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A New Feature-Based Wavelet Completed Local Ternary Pattern (Feat-WCLTP) for Texture Image Classification

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ABSTRACT LBP is one of the simplest yet most powerful feature extraction descriptors. Many descriptors based on LBP have been proposed to improve its performance. Completed Local Ternary Pattern (CLTP) is one of the important LBP variants that was proposed to overcome LBP's drawbacks. However, despite the impressive performance of CLTP, it suffers from some limitations, such as high dimensionality, thereby leading to higher computation time and may affect the classification accuracy. In this paper, a new rotation invariant texture descriptor (Feat-WCLTP) is proposed. In the proposed Feat-WCLTP descriptor, first the redundant discrete wavelet transform RDWT is integrated with the original CLTP. Then, CLTP is extracted based on the LL wavelet coefficients. Next, the mean and variance features are used to describe the magnitude information instead of using P-dimensional features as the normal magnitude components of CLTP. Reducing the number of extracted features positively affected the computational complexity of the descriptor and the dimensionality of the resultant histogram. The proposed Feat-WCLTP is evaluated using four texture datasets and compared with some well-known descriptors. The experimental results show that Feat-WCLTP outperformed the other descriptors in terms of classification accuracy. It achieves 99.66% in OuTex, 96.89% in CUReT, 95.23% in UIUC and 99.92% in the Kylberg dataset. The experimental results showed that the Feat-WCLTP not only overcomes the CLTP's dimensionality problem but also further improves the classification accuracy.

INDEX TERMS Texture classification, local binary pattern (LBP), completed local ternary pattern (CLTP), RDWT.

I. INTRODUCTION

Texture classification is increasingly recognised as a serious issue in the texture analysis field [1]. As it plays a key role in a wide variety of real-life applications such as medical images analysis [2]–[4], human detector [5], human action recognition [6], manufacturing industry [7], image segmentation [8], remote sensing [9], object tracking [10], [11], face recognition [12], [13], and image retrieval [14], [15]. Generally, texture classification aims to design an algorithm that can address a sample image to reference image in a predefined image database based on image texture property. The extraction of efficient and robust texture feature is the main task of texture classification [16]–[18]. The main challenge of texture classification is how to deal with external changes in the imaging conditions such as rotation, scaling, illumination, viewpoint and noise. Accordingly, numerous numbers of descriptors have been developed and introduced over the past decades. The common purpose of all descriptors is how to extract powerful texture features that are robust to intra-class variance and can perform well in real-life applications.

Of the many descriptors, Local Binary Pattern (LBP) have brightened up as one of the most eminent and widely studied texture descriptor [19]. LBP was first proposed two decades ago by [20]. It was initially defined within the concept of 8 grey pixels with a centre pixel. The LBP encoding

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