

Comparison of CNN based and self-similarity based denoising methods

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Motivation

- Denoising images has been an important research topic in computational imaging, especially in low level vision.
- We implement two state-of-the-art denoising techniques for Gaussian noise, both a traditional method (BM3D) and a deep learning method (DnCNN), and compare with the NLM method.

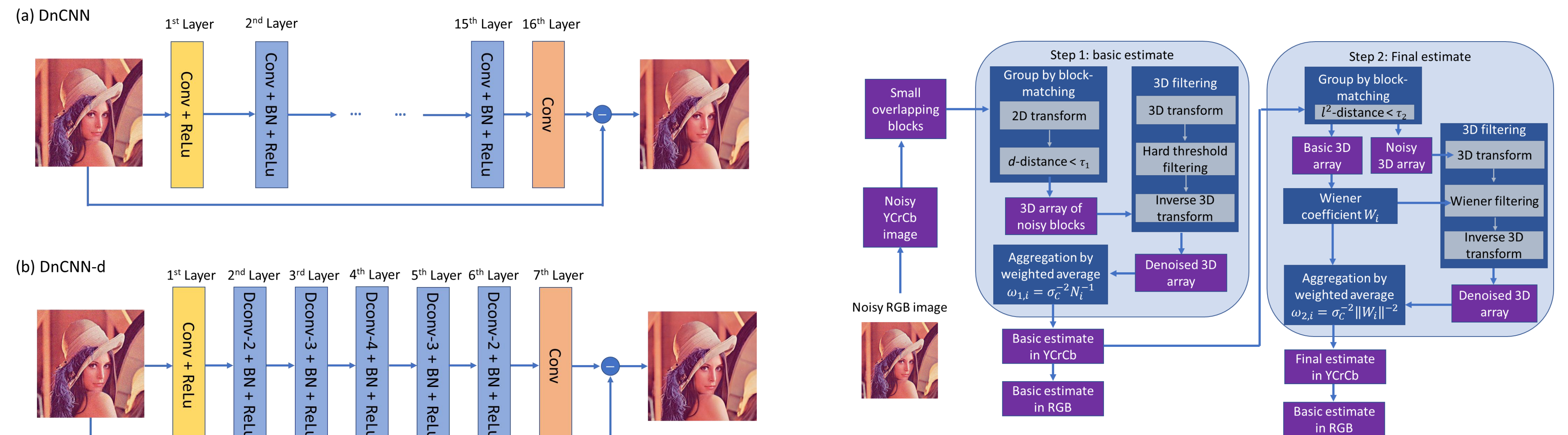
Related Work

- NLM [1] is one of the simplest and most efficient self-similarity based models.
- BM3D [2] is one of the state-of-the-art denoising methods. BM3D also exploits self-similarity in the image.
- DnCNN [3] is based on deep neural network using residual learning technique.
- Dilated convolution [4] can be used to decrease computational cost.

