Fuzzy aura matrices for texture classification

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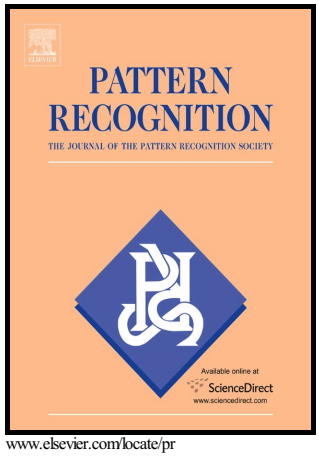

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Fuzzy aura matrices for texture classification

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Abstract

The aura concept has been developed from the set theory and is an efficient tool to characterize texture images. It is based on the notion of "aura set" and on the associated "aura measure" that involve the neighborhood of each image pixel. In this paper, we propose to extend this concept to the framework of fuzzy sets in order to take the imprecise nature of images into account. We define the notions of fuzzy aura sets and of aura measures to compute fuzzy aura matrices as texture descriptors. Fuzzy aura measures assume no restrictions about the neighborhood shape, size, and spatial invariance. Extensive tests of texture classification on Outex benchmark datasets show that fuzzy aura matrices computed with spatially-variant neighborhoods often outperform other powerful texture descriptors on both gray-level and color images.

Keywords: Fuzzy aura set, Fuzzy aura matrix, Texture classification, Spatially-variant neighborhood

1. Introduction

The classification of texture images is a fundamental problem in computer vision [1] and many texture features that characterize the relationships between gray levels of neighboring sites have been proposed for texture classification [2]. Among them, those derived from Gray-Level Co-occurrence Matrices (GLCMs) are very popular [3] because they provide good texture classification results [4]. A GLCM well characterizes textures because it gathers all the spatial co-occurrences of the pairs of sites associated to all the pairs of gray levels of an image.

Gray-Level Aura Matrices (GLAMs) proposed by Elfadel and Picard [5] rely on a set-theoretic concept called the "aura set" which describes the relative presence of a set of sites with a given gray level in the neighborhood of another set of sites with another gray level. An aura set can be characterized by a number called "aura measure" that expresses the amount of mixing between the two neighboring site sets. A GLAM gathers all the aura measures of the pairs of site sets associated to all the pairs of gray levels present in an image.

With Elfadel and Picard's aura measure, GLAMs can be viewed as a generalization of GLCMs and their computation schemes are very similar. Formally, a co-occurrence is defined according to

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