Author’s response to reviews

Title: An Enhanced Adaptive Non-Local Means Algorithm for Rician Noise Reduction in Magnetic Resonance Brain Images

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Dear Editors and Reviewers:

Thank you for your letter and for the reviewers’ comments concerning our manuscript entitled “An Enhanced Adaptive Non-Local Means Algorithm for Rician Noise Reduction in Magnetic Resonance Brain Images” (BMIM-D-19-00279R1). Those comments are all valuable and very helpful for revising and improving our paper, as well as the important guiding significance to our researches. We have studied comments carefully and have made correction which we hope meet with approval. Revised portion are marked in yellow in the paper. The main corrections in the paper and the responds to the reviewer’s comments are as flowing:

Responds to the reviewer’s comments:

Reviewer 1: Junaid Ahmed
1. In Abstract section, the sentence ‘The Rician noise formed in the imaging process of magnetic resonance (MR) images reduced greatly the accuracy and reliability in the subsequent processing and analysis.’ is grammatically incorrect & needs to be paraphrased.
Responds: We have paraphrased the sentence as following: The Rician noise formed in the imaging process of magnetic resonance (MR) had greatly reduced the accuracy and reliability in the subsequent analysis.

2. Kindly mention the full form of ‘FANLM’ in the Abstract section.
Responds: We have mentioned the full form of ‘FANLM’ in the Abstract section. FANLM (fuzzy c-means and adaptive non-local means)

3. In Abstract section, under the sub-heading of Methods, the sentence ‘The algorithm adaptively chose the optimal size of search window according to the estimated noise variance by using the improved median absolute deviation (MAD) estimator for Rician noise in the wavelet domain, and solved the problem that the traditional NLM algorithm used the fixed search window size in calculation.’ is grammatically incorrect & needs to be paraphrased. Also, kindly break the long sentence into one or more sentences for better understanding.
Responds: We have paraphrased the sentence as following: The algorithm chose the optimal size of search window automatically based on the noise variance which was estimated by the improved estimator of median absolute deviation (MAD) for Rician noise. In the meanwhile, it solved the problem that the traditional NLM algorithm have to use the fixed size of search window.

4. In background section, the sentence-'The accuracy of clinical diagnosis depends on the quality of the MR image, while the noise generated during the imaging process reduces the quality of the MR image, making the boundaries of some tissue boundaries and structures blurred, increased the difficulty of recognition and analysis of image details...' is too long and needs to be broken down to one or more sentences for ease of understanding.
Responds: We have paraphrased the sentence as following: The accuracy of clinical diagnosis is dependent on the quality of the MR image, but the noise generated during the imaging process reduces the quality of the MR image. So it made the boundaries of some tissue structures blurred, which had increased the difficulty to recognize the image details.

5. In background section, the sentence-'The original NLM algorithm was designed to remove Gaussian noise, but it has also begun to be applied to MR image denoising and it has better results than using the Gaussian filter, Wiener filter and etc.' is grammatically incorrect & needs to be paraphrased.
Responds: We have paraphrased the sentence as following: The original NLM algorithm was designed to remove Gaussian noise, but when it was applied to remove the MR image noise, it had been found better than the Gaussian filter, Wiener filter and etc..

6. In background section, what is the meaning of the sentence-'First of all, it is different from the assumptions that the noise obeys the Gaussian distribution proposed in [13,14]...'. Are you telling the readers to look up the references and automatically understand what you are trying to convey? This format of writing is completely unacceptable.
Responds: We have elaborated [13,14] and explained the two references in a previous paragraph. Maybe we didn’t express ourselves clearly, and we have paraphrased the sentence as following: As we mentioned above, the proposed methods in [13,14] were based on the assumption that the noise is modeled as the Gaussian distribution.

7. Please mention the full forms of the 'NLM, LMMSE and UWT'
Responds: We have mentioned the full forms of the 'NLM, LMMSE and UWT' in the paper. NLM (non-local means), LMMSE (linear minimum mean square error) and UWT (undecimated wavelet transform).

