Feature Selection and Fusion for Texture Classification

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Abstract. In this paper, a novel texture classification method using selected and combined features from wavelet frame and steerable pyramid decompositions has been proposed. Firstly, wavelet frame and steerable pyramid decompositions are used to extract complementary features from texture regions. Then the number of features is reduced by selection using maximal information compression index. Finally the reduced features are combined and forwarded to SVM classifiers. The experimental results show that the proposed method used selected and fused features can achieve good classification accuracy and have low computational complexity.

1 Introduction

In the past few decades, a large number of texture features have been proposed. Tuceryan and Jain identify these into four major categories, namely, statistical, geometrical, model-based and signal processing features [1]. Recently, one of the major developments in texture classification has been the use of multiresolution and multichannel descriptions. This description provides information about the image contained in time-frequency domain, and thus provides a powerful tool for the description of similar textures. Several multiresolution and multichannel transform algorithms have been used for texture classification [2]. However, most of them were used separately.

In this paper, a novel texture classification method using selected and combined features from wavelet frame and steerable pyramid has been proposed. Firstly, wavelet frame and steerable pyramid are used to extract complementary features. Then the number of features is reduced by selection using maximal information compression index. Finally the reduced features are combined and forwarded to SVM classifiers. The experimental results show that the proposed method used selected and fused features can achieve good classification accuracy and have low computational complexity.

The rest of this paper is organized as follows. The proposed method is described in Section 2. Section 3 describes the experimental setup and results. The last section gives some concluding remarks.

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2 The Proposed Method

The scheme of the proposed method is shown in Fig.1. A texture region is firstly decomposed by wavelet frame and steerable pyramid to extract complementary features. Then the two feature sets are reduced by feature selection phase, which is based on maximal information compression index. Finally the reduced features are combined and forwarded to SVM classifiers. The details of the scheme are described as follows.

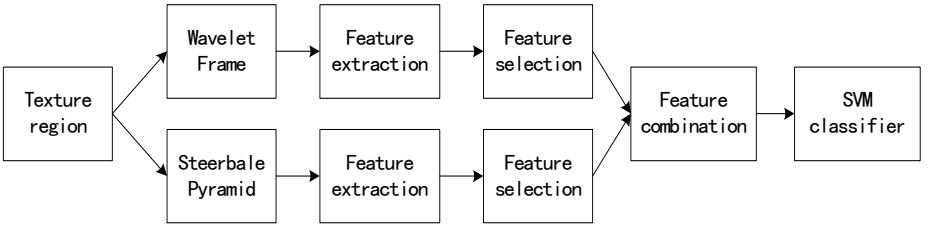

Fig. 1. Scheme of the proposed method

2.1 Wavelet Frame Transform

Unser proposed an overcomplete wavelet representation called a wavelet frame transform (WFT) [3]. The "overcompleteness" is due to the fact that WFT has no dyadic decimation on each decomposition level, shown in Fig.2(a). Avoiding down-sampling guarantees both aliasing free and translation invariant properties. Although the resulting transform is highly redundant from an information theoretic point of view, it is still simple to compute.

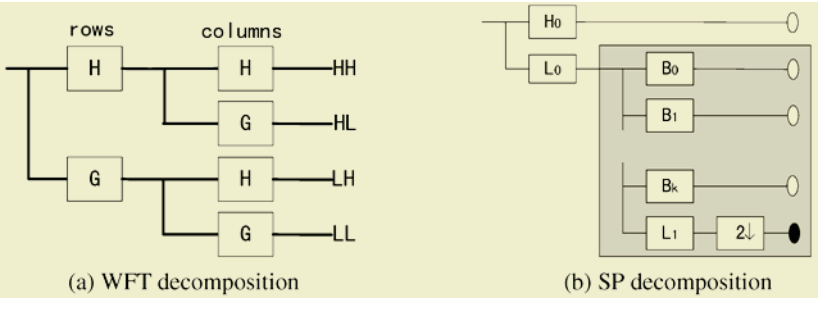

Fig. 2. Decomposition diagram of WFT and SP pyramid

2.2 Steerable Pyramid

The steerable pyramid (SP) is a linear multi-scale, multi-orientation image decomposition method, unlike most discrete wavelet transforms, which is non-orthogonal and overcomplete [4]. Fig.2(b) shows the analysis diagram of steerable pyramid for a single stage. The circles represent the decomposed subband images. The image is first