Improving Denoising Algorithms via a Multi-scale Meta-procedure

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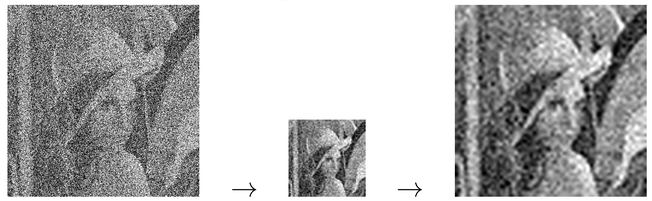
Teaser: Results on strong noise

noisy, $\sigma = 200$ PSNR: 7.59dB | BM3D [1] PSNR: 18.88dB | BM3D+our approach PSNR: 20.96dB

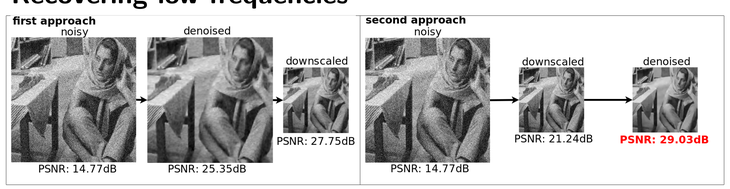
Denoising by downscaling



noisy | down-sampled | up-sampled

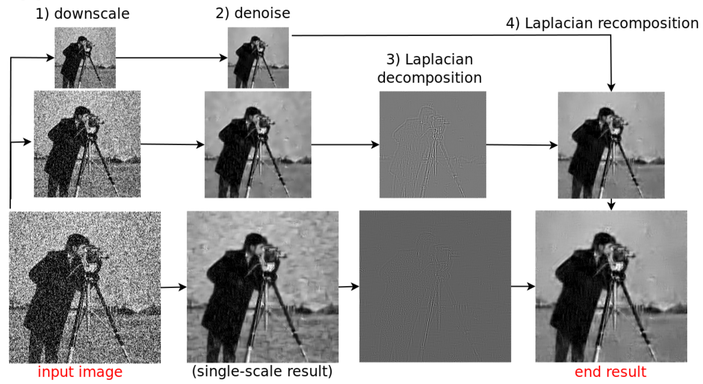
→ Down-scaling averages out the uncorrelated values of the noise.

Recovering low frequencies



→ Denoising algorithms are not good at recovering large scale (low frequency) information.

Approach outline

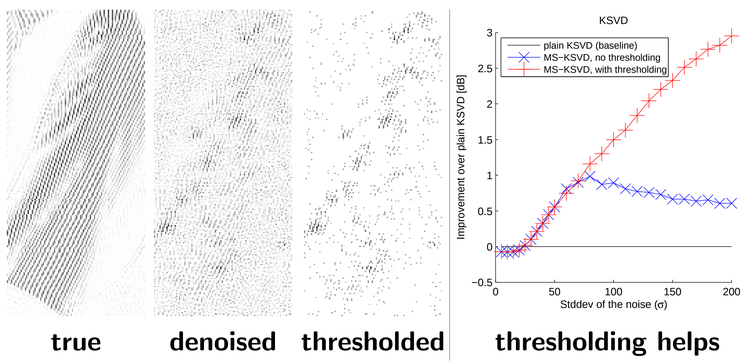


1. Denoise at different scales
2. Combine results using Laplacian pyramids.

Why it works:

- Images have most energy in low frequencies.
- Noise is uniformly spread across the spectrum.
- Many denoising algorithms are not good at recovering low frequency information.
- Down-sampling effectively transforms low-frequency information into high-frequency information.

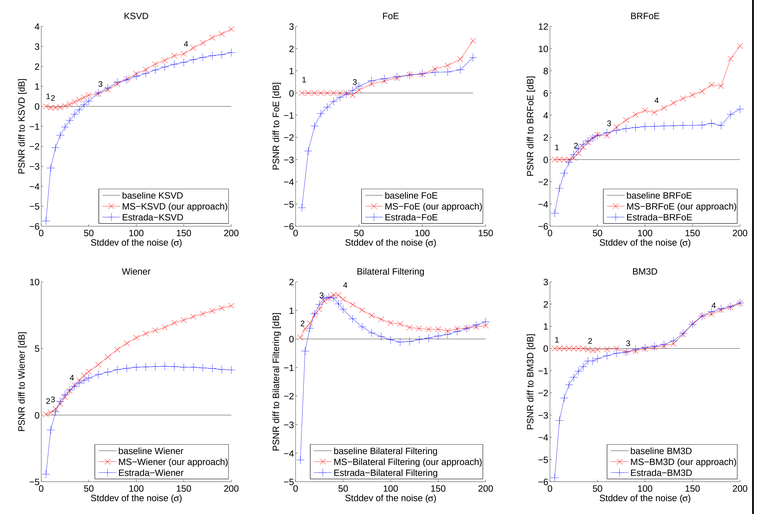
Shrinking high frequency coefficients



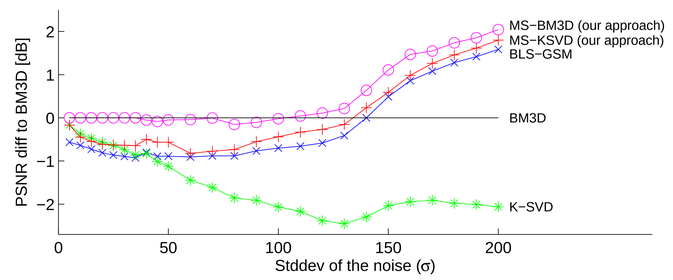
true | denoised | thresholded | thresholding helps

→ At very high noise levels, the denoising algorithm becomes incompetent at recovering high-frequencies.

Results of our approach vs. Estrada's [3] for six denoising algorithms [2], [4], [6], [5], [1]



Results compared to BM3D [1]



References

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[4] S. Roth and M.J. Black. Fields of experts. *International Journal of Computer Vision*, 82(2):205–229, 2009.

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