Chapter 7
A Novel Approach of K–SVD–Based Algorithm for Image Denoising

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ABSTRACT

In recent years, denoising has played an important role in medical image analysis. Image denoising is still accepted as a challenge for researchers and image application developers in medical image applications. The idea is to denoise a microscopic image through over-complete dictionary learning using a k-means algorithm and singular value decomposition (K-SVD) based on pursuit methods. This approach is good in performance on the quality improvement of the medical images, but it has low computational speed with high computational complexity. In view of the above limitations, this chapter proposes a novel strategy for denoising insight phenomena of the K-SVD algorithm. In addition, the authors utilize the technology of improved dictionary learning of the image patches using heap sort mechanism followed by dictionary updating process. The experimental results validate that the proposed approach successfully reduced noise levels on various test image datasets. This has been found to be more accurate than the best in class denoising approaches.

INTRODUCTION

In recent developments of modern digital image analysis, denoising assumes a key part of image processing. Denoising is an elementary issue of signal improvement in image processing then it requires moderating the noise levels of the detected images while stabilizing the texture features, corner features and edge particulars of the original image (Wang, Wang, & Liu, 2017). Image denoising is the method of reducing the noise levels, which makes imaging analysis easier (de FontesGuillermo, Pierrick Coupé, & Hellie, 2011). The aim of denoising method is to reduce the noise levels homogeneous regions while stabilizing the image forms and reconstruct the original image form (de FontesGuillermo, Pierrick Coupé, & Hellie, 2011; Guo, Zhang, Zhang, & Liu, 2016). In recent decades, numerous researchers have proposed distinctive sorts of image denoising algorithms to enhance the quality and decrease the noise in images (Wang, Wang, & Liu, 2017). Because such noise could affect the major applications such as medical image analysis (Han, Xu, Baciu, & Li, 2015; Liang & Weller, 2016; Wu, Huang, & Shi, 2015; Gu, Tao, Qiao, & Lin, 2018; Hung & Siu, 2012), signal processing and video processing (Mairal, Sapiro, & Elad, 2008), and others (Aharon, Elad, & Bruckstein, 2006), suggested K- means based SVD algorithm for single-scale dictionary learning and sparse representation of grayscale image related patches. In the literature, K-SVD algorithm has represented dictionary learning for sparsity representation (Yang, Bouzerdoum, & Phung, 2009). Similarly, K-SVD has several issues in dealing with higher dimensional signals. A major limitation of K-SVD is to choose suitable dictionary learning for the dataset, which is a non-convex problem then it works by an iterative update passion that does not an assurance to find the global optimum. In addition, another disadvantage of K-SVD is that it is relatively slow in time complexity with every iteration of decomposition. Still, interesting sparse representation technique has been verified fruitful for Gaussian and impulse noise elimination. This research, motivated by earlier research works highlight on impulse noise elimination and sparse representation. Keeping these issues, we suggested an efficient three-stage patch-based denoising method. That is to combine the heap sorting technique (Hwang & Haddad, 1995; Ko & Lee, 1991) with a competent dictionary learning approach and improved images abnormal by Gaussian and impulse noise (Hwang & Haddad, 1995; Aharon, Elad, & Bruckstein, 2006). The first stage, we use the dictionary initialization method to detect the overlapping patches. In the second stage, we follow the sparse coding with the help of orthogonal matching pursuit (OMP) in this stage, the denoising phenomenon applied through heap sort technique. Finally, the dictionaries are updated in such a way that image reconstruction occurs through the noise-based image. The objective of this research is a dual sparsity-based methodology for Gaussian noise and impulse noise elimination using both heap sort and SVD based approximations.

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