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Directional Wavelet based Features for Colonic Polyp Classification

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Abstract

In this work, various wavelet based methods like the discrete wavelet transform, the dual-tree complex wavelet transform, the Gabor wavelet transform, curvelets, contourlets and shearlets are applied for the automated classification of colonic polyps. The methods are tested on 8 HD-endoscopic image databases, where each database is acquired using different imaging modalities (Pentax's i-Scan technology combined with or without staining the mucosa), 2 NBI high-magnification databases and one database with chromoscopy high-magnification images. To evaluate the suitability of the wavelet based methods with respect to the classification of colonic polyps, the classification performances of 3 wavelet transforms and the more recent curvelets, contourlets and shearlets are compared using a common framework. Wavelet transforms were already often and successfully applied to the classification of colonic polyps, whereas curvelets, contourlets and shearlets have not been used for this purpose so far. We apply different feature extraction techniques to extract the information of the subbands of the wavelet based methods. Most of the in total 20 approaches were already published in different texture classification contexts. Thus, the aim is also to assess and compare their classification performance using a common framework. Three of the 20 approaches are original. These three approaches extract Weibull features from the subbands of curvelets, contourlets and shearlets. Additionally, 5 state-of-the-art non wavelet based methods are applied to our databases so that we can compare their results with those of the wavelet based methods. It turned out that extracting Weibull distribution parameters from the subband coefficients generally leads to high classification results, especially for the dual-tree complex wavelet transform, the Gabor wavelet transform and the Shearlet transform. These three wavelet based transforms in combination with Weibull features even outperform the state-of-the-art methods on most of the databases. We will also show that the Weibull distribution is better suited to model the subband coefficient distribution than other commonly used probability distributions like the Gaussian distribution and the generalized Gaussian distribution.