Using a novel algorithm in ultrasound images to detect renal stones

ABSTRACT

Medical ultrasound is utilized as the primary method for the detection of kidney stones. Ultrasound imaging is often more popular than other imaging techniques because it is portable, low-cost, non-invasive, and does not utilize ionizing radiations. In this paper, three essential segmentation algorithms, namely Fuzzy C-means, K-means, and Expectation–Maximization algorithms, are proposed for the identification of renal stone in kidney ultrasound images. Expectation–Maximization algorithm is a novel method used by us for the first time for identifying renal stones. Initially, ultrasound kidney image is pre-processed. The pre-processing of ultrasound images comprises of denoising utilizing wavelet thresholding technique. The pre-processed image is taken as input for the segmentation process. Fuzzy C-means, K-means, and Expectation–Maximization algorithms are used to segment the renal calculi from the kidney ultrasound image; further region parameters are extracted from the segmented region. According to our results, K-means algorithm has the average accuracy, precision, and sensitivity equal to 99.82%, 92.83%, and 48.44%, respectively, and the average computation time is 4.31 s. As for the Fuzzy C-means algorithm, we report those values: 99.87, 80.59, 53.17%, and the average computation time is 346.29 s. Finally, for the proposed Expectation–Maximization algorithm, the values are 99.96, 82.38, and 84.52%, with the average computation time equal to 58.02 s. Fuzzy C-means produce better results than K-means segmentation, but it requires more computation time than K-means segmentation. Our proposed method has much better results than the other two methods and can find the renal stones in less than a minute.