

Denoising of Magnetic Resonance Images

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Motivation

- Magnetic resonance imaging (MRI) is an excellent modality for soft tissue imaging.
- However, MR images are often susceptible to low SNR. This can be especially problematic for performing quantitative imaging where measurements are intrinsically SNR limited.



Fig: Sampled images for use in quantitative MRI

New Technique

- I propose to compare the functionality of denoising algorithms such as bilateral filtering (BF), non-local means (NLM), and block-matching and 3D filtering (BM3D) by evaluating **SNR improvement**, **run-time**, and **visual quality**.
- I propose to tailor the use of denoising methods to accommodate a **Rician noise model** that is at play in low-SNR magnetic resonance imaging.

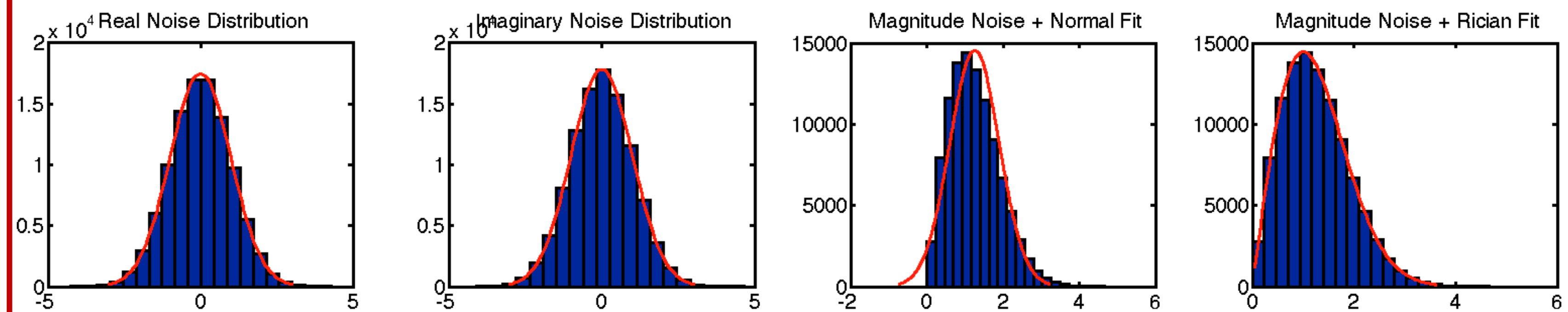
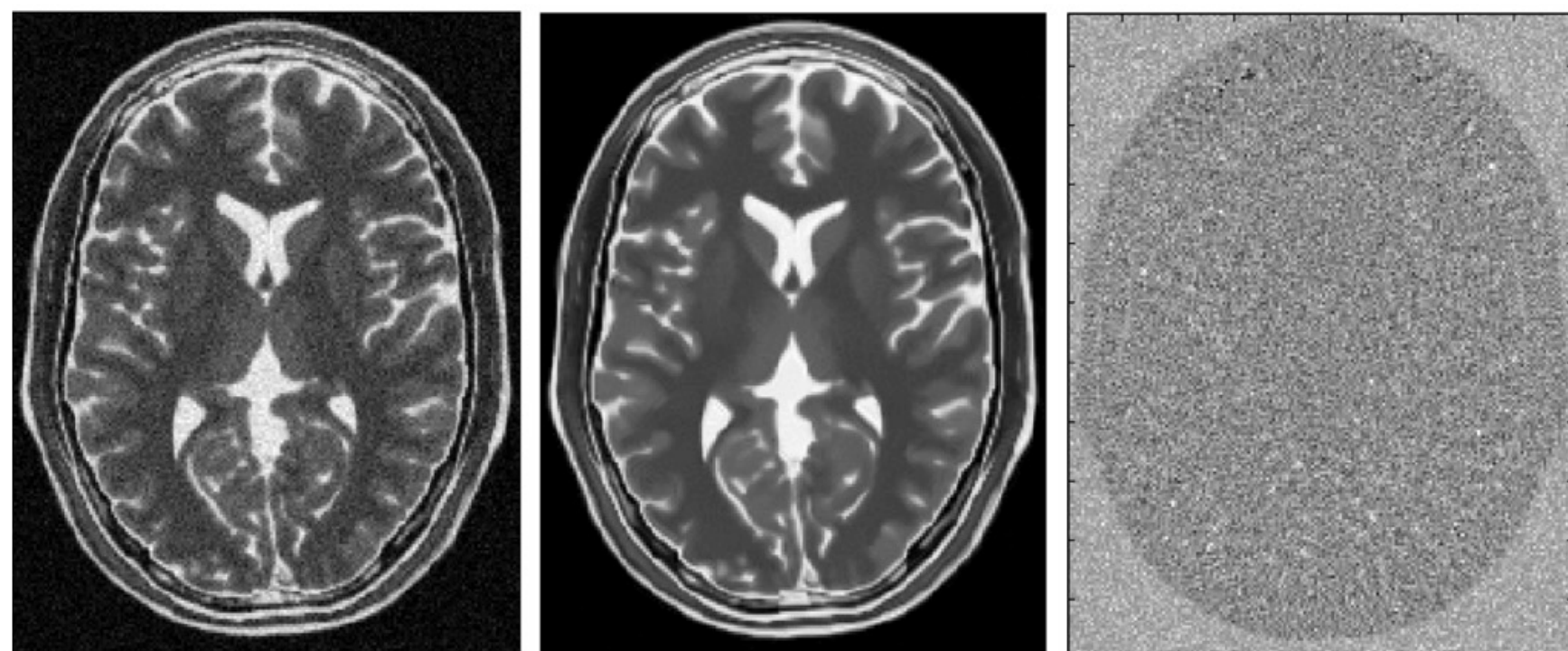


