LSP: LOCAL SIMILARITY PATTERN, A NEW APPROACH FOR ROTATION INVARIANT NOISY TEXTURE ANALYSIS

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ABSTRACT

Characterization of two-dimensional textures has many potential applications such as remote sensing, content base image retrieval, image segmentation, etc. In real world, noise has a disturbing effect in the analysis of images and textures. In this paper, a new rotation invariant texture descriptor, LSP (Local Similarity Pattern) is proposed to characterize the local contrast information based on the similarity or dissimilarity of adjacent pixels into a one-dimensional LSP histogram. The aligned histogram could be used as a feature vector to describe the related texture. Experimental results show that the proposed LSP operator can achieve significant improvement in the classification of textures in spite of their embedded noise. Especially, increasing the noise has a few effects on the performance of this method.

Index Terms—Texture classification, LBP, LSP, Local Similarity Pattern, Noisy Texture

1. INTRODUCTION

Texture analysis is one of the main research topics in the field of machine vision. A wide range of applications such as biomedical image analysis, remote sensing, etc., apply it to classify images based on texture content, to segment an image into regions of homogenous texture, etc. [1].

Three principal approaches used in image processing to describe the texture of a region are statistical, structural and spectral [2]. Statistical approaches yield characterizations of textures as smooth, coarse, grainy and so on. Some of these techniques are discussed in [3]. Structural techniques deal with the arrangement of image primitives, often called texels or textons. To describe a texture, a vocabulary of texels and a description of their relationships is needed. The goal is to describe complex structures with simpler primitives such as graphs [4]. Some methods of structural approaches have been presented in [5, 6]. Spectral techniques are based on properties of the Fourier or wavelet spectrum and are used primarily to detect global periodicity in an image by identifying high-energy, narrow peaks in the spectrum. [2]

Ojala et al., introduced a unifying approach called LBP which combines aspects of statistical and structural texture analysis [1, 7]. LBP and some of its extensions have good results in texture analysis.

In spite of simplicity and efficiency of LBP, it suffers from constant problem in real world: LBP is sensitive to noise. However, in real world, images may be noisy. We present a method like LBP, which makes a code of texture that describes the similarity or dissimilarity of a pixel with its neighbors. We show this method is more robust against the noise. Whereas, our method is similar to LBP in some aspects, the rest of the paper is organized as follow: Section 2 briefly reviews the LBP method. Section 3 presents LSP and section 4 reports the experimental results on Brodatz texture database [8]. Section 5 gives the conclusion and future works.

2. LBP

The local binary pattern texture operator was first introduced as a complementary measure for local image contrast. The first incarnation of the operator worked with the eight neighbors of a pixel, using the value of the center pixel as a threshold. [7]

Each neighbor is compared to center pixel. 0 code is assigned to each neighbor with smaller gray level than threshold and 1 to those with greater or equal value. An LBP code for a neighborhood is produced by multiplying these codes with weights given to the corresponding pixels and summing up the results. Figure 1 illustrates how to compute this code for a center pixel by the value of 3.

![Figure 1. Computation of LBP code](image)

This definition, which we call LBPBase, was changed later while keeping the basic idea. Neighborhood was defined as a circular form around the center pixel with varying radius. Therefore, some neighbors could be placed in diagonal pixels that should be interpolated. These extensions have been explained in [1].

LBP (and its extensions) is a very simple and efficient method to analyze a texture but it has two problems: first, it by definition discards an important property of local image texture, contrast. New approaches called LBP/VAR and LBPV are presented to enhance the performance of LBP,[1, 9] However they may be complex or nearly time consuming.

Second, LBP is very sensitive to noise, because each neighbor is compared to center pixel and just one level difference between gray-levels could change the LBP code. Therefore, noise leads to make different LBP codes for images belongs to the same class. In spite of trying to solve this problem in