TEXTURE SEGMENTATION USING AREA MORPHOLOGY LOCAL GRANULOMETRIES

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Abstract Texture segmentation based on local morphological pattern spectra provides an attractive alternative to linear scale spaces as the latter suffer from blurring and do not preserve the shape of image features. However, for successful segmentation, pattern spectra derived using a number of structuring elements, often at different orientations, are required. This paper addresses this problem by using area morphology to generate a single pattern spectrum, consisting of a local granulometry and anti-granulometry, at each pixel position. As only one spectrum is produced, segmentation is performed by directly using the spectrum as the feature vector instead of taking pattern spectrum moments. Segmentation results for a simulated image of Brodatz textures and test images from the Outex texture database show the potential of the new approach.

Keywords: Texture analysis, granulometries, area morphology

Introduction

Automated texture classification and segmentation remains a challenging task for computer vision algorithms. Texture refers to the variation of intensity in a local neighbourhood and therefore cannot be defined by a single pixel [8]. In supervised texture classification schemes a feature vector, consisting of a number of textural features, is evaluated against a selected library of feature vectors for particular textures. Alternatively, if an a priori library is not available clustering techniques can be used to classify the feature vectors into an appropriate number of classes [10]. As texture can be said to consist of a distribution of image features at different scales, multiscale texture analysis schemes are an attractive alternative to the traditional fixed scale approach. In

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practice, multiscale feature vectors can be found by decomposing the signal into elements of different resolutions with a linear filterbank and then extracting the structural information in each sub-band. Popular methods include Gabor filtering [9] and, more recently, wavelet analysis [17]. However, despite its popularity, linear image analysis suffers from a number of drawbacks including the shifting and blurring of image features, a scale parameter that is not related to a size-based definition of scale and the fact that it produces filtered images that do not correspond to the shape of image features [11].

An alternative method of decomposition uses mathematical morphology operators to produce an improved representation both in terms of scale and the position of sharp edged objects. In practice, this can be achieved by differencing a series of openings and closings by increasing scale structuring elements to produce a granulometric size distribution for greyscale images, termed a pattern spectrum [11], that has its roots in the binary granulometries of Matheron and Serra [12, 16]. Feature vectors are formed by taking moments of the local pattern spectra produced by a number of different structuring elements, where the term "local" refers to a window centred on the pixel of interest [7]. In terms of texture classification, morphological scale spaces obtained using standard open and close filters suffer from two disadvantages. Firstly, the shape of the structuring element produces edge movement such as corner rounding and, secondly, a large number of structuring elements may be required to capture textual features. The latter problem is further exacerbated when linear features are present in the texture at different orientations. Consequently, many pattern spectra are required at each image point and this explains in part why only moments of the spectra are used to form the feature vectors.

Area morphology operators [18, 15] address both these problems. The scale spaces resulting from increasing area open-close (AOC) and area close-open (ACO) operations exhibit the property of strong causality thus guaranteeing the preservation of edge positions through scale [1]. In addition, as area operations can be considered as the maximum (resp. minimum) of openings (resp. closings) with all possible connected structuring elements with a given number of elements [5], the need for a set of differently orientated structuring elements is removed. An area morphology scale space classification scheme using a feature vector whose elements are the intensities of a particular pixel at a given set of scales is described in [1]. Here, a new local granulometric texture analysis technique is proposed that combines the advantageous properties of area morphology scale spaces with a local pattern spectrum approach.

This paper is arranged as follows. Section 1 discusses local granulometric texture analysis in more detail and the new area morphology local granulometric method is described in section 2. Experimental results for a compound image consisting of a number of Brodatz textures and images from the Outex