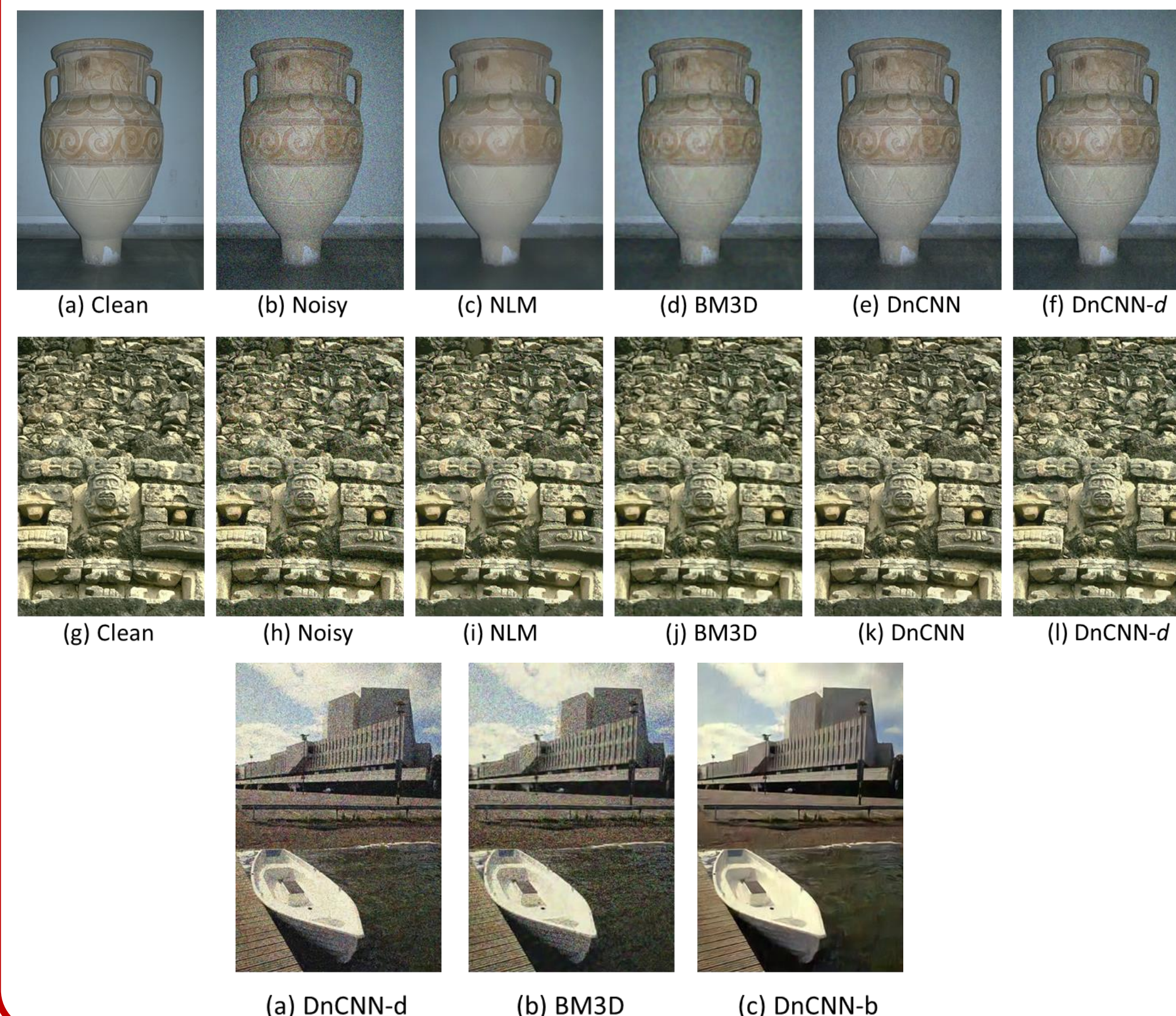
References

- [1] A. Buades, B. Coll and J. -. Morel, "A non-local algorithm for image denoising," 2005 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'05), USA, 2005, pp. 60-65 vol. 2
- [2] F. Dabov, E. Katkovnik, "Image denoising by sparse 3D transform-domain collaborative filtering", IEEE Trans. Im. Proc. 2007.
- [3] K. Zhang, W. Zuo, Y. Chen, D. Meng, "Beyond a Gaussian Denoiser: Residual Learning of Deep CNN for Image Denoising," IEEE Transactions on Image Processing, Volume: 26, Issue: 7, July 2017
- [4] T. Wang, M. Sun and K. Hu, "Dilated Deep Residual Network for Image Denoising," 2017 IEEE 29th International Conference on Tools with Artificial Intelligence (ICTAI), Boston, MA, 2017, pp. 1272-1279.

Method



Results



Noise level	NLM	BM3D	DnCN N	DnCNN-d	DnCNN -b
25					
PSNR	27.50	28.25	31.00	30.46	30.77
SSIM	0.7996	0.8169	0.9324	0.9243	0.9293
Test time(s)	30.86	247.0	1.583	0.9528	0.9630

- BM3D and NLM denoising works better for images with less details and more regular patterns.
- DnCNN has better performance for images with irregular structures.
- Challenges:
 1. BM3D algorithm is quite complex
 2. Working with tensorflow and training the networks
- Future work: Combine BM3D with DnCNN