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Different Deep Learning Training Strategies for Attenuation and Scatter Correction in PET

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Attenuation correction (AC) and scatter correction (SC) are essential in PET for accurate tracer quantification. Current AC methods use CT scans to derive AC factors but CT-based AC introduces extra radiation and can lead to artefacts due to spatial mismatch between PET and CT. Single scatter simulation is widely used for SC but is sensitive to errors in the attenuation map and relies on iterative reconstruction of emission images. Deep learning (DL) shows promise to improve the accuracy and efficiency of PET AC and SC. Yet, it is challenging to develop a DL solution that works for long axial field-of-view (LAFOV) images and is also tracer-independent. We study different DL frameworks for AC and SC, starting from a non-corrected (NC) PET image as input. Two training strategies are proposed to fine-tune such neural networks for LAFOV PET and multiple tracer studies: (1) A two-stage neural network is trained separately for the tasks of AC and SC, under the premise that AC is multiplicative and object-dependent, while SC is subtractive and distribution-dependent. (2) A co-learning strategy uses NC PET and radiographic projection (scout) images in a multi-branch neural network to extract complementary, modality-specific features. The rationale is to leverage the scout scans for anatomical information to constrain network training. Qualitative and quantitative evaluations showed that both approaches removed artefacts seen with CT-based AC and reduced liver and lung SUVmean bias.

Field

Software and quantification

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