

Denoising for amplified Magnetic Resonance Imaging (aMRI)

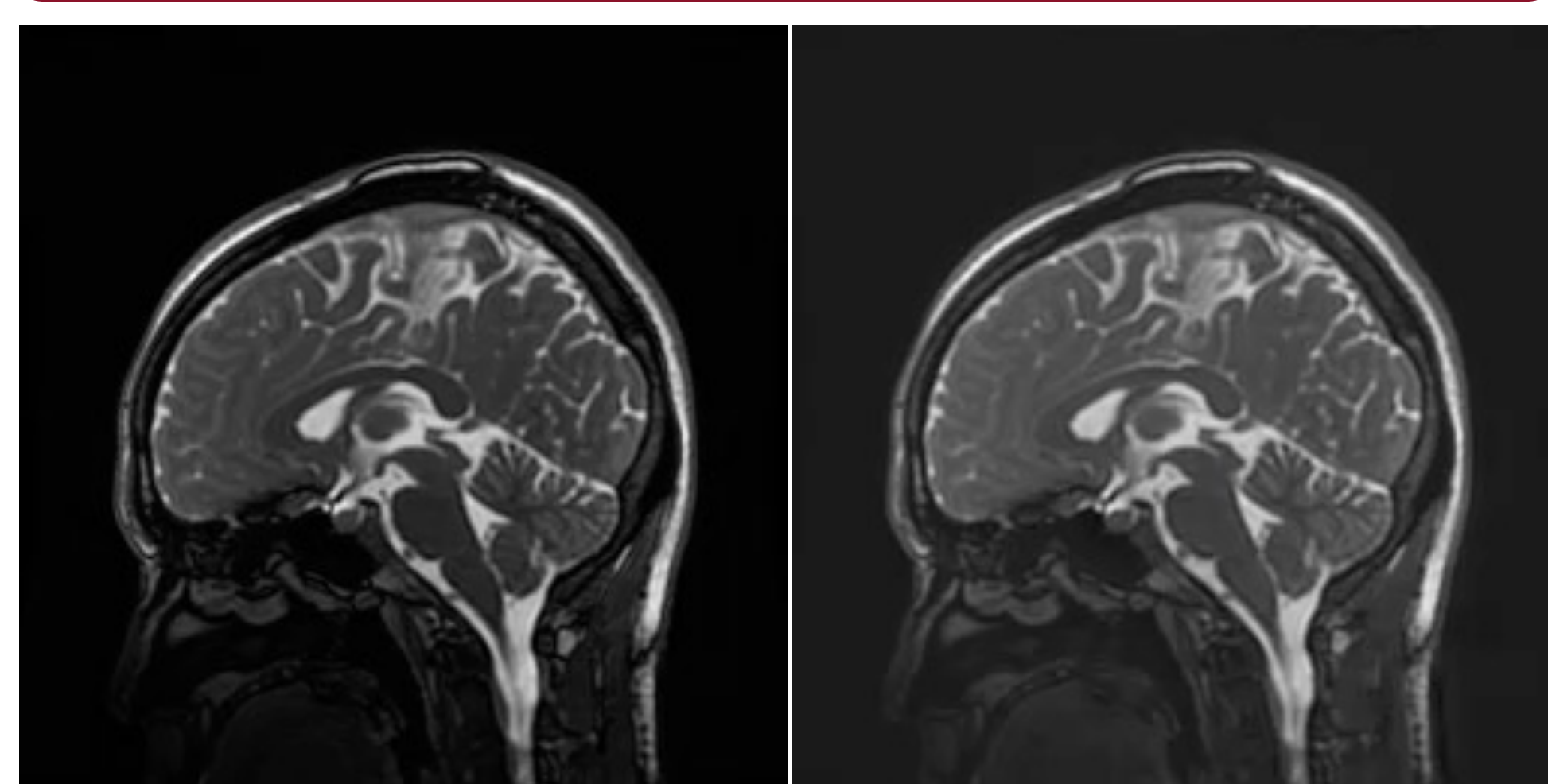


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Motivation

Amplified MRI (aMRI) [1,2] has been introduced recently as a new brain motion detection and visualization method, which enables one to dramatically amplify the brain tissue response due to blood pulsation and Cerebrospinal Fluid (CSF) motion. One limitation of aMRI is its sensitivity to noise. In this work, we evaluated the performances of different denoising algorithms, namely Non-Local Means (NLM), Block-Match and 3D Filtering (BM3D), and DnCNN for their ability to improve aMRI output in the present of different noise levels. Our analysis shows that BM3D offered the best denoising results (highest PSNR and SSIM scores) while maintaining enough magnification and minimal noise motion artifacts.

