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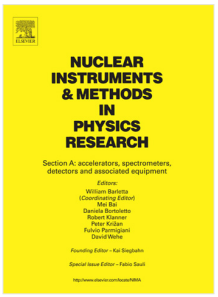

Performance evaluation of image denoising developed using convolutional denoising autoencoders in chest radiography

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Title: Performance evaluation of image denoising developed using convolutional denoising autoencoders in chest radiography

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Abstract

When processing medical images, image denoising is an important pre-processing step. Various image denoising algorithms have been developed in the past few decades. Recently, image denoising using the deep learning method has shown excellent performance compared to conventional image denoising algorithms. In this study, we introduce an image denoising technique based on a convolutional denoising autoencoder (CDAE) and evaluate clinical applications by comparing existing image denoising algorithms. We train the proposed CDAE model using 3000 chest radiograms training data. To evaluate the performance of the developed CDAE model, we compare it with conventional denoising algorithms including median filter, total variation (TV) minimization, and non-local mean (NLM) algorithms. Furthermore, to verify the clinical effectiveness of the developed denoising model with CDAE, we investigate the performance of the developed denoising algorithm on chest radiograms acquired from real patients. The results demonstrate that the proposed denoising algorithm developed using CDAE achieves a superior noise-reduction effect in chest radiograms compared to TV minimization and NLM algorithms, which are state-of-the-art algorithms for image noise reduction. For example, the peak signal-to-noise ratio and structure similarity index measure of CDAE were at least 10% higher compared to conventional denoising algorithms. In conclusion, the image denoising algorithm developed using CDAE effectively eliminated noise without loss of information on anatomical structures in chest radiograms. It is expected that the proposed denoising algorithm developed using CDAE will be effective for medical images with microscopic anatomical structures, such as terminal bronchioles.

Keyword: Image denoising; Deep learning; Denoising autoencoder; Chest radiography