Extended Abstract

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The theory of random sets as flexible texture descriptor for biological and medical objects and self-similarity as feature descriptors for the description of the appearances of cells and motion

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Abstract:

Statistical methods play an important role in the description of image objects. The texture is one of the most important methods to describe the appearance of the objects such as cells, tissues and so on. While the standard statistical texture descriptor is based on the co-occurrence matrix we propose a very flexible texture descriptor based on Random Sets. The texture descriptor can describe small objects as well as large objects in fine granularity. It also has an explanation capability that allows humans to understand the nature of the texture. Self-similarity is another important method to describe the appearance of the cells as well as the motion or kinetics of the cells. This descriptor summarizes a bunch of features in one feature and gives a semantic description of what is going on. Both novel statistical descriptors are flexible enough in order to describe the different things going on with an object and they are also very fast to calculate. They can form a standard tool for different descriptions of medical and biological objects and other objects under consideration.

Texture analysis is used in a very broad range of fields and applications, from texture classification (e.g., for remote sensing) to segmentation (e.g., in biomedical imaging), passing through image synthesis or pattern recognition (e.g., for image in painting). For each of these image processing procedures, first, it is necessary to extract—from raw images—meaningful features that describe the texture properties. Various feature extraction methods have been proposed in the last decades. Each of them has its advantages and limitations: performances of some of them are not modified by translation, rotation, affine, and perspective transform; others have a low computational complexity; others, again, are easy to implement; and so on. This paper provides a comprehensive survey of the texture feature extraction methods. The latter are categorized into seven classes: statistical approaches, structural approaches, transform-based approaches, model-based approaches, graph-based approaches, learning-based approaches, and entropy based approaches. For each method in these seven classes, we present the concept, the advantages, and the drawbacks and give examples of application. This survey allows us to identify two classes of methods that, particularly, deserve attention in the future, as their performances seem interesting, but their thorough study is not performed yet

To study human image cognition is more than ever an important topic since the number of vision-based materials has been increased over the years. Texture seems to be a powerful tool to describe the appearances of objects. Therefore, very flexible and powerful texture descriptors are of importance that allows to recognize the texture and to understand what makes up the texture. The most used texture descriptor is the well-known texture descriptor based on the co-occurrence matrix. We propose a texture descriptor based on random sets. This descriptor gives us more freedom in describing different textures. In this paper, we compare the two texture descriptors based on a medical data set. We review the theory of the two texture descriptors and describe the procedure for the comparison of the two methods. Polyp images are used that are derived from colon examination. Decision tree induction is used to learn a classifier model. Cross-validation is used to calculate the error rate. The comparison of the two texture descriptors is based on the error rate, the properties of the two best classification models, the runtime for the feature calculation, the selected features, and the semantic meaning of the texture descriptors. The medical data set was chosen since texture seems to play an important role in describing medical objects.

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