Background & Related Work



Original

Amplify

Visualization of pulsatile brain motion:

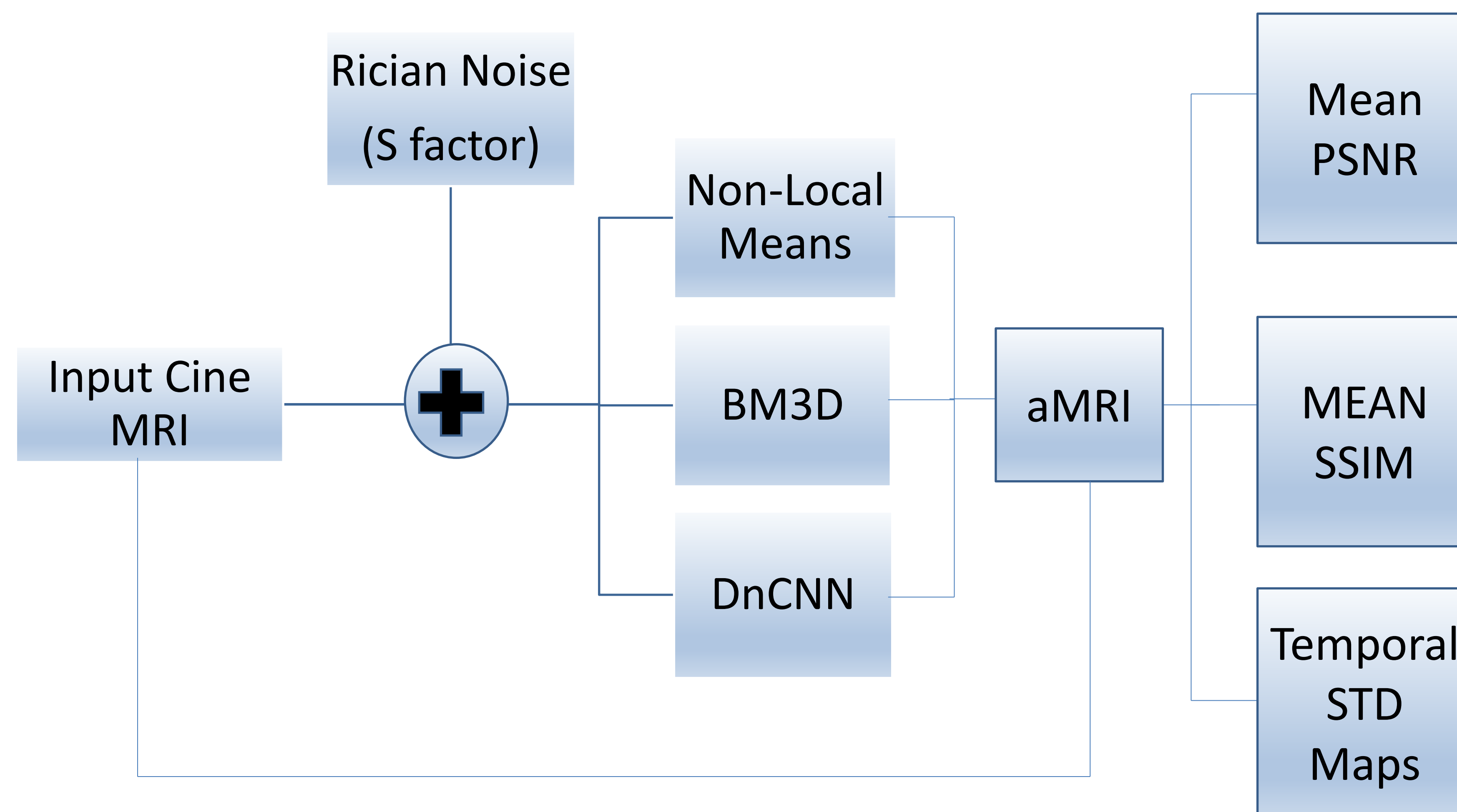
- Phase Contrast MRI [3]
- Displacement Encoded Imaging with Stimulated Echoes (DENSE) MRI [4]

MRI Denoising Algorithm:

