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Performance evaluation of total variation noise reduction algorithm with self-produced AAPM computed tomography phantom by using 3D printer

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Recently, many studies for development of the algorithm using image processing have been conducted to reduce the noise in medical image [1]. In this study, we proposed total variation (TV) noise reduction algorithm and confirmed application feasibility in the self-produced phantom by 3D printer. For that purpose, we designed the TV noise reduction algorithm using L1-norm gradient operator that can maintain a stable signal than L2-norm. In addition, a self-produced phantom was designed based on AAPM computed tomography (CT) performance phantom, and manufactured using a 3D printer of the fused filament fabrication technique with polylactic acid filament. To quantitatively evaluate image performance, we calculated the coefficient of variation (COV) and contrast to noise ratio (CNR) of the proposed TV noise reduction algorithm and conventional noise reduction algorithm (median filter and Wiener filter). Fig. 1 shows the result images, COV, and CNR results in this study. According to the results, the COV and CNR values of the TV noise reduction algorithm applied images show improvement values more than conventional noise reduction algorithms. Especially, COV and CNR values were improved averagely about 3.89 and 3.12 times, compared to original image. In conclusion, our results demonstrated that the suggested TV noise reduction algorithm can efficiently remove noise and improve the image quality in CT image.

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