A Multiresolution Bilateral Filter for Speckle Reduction in Ultrasound Kidney Images

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Abstract

The kidney stones (renal calculi) are the most common medical problems that occur to the people, irrespective of age group. The ultrasonography is a versatile and noninvasive imaging modality often preferred over other techniques such as CT, MRI and X-ray for kidney stone detection. It does not use any ionizing radiation for its operation. However, the main disadvantage associated with ultrasound scanning is the presence of speckle noise which mimics as a kidney stone and leads to fault diagnosis. The existence of speckle affects the further image processing steps such as feature extraction, segmentation, and classification of stones. A new wavelet based bilateral filtering technique is proposed for speckle reduction of ultrasound kidney images in order to make the diagnosis procedure of kidney stones in the easiest way. In this method, the approximation coefficients of decomposed image are processed using the bilateral filter. The noise reduction in detail coefficient is performed using wavelet soft thresholding technique. The threshold value is derived from a Bayesian framework. This method of speckle reduction is applied on various ultrasound kidney images with stone and visual investigation made on the filter performance in terms of the identification of actual stones by reducing the effect of speckle resembles like a stone. Also, the effectiveness of the proposed method is examined by means of RMSE, PSNR, and SSIM. The proposed hybrid architecture is compared with wavelet Hard and Soft thresholding and Bilateral Filter.

Keywords: Ultrasound images, kidney stone, speckle noise, Bilateral Filter, Wavelet, Bayes thresholding.
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