- NLM [5]
- BM3D [6]
- Multi-Channel Residual Learning of Convolutional Neural Network (MCDnCNN) [7]

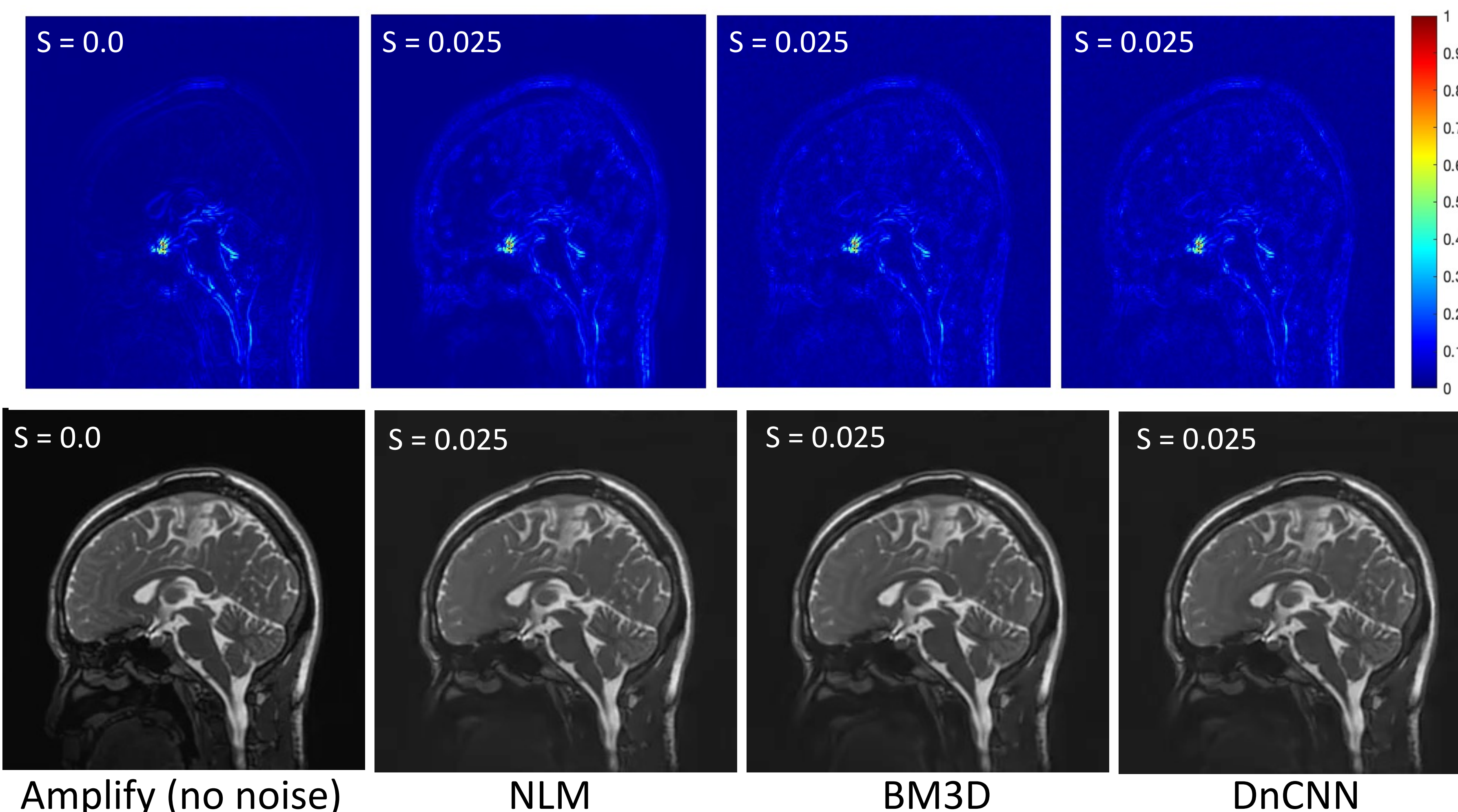
The first-time denoising algorithm are tested to improve aMRI performances

