Image Fusion for Classification of High Resolution Images based on Mathematical Morphology

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Abstract

Satellites provide very valuable data about the Earth, e.g., for environmental monitoring, weather forecasting, map making, and military intelligence. Satellites are expensive both to build and operate. This implies that we are somehow obliged to do the best with the data we get from existing satellites, e.g., by combining the output from different sensors and to increase the knowledge we can infer. In [1] the authors deal with the merging of low spatial and high spectral resolution satellite images with high spatial and low spectral ones with the aim of creating high spatial and high spectral images. This is also known as *image fusion*. The applied fusion method is model-based, and the fused images obtained spectrally are consistent by design. The problem of satellite image fusion is an ill-posed problem, and therefore, regularization is necessary for its solution. For this purpose, the framework for pixel neighbourhood regularization was also presented in [1]. In [1] the low-resolution RGB image was only used in the image fusion. Here we add the near infrared (NIR) band of the low-resolution (spectral) image to the image fusion method in [1]. In experiment we will use IKONOS image of an urban area (Reykjavik Iceland) [12]. The low-resolution image consists of four bands R, G, B, and NIR and 16 panchromatic values in the high-resolution image. The resulting fused image is then going to be used for classification.

The classification of high resolution urban remote sensing imagery is a challenging research problem. In the latter part of this paper we will consider the classification of such data by both considering the classification of panchromatic imagery (single data channel) and spectral image (multiple data channels) obtain from the extended fusion method in [1] (see above). Panchromatic images are characterized by a very high spatial resolution. The high spatial resolution allows the identification of small structures in a dense urban area. However, the analysis of a scene by considering the value of a pixel only will produce

very poor classification results compared to the fine resolution; for example it will not be possible to distinguish between pixels belonging to the roof of small houses or large buildings if both the roofs have the same reflectance. To solve this problem, some local spatial information is needed. An interesting approach to provide such information is based on the theory of *Mathematical Morphology* [2], which provides tools to analyze spatial relationship between pixels. The morphological profile (MP) was proposed in [3,4], for segmentation of high-resolution satellite images. An MP is made up of an opening profile (OP) and a closing profile (CP) and we will also use derivative of the morphological profile (DMP). Information provided by the MP-DMP is both spatial and radiometric. For classification, the MP-DMPs are regarded as feature vectors, where each class has a typical MP-DMP. Hence each DMP is considered as a *channel* of a multispectral image. This way, classification methods applied to multispectral images can be applied [5,6,7]. The classification will be performed using support vector machine SVM. We will also add the four channelled fused image as new element in the feature vectors obtained using MP-DMP on the IKONOS panchromatic image for classification with SVM.

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