Author’s response to reviews

Title: An Automatic Restoration Framework Based on GPU-Accelerated Collateral Filtering in Brain MR Images

Authors:

Herng-Hua Chang (herbertchang@ntu.edu.tw)
Cheng-Yuan Li (greent911@gmail.com)

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Author’s response to reviews:

We greatly appreciate the efforts of the reviewers in carefully scrutinizing and constructively criticizing the submitted manuscript, which were tremendously helpful in preparing this revision. Accordingly, we have deliberately revised the manuscript to address the criticisms and suggestions made by the reviewers. Please find our point by point responses below. For your convenience, all major revision phrases have been highlighted.

Reviewers’ Comments

Yudong Zhang (Reviewer 1):

This paper first accelerated the collateral filter with parallel computing using the graphics processing unit (GPU) architecture. The authors adopted the compute unified device architecture (CUDA), an application programming interface for the GPU by NVIDIA, to hasten the computation.

(1) Line 61, "square" should be "squared".

Response: It has been corrected (Line 64) in the revised manuscript.

(2) Except GPU, please also discuss TPU.

Response: In the revised manuscript, we have discussed the TPU in Lines 89-92.

(3) Line 112, why collateral filtering is important in your method? Please discuss local filter method.

Response: We appreciate the reviewer’s comment. The collateral filter has been shown more powerful than many existing methods as described in Lines 86-88 in the revised manuscript. This
paper aims to optimize this filter with more thorough evaluation. Local filter methods such as the Gaussian and median filters have been discussed in Lines 53-56 and 85-86 in the revised manuscript.

(4) Line 197, how to calculate the image mean?
Response: It should be “intensity mean” and has been corrected as “mean intensity” (Line 207) in the revised manuscript.

(5) Line 229, can you give the formula of Tamura features?
Response: Their formulas have been stated in Line 246 and described in Appendix in the revised manuscript.

(6) Did you consider to use convolutional neural network, which can extract features automatically.
Response: We appreciate the reviewer’s comment. We did not try modern convolutional neural networks (CNNs) to find the features as CNNs have been shown powerful in segmentation and classification, and require heavy computation. Even though we had applied CNNs to obtain the features, it still required a mechanism to connect them to the filter parameters, which is one of the main contributions of this paper. Nevertheless, we believe that CNNs are worth investigating when more complicated image types are involved in the future.

(7) Results are good. Can you compare your method with state-of-the-art approaches?
Response: To address this comment, we have included two more state-of-the-art methods, namely NLM and BM3D, for more thorough comparison. Their descriptions are in Lines 75-83 and results are shown in Figs. 4, 5, and 7-9 in the revised manuscript.

(8) Some related papers should be mentioned, see "Twelve-layer deep convolutional neural network with stochastic pooling for tea category classification on GPU platform" and "Polarimetric synthetic aperture radar image segmentation by convolutional neural network using graphical processing units".
Response: These two papers have been stated in Lines 99-101 and cited in the revised manuscript.

Reviewer 2:
GENERAL COMMENTS: Authors have found the parallel adaptability of collateral filter in CUDA programming. Shared memory is used to improve the speedup. In addition, optimal features were found using t-test and SFFS methods. Results are represented in terms of qualitative and quantitative level. This results have accepted level (PSNR>30db) and the method has novelty. This study motivates the researchers in the field of medical image denoising with CUDA.

ADDITIONAL REQUESTS/SUGGESTIONS:

Minor Revision:

1. Flowchart of the methodology should be included.

Response: The flowchart has been described in Lines 296-297 and shown in Fig. 2 in the revised manuscript.

2. Programming language of CPU is not provided throughout the manuscript. If it is MATLAB? or C? or Python?

Response: The programming language has been stated in Lines 323-325 in the revised manuscript.

3. Qualitative comparison between CPU and GPU is not given.

Response: We have included the qualitative comparison between CPU and GPU, which is summarized in Table 1, shown in Fig. 3, and described in Lines 332-337 in the revised manuscript.

4. Author should explain why used pixel per thread instead of voxel per thread.

Response: In the revised manuscript, we have included the explanation in Lines 194-195.

5. Background of CUDA is general. Paragraph 1 and 2 from page 4 may be reduced. Paragraph 2 from page 8 may be combined with background of CUDA.

Response: To address this comment, we have significantly removed unnecessary phrases on pg. 4 and combined the background knowledge on pg. 8 to pg. 4 to make the description precise, which appeared on pgs. 4 and 5 in the revised manuscript.

6. Line 171 and 172 are not properly aligned.
Response: It has been corrected in the revised manuscript.