Fig: Noise statistics in low SNR MRI. Rician versus normal models.

- I will implement genetic algorithms to improve parameters in use in BM3D.

Related Work

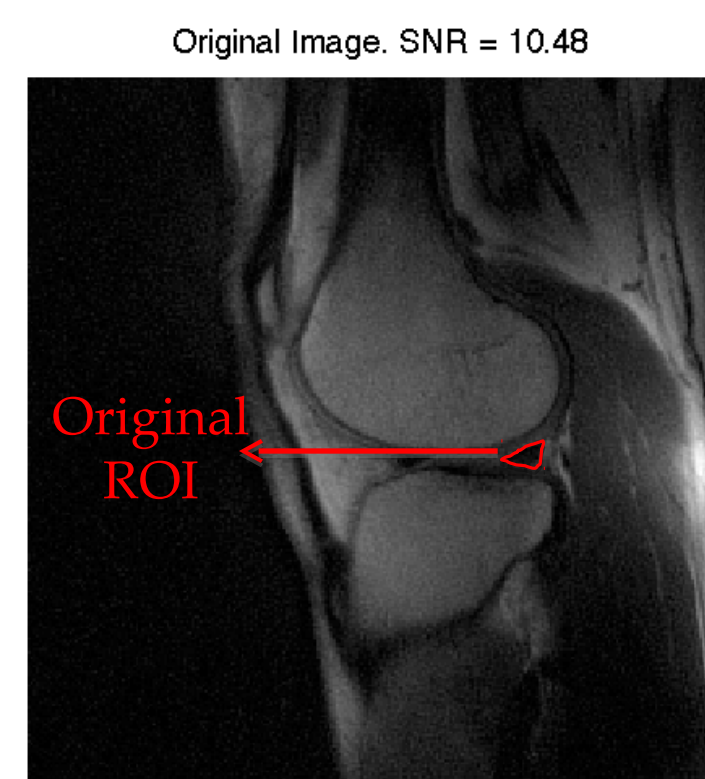
- In the past, relatively primitive denoising algorithms such as non-local means (NLM) have been used in limited quantities¹.
- However, denoising has so far only been applied for qualitative SNR improvement.



