JBFnet - Low Dose CT Denoising by Trainable Joint Bilateral Filtering

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Abstract. "Deep neural networks have shown great success in low dose CT denoising. However, most of these deep neural networks have several hundred thousand trainable parameters. This, combined with the inherent non-linearity of the neural network, makes the deep neural network difficult to understand with low accountability. In this study we introduce JBFnet, a neural network for low dose CT denoising. The architecture of JBFnet implements iterative bilateral filtering. The filter functions of the Joint Bilateral Filter (JBF) are learned via shallow convolutional networks. The guidance image is estimated by a deep neural network. JBFnet is split into four filtering blocks, each of which performs Joint Bilateral Filtering. Each JBF block consists of 112 trainable parameters, making the noise removal process comprehendable. The Noise Map (NM) is added after filtering to preserve high level features. We train JBFnet with the data from the body scans of 10 patients, and test it on the AAPM low dose CT Grand Challenge dataset. We compare JBFnet with state-of-the-art deep learning networks. JBFnet outperforms CPCE3D, GAN and deep GFnet on the test dataset in terms of noise removal while preserving structures. We conduct several ablation studies to test the performance of our network architecture and training method. Our current setup achieves the best performance, while still maintaining behavioural accountability". [1]

References

1. Patwari M, Gutjahr R, Raupach R, Maier A. JBFnet - Low Dose CT Denoising by Trainable Joint Bilateral Filtering. In: Martel, Anne L and Abolmaesumi, Purang and Stoyanov, Danail and Mateus, Diana and Zuluaga, Maria A and Zhou, S Kevin and Racoceanu, Daniel and Joskowicz, Leo, editor. Medical Image Computing and Computer Assisted Intervention – MICCAI 2020. Springer International Publishing; 2020. p. 506–515. Available from: http://dx.doi.org/10.1007/978-3-030-59713-9_49.