

## Accepted Manuscript

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

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PII: S0168-9002(17)31456-0  
DOI: <https://doi.org/10.1016/j.nima.2017.12.050>  
Reference: NIMA 60391

To appear in: *Nuclear Inst. and Methods in Physics Research, A*

Received date: 14 August 2017  
Revised date: 23 October 2017  
Accepted date: 15 December 2017

Please cite this article as: D. Lee, S. Choi, H.-J. Kim, Performance evaluation of image denoising developed using convolutional denoising autoencoders in chest radiography, *Nuclear Inst. and Methods in Physics Research, A* (2017), <https://doi.org/10.1016/j.nima.2017.12.050>

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

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13 Abstract

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

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

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