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Advanced TOF MLEM reconstruction of a human patient scanned by the modular J-PET

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We present one of the first images for an in vivo scan of a human patient, measured by the modular Jagiellonian positron emission tomographic (J-PET) prototype, which records 511-keV annihilation photons via Compton scattering in plastic scintillators [1]. The original reconstruction algorithm is adapted from the maximum likelihood expectation maximisation (MLEM), with the realistic J-PET system matrix modelling, time-of-flight (TOF) information and attenuation and scatter correction applied [2].

The attenuation map of the patient was measured by a CT scan. The scatter factors were estimated by the single scatter simulation (SSS), implemented in the STIR software [3]. The subsampled SSS-sinogram was acquired using the known attenuation factors and a prior MLEM reconstruction, made without additive corrections and later upscaled by interpolation. As a result, a significant improvement was achieved in noise suppression and resolution recovery for the reconstructed PET image.

[1] Moskal P et al. MedRxiv 2024.02.01.23299028 (2024)
[2] Shopa RY et al. IEEE TRPMS 7 509 (2023)
[3] Thielemans K et al. PMB 57 867 (2012)

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