Supplement to the article:

O. Rainio, J. Hällilä, J. Teuho, and R. Klén: Methods for estimating full width at half maximum.

Details of the experimental data collection and analysis:

Resolution Phantom imaging with the Quadra and HRRT. A resolution phantom injected with 218.6 MBq 18F-FDG was imaged with High Resolution Research Tomograph (HRRT) concept camera (Siemens, Erlangen, Germany) and PET/CT scanner Biograph Vision Quadra (Siemens Healthineers).

The HRRT represents a high-resolution dedicated brain imaging system with resolution up to 2 - 3 mm (de Jong et al. 2007), whereas the Quadra represents a total body imaging system with a resolution of 3 - 6 mm (Prenosil et al. 2023). The resolution phantom has cylindrical cavities with a diameter of 5 mm, 4 mm, 3 mm and 2 mm which are filled with radioactivity. The resolution phantom is shown in Supplement Figure 1.

The phantom data was collected in two consecutive measurements to ensure identical filling on both systems. The phantom was imaged first on the HRRT for 2 hours and was thereafter moved to Quadra where the imaging time was 6 hours. The calculated activities at scan start time were 189.05 MBq and 85.32 MBq, respectively. The PET emission data from the phantom was reconstructed using different total imaging times varying from 15 to 360 minutes, which were used to simulate different noise realizations of the data. The exact imaging times were 15, 30, 60 and 120 minutes for the HRRT and 35, 76, 190 and 360 minutes for the Quadra.

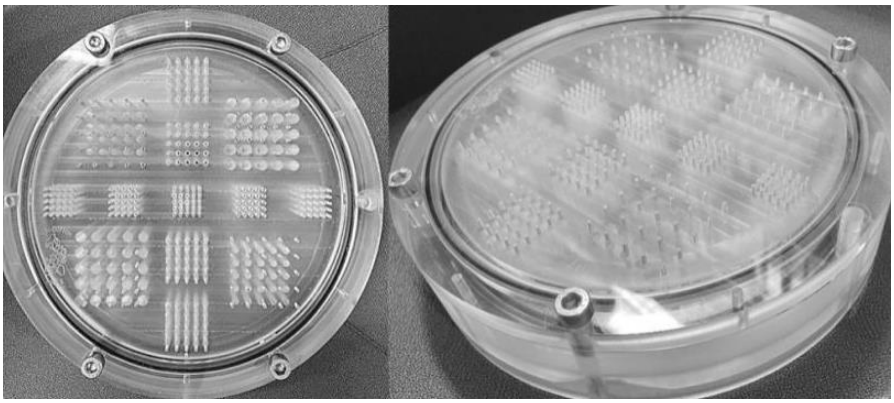
Images were reconstructed with all quantitative corrections available, including attenuation, scatter and randoms. Attenuation correction was performed with transmission-based method with the HRRT and a CT-based method with the Quadra. The images were reconstructed using iterative reconstitution with the OP-OSEM-PSF 3D algorithm using 10 iterations and 16 subsets on the HRRT. The images were reconstructed using 244 mm axial FOV size, 1.22 mm isotropic voxel size and 2.5 mm Gaussian post-filter. For the Quadra system, the reconstructions were performed using 3D OSEM with TOF and PSF (vendor name: UltraHD) using 8 iterations and 5 subsets, 440 x 440 image matrix size, zoom factor 2 and using an all-pass filter, which corresponds to performing no filtering at all.

The resulting images were analyzed with Carimas. Line profiles were drawn above the hot cavities of the phantom containing 18F-FDG (Supplement Figure 2). The data points of the peaks in the line profile representing hot cavities were separated from each other with vertical lines in 2D plots. Only the data of the holes with a diameter of 5 mm were included in the comparison (Supplement Figure 2, low left hand side image). The final data contained 8 sets of 29-39 coordinate points for corresponding imaging times and PET system so that the distance between the xcoordinates of two adjacent points was always 0.5 mm. The FWHM was estimated from these peaks with methods F1-F7 from and the mean values were computed from each set of 8 estimates.

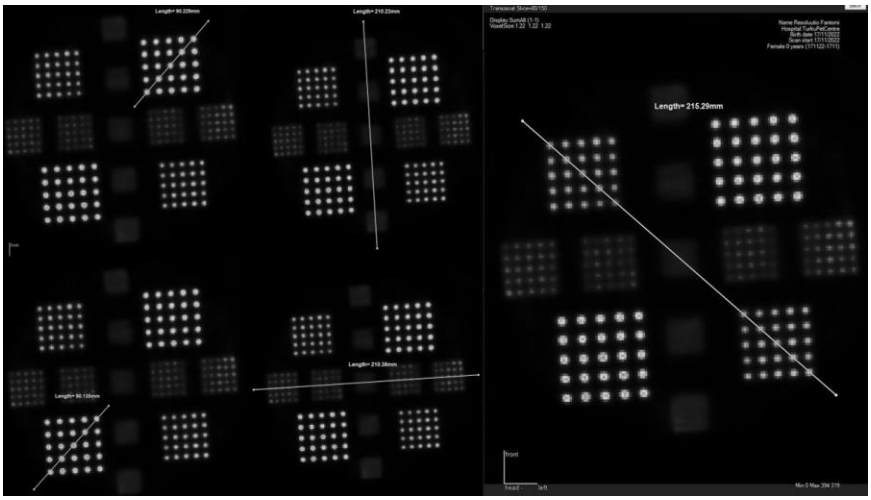
Point source measurements on the preclinical system: The point source measurements were performed using a 22Na point source embedded in a 1 × 1 × 1cm3 acrylic cube (Eckert and Ziegler, Valencia, CA), which was imaged with the RAYCAN X5 preclinical PET/CT system (RAYCAN Technology Co., Ltd. Shuzou, China) which has resolution characteristics of 1 - 2 mm. The active diameter of the source was 0.25 mm with an activity of 0.342 MBq at the time of the measurement. The PET measurement data was collected with the point source placed in the center of the axial field of view of the imaging system, using acquisition time of 60 seconds. All acquisitions were performed without CT-based attenuation correction. The PET images were reconstructed with 2D-FBP using SSRB for data rebinning. The image matrix and pixel size were 140 × 140 ×

47 and 1 × 1 mm with a slice thickness of 1 mm. No post-smoothing was applied nor was the ramp filter modified in the PET image reconstruction.

The image reconstruction resulted to a static PET image visualizing the point source. Data was extracted from the point source images by drawing of point source response functions in axial, radial, and tangential directions and summing of 1D profiles drawn parallel to the direction of the measurement. The final data sets contained 47, 140, and 140 coordinate points for axial, radial, and tangential directions, respectively. The x-coordinates had an even interval of 1 mm. The FWHM was estimated from the data points for each direction separately.



Supplement Figure 1. Custom resolution phantom used for data collection on the HRRT and the Quadra. Original image appears in the Master's thesis of Johanna Hällilä (2023): Cross-calibration of human PET scanners with phantom studies. University of Turku.



Supplement Figure 2. Location of line profiles drawn along the image of the phantom. Original image appears in the Master's thesis of Johanna Hällilä (2023): Cross-calibration of human PET scanners with phantom studies. University of Turku.

References:

J. Hällilä. Cross-calibration of human PET scanners with phantom studies. University of Turku, (2023).

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