Flow Diagram



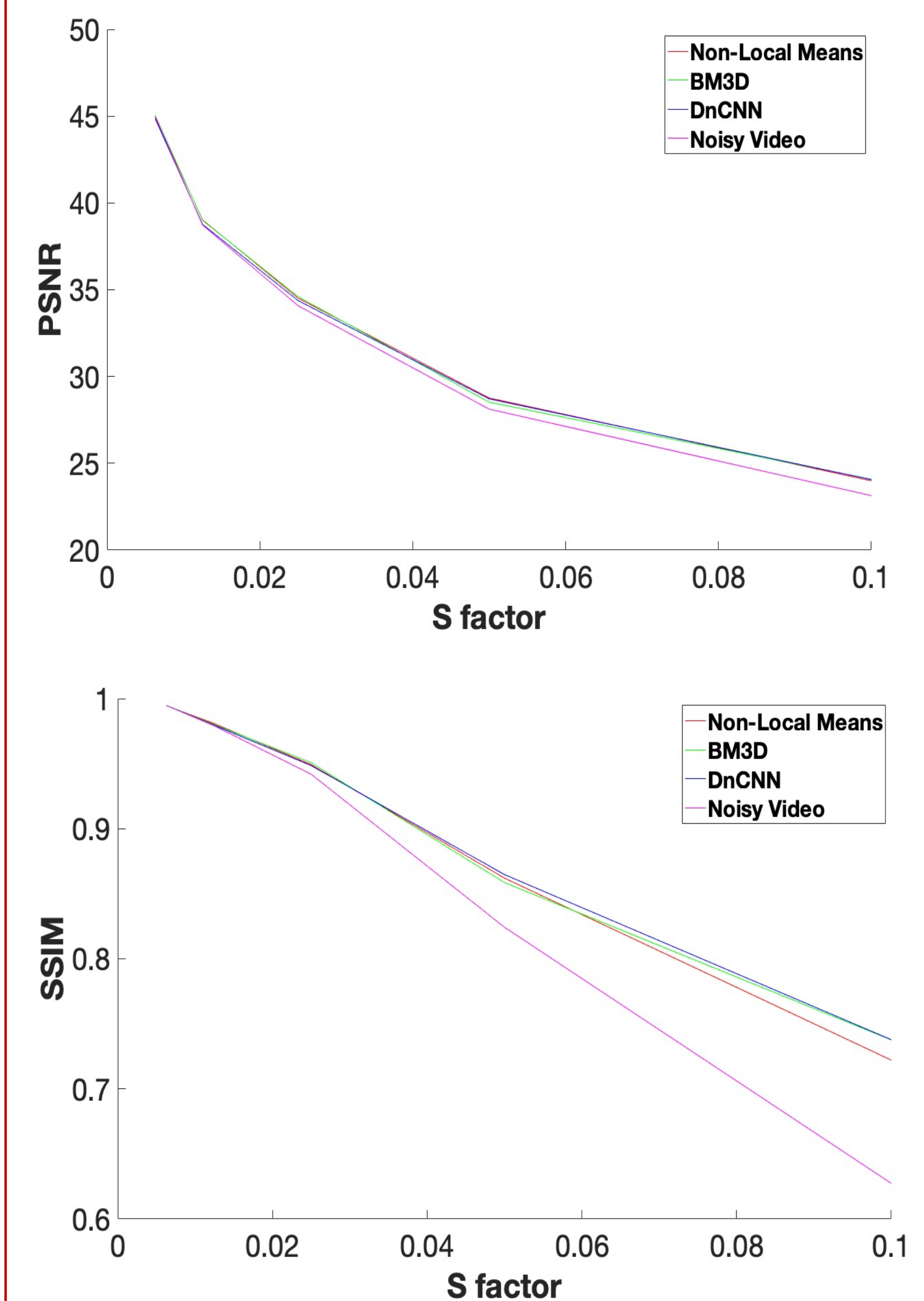
Qualitative Results

Normalize Temporal Standard Deviation Maps



Quantitative Results

Denoising Algorithm	Mean PSNR (S = 0.025)	Mean SSIM (S = 0.025)
Noisy Video (reference)	34.078	0.941
NLM	34.517	0.949
BM3D	34.599	0.950
DnCNN	34.374	0.948



Discussion

- Among the three denoising methods BM3D got the highest PSNR and SSIM scores.
- Significant temporal noise was observed in all denoise movies.
- For low level of Rician noise ($S < 0.025$) the resulting amplified denoised videos are comparable to the reference amplify video, but for ($S > 0.025$) the resulting amplified denoise videos contain significant amount to motion artifacts
- Future work should include temporal spatial denoising in addition to hyper parameter tuning.

References

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