8. In Method section, the sentence-'They didn't use the regular Euclidean distance in the weight function, while calculated the distance between blocks based on the edge graph instead, therefore the weight function adaptively changed along with the calculated similar distances.' is grammatically incorrect & needs to be paraphrased.
Responds: We have paraphrased the sentence as following: They didn’t use the regular Euclidean distance in the calculation of weight function, while calculated the distance between blocks based on the edge graph. Therefore, the weight function had changed automatically along with the calculation of similar distances.
9. In method section, the sentence- 'However, FCM also has limitations: it can only segment simple texture images and also is sensitive to noise, it can't work well for noisy images.' is grammatically incorrect & needs to be paraphrased.
   Responds: We have paraphrased the sentence as following: However, FCM has its limitations: it can only segment simple texture images and is sensitive to noise, so it can’t work well for noisy images.

10. In Method section, the sentence- 'Gong, M et al. and Maoguo, G et al. make some improvements in FLICM while the computational complexity was higher.' is grammatically incorrect & needs to be paraphrased.
    Responds: We have paraphrased the sentence as following: Gong, M et al. and Maoguo, G et al. made some improvements in FLICM while the computational cost was still high.

11. In Results section, in the sentence- 'The picture below Fig. 4 displays the original MR image (noise level of 9%) and the denoise results using those four methods', what does picture below Fig 4 mean?
    Responds: We have already corrected the misunderstanding of this sentence. We modified it to "As shown in The Fig. 4, it displays the original MR image (noise level of 9%) and the denoise results that used those four methods."

12. Discussion is too short & abrupt. Needs to be expanded for better understanding.
    Responds: We have added some analysis into Discussion and expanded the experiment results of Table 2 for better understanding.

13. Grammatical errors are present throughout the manuscript and needs to be corrected.
    Responds: The grammar errors have been checked and corrected in the revised manuscript, and revised portion are marked in yellow in the paper.

14. The written style of the manuscript & the formatting is a little hard to understand and needs to be written in a more simplified manner for better understanding.
    Responds: We have modified the written style of the manuscript and the formatting.

Reviewer 2: Boguslaw Tomanek
1. How the theory was implemented? I mean what software was used?
   Responds: We used MATLAB, and the theory was implemented in MATLAB. MATLAB is a technical computing environment for high-performance numeric computation and visualization.

2. The authors mentioned MATLAB. Was any other program used?
   Responds: No, MATLAB is perfect to implement our methods

3. What was the total calculation time? using what processor(s)?
   Responds: The total calculation time is 9.43s at 9% Rician noise levels, and Table.1 and Table.2 show the calculation time obtained from four methods with different MR images. These results are obtained on Intel(R) Core i5-3470, 3.40Ghz CPU and 4GB RAM.
Minor comments:
1. Define variables (p(Ni), a, h etc) … in eq. (2)
   Responds: We have added the definition of variables (p(Ni), a and h) into the revised manuscript

2. Abstract: In Conclusions: "However, the FANLM method takes long to select the window size and the steps are slightly cumbersome" .. "takes long time"… how much time exactly (at least provide estimate, minutes?, hrs?); explain "slightly cumbersome"?
   Responds: We modified it to" However, the FANLM method took an average of 13s throughout the experiment, and its computational cost was not shortest."
Our proposed method is to select the optimal size of search window. First, we should estimate the noise variance by the improved MAD estimator for Rician noise. And then we need to compare the variance obtained from the original images and filtered images among small(s), medium(m), large(l) search windows. So the steps are slightly complicated and takes longer time than LMMSE method. We think it was the main reason of computational burden.

3. English needs improvement, for example: "the problem that the traditional NLM algorithm used the fixed search window size in calculation" .. "making the boundaries of some tissue boundaries"; "time required of NLM method". Images got after being filtered" These are just examples, there are more spelling/grammar mistakes in the text.
   Responds: The spelling/grammar mistakes have been checked and corrected.

4. Define FANLM and other abbreviation (eg. NLM, UWT etc) in the text, not only at the end.
   Responds: The FANLM and other abbreviations has been added into the revised manuscript.
   We tried our best to improve the manuscript and made some changes in the manuscript. These changes will not influence the content and framework of the paper. And here we did not list the changes but marked in yellow in revised paper.
   We appreciate for Editors/Reviewers’ warm work earnestly, and hope that the correction will meet with approval.
   Once again, thank you very much for your comments and suggestions.

Yours sincerely,

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