially the case of when Unmanned Aerial Vehicles (UAVs) are used for data acquisition, in which the imaging process may be influenced by weather, flying altitude and posture, and thus generate quite different images at the same scene or location. When capturing objects in a controlled environment, it is also difficult to guarantee that the positions of camera and target object are always the same, and the illumination condition remains unchanged.

Compared with conventional image matching or retrieval such processes for hyperspectral images is challenging due to their high dimensions. This problem is complicated when a hyperspectral image has to be matched to images with different dimensions, for example, matching to multispectral, RGB or simply monochromatic greylevel images. The obstacle also comes from the distinctive representation of content in multi-modal images. In Environmental Informatics and Remote Sensing researchers have investigated registration, fusion, and object detection approaches to partially tackle this problem (Hordley et al., 2004; Hao Du et al., 2009). However, robust matching methods are seldom reported. Similar problems exist in ground based environmental applications in which large scale multimodal image database are involved.

In this chapter, we introduce a multi-dimensional image data matching approach for Environmental Informatics. We deal with two issues:

Figure 1. Matching image with different dimensions and the key idea in the proposed solution
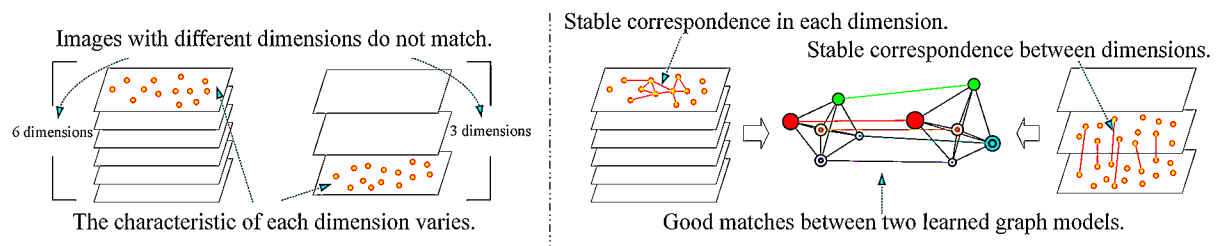
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