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Sinogram Denoising Using Transformer-based Learned Sinusoidal Patterns

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Low-Dose Positron Emission Tomography (LDPET) technique, designed to minimize radiation burden to patients, is increasingly garnering attention in the PET imaging field. Given the degradation of image quality associated with reduced radiation levels, LDPET imaging requires specialized reconstruction methods or denoising algorithms to enhance image quality and diagnostic accuracy. Most of the recent effective denoising methods utilize CNN. Yet, these architectures often fall short in capturing long-range non-local interactions, potentially resulting in inaccuracies when representing global structures. Considering the benefits of transformer architectures compared to CNNs, our study presents a novel sinogram denoising algorithm customized to improve the quality of PET sinograms. Furthermore, we introduce a sinogram transformer module designed to learn sinusoidal patterns rather than projections from different view angles or radial positions, thereby enhancing sinogram feature extraction. By leveraging a transformer architecture with a self-attention mechanism, this module effectively preserves sinogram inner-structure, leading to superior performance in sinogram denoising and preventing noise from propagating into the image domain. Evaluations conducted on a clinical dataset reveal that our transformer module, which learns sinusoidal patterns, outperforms other methods that learn projections from various view angles or radial positions both qualitatively and quantitatively.

Field

Software and quantification

Primary author: RASHIDY KANAN, Hamidreza (KTH University)

Co-authors: Mr ADELÖW, Anton (KTH University); Prof. COLARIETI-TOSTI, Massimiliano (KTH University)

Presenter: RASHIDY KANAN, Hamidreza (KTH University)

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