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Development of a deep learning method for CT-free correction for an ultra-long axial field of view PET scanner

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Introduction: The possibility of low-dose positron emission tomography (PET) imaging using high sensitivity long axial field of view (FOV) PET/computed tomography (CT) scanners makes CT a critical radiation burden in clinical applications. Artificial intelligence has shown the potential to generate PET images from non-corrected PET images. Our aim in this work is to develop a CT-free correction for a long axial FOV PET scanner. Methods: Whole body PET images of 165 patients scanned with a digital regular FOV PET scanner (Biograph Vision 600 (Siemens Healthineers) in Shanghai and Bern) was included for the development and testing of the deep learning methods. Furthermore, the developed algorithm was tested on data of 7 patients scanned with a long axial FOV scanner (Biograph Vision Quadra, Siemens Healthineers). A 2D generative adversarial network (GAN) was developed featuring a residual dense block, which enables the model to fully exploit hierarchical features from all network layers. The normalized root mean squared error (NRMSE) and peak signal-to-noise ratio (PSNR), were calculated to evaluate the results generated by deep learning. Results: The preliminary results showed that, the developed deep learning method achieved an average NRMSE of 0.4±0.3% and PSNR of 51.4±6.4 for the test on Biograph Vision, and an average NRMSE of 0.5±0.4% and PSNR of 47.9±9.4 for the validation on Biograph Vision Quadra, after applied transfer learning. Conclusion: The developed deep learning method shows the potential for CT-free AI-correction for a long axial FOV PET scanner. Work in progress includes clinical assessment of PET images by independent nuclear medicine physicians. Training and fine-tuning with more datasets will be performed to further consolidate the development.

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