1. Manjón, José V., et al. "MRI denoising using non-local means." Medical image analysis 12.4 (2008): 514-523.

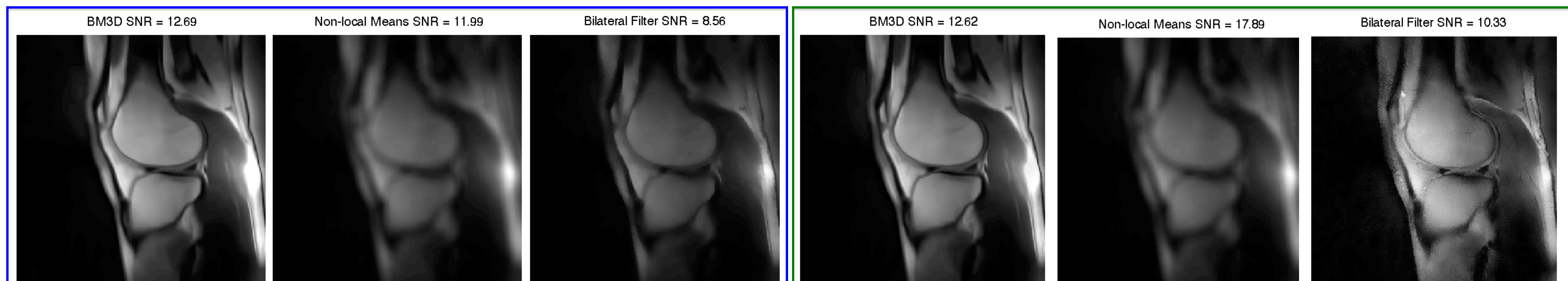
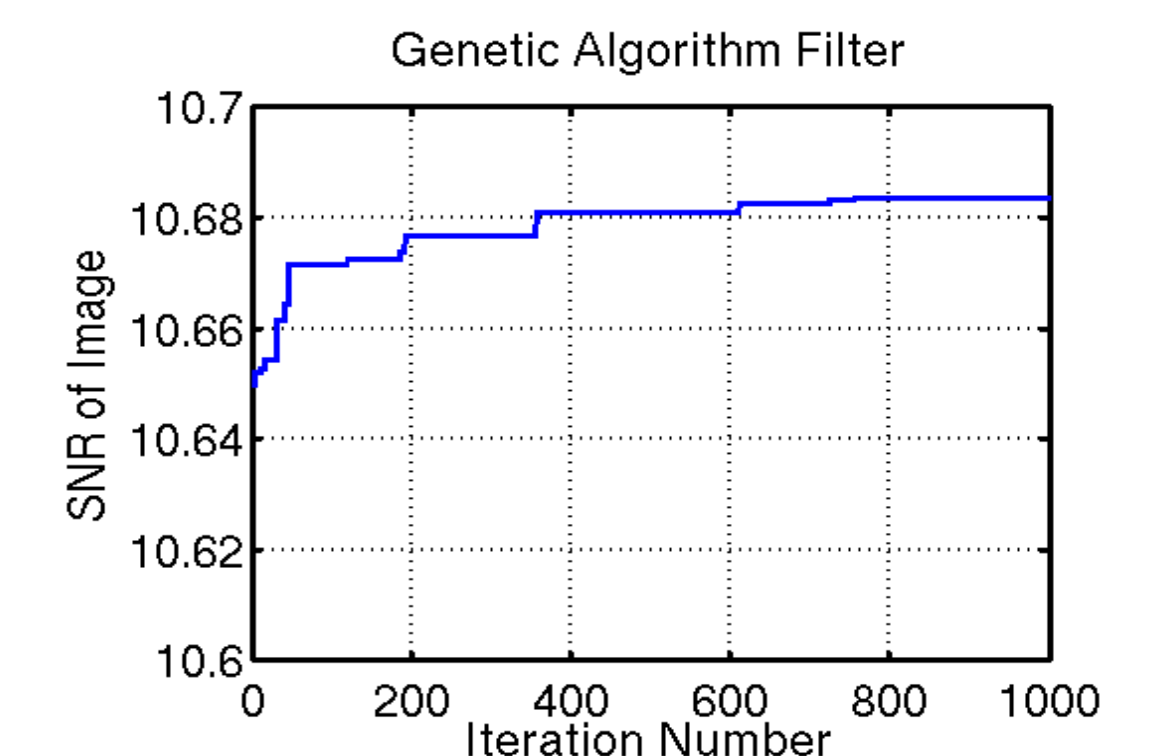
Fig: NLM increases SNR but decreases resolution¹.

Experimental Results



Method	Time	SNR Gain [‡]	Quality*
NLM	33.2 s	70.7%	1
BF	6.0 s	-1.2%	2
BM3D	0.6 s	20.4%	4

[‡] For complex denoising. * 1 = Worst, 5 = Best



Magnitude Denoising

Complex Denoising