

Supplementary material for Bernchou U. et al. Radiopaque marker motion during pre-treatment CBCT as a predictor of intra-fractional prostate movement. Acta Oncologica, 2013;52:1168–1174.

Supplementary Appendix

Image analysis

The seeds were initially located in the reconstructed volumetric 3D CBCT images using template matching. In this procedure a $11 \times 7 \times 15$ voxel image of a seed and the reconstructed volumetric image were filtered with a Laplacian of Gaussian filter (standard deviation of 0.5 voxels) and subsequently Fourier transformed and multiplied together. The product was inversely Fourier transformed and the final image was segmented based on voxel intensity. The voxel size in the reconstructed volumetric CBCT images was $1 \times 1 \times 1 \text{ mm}^3$.

To facilitate tracking, noise in the raw projection images was reduced by averaging three consecutive images followed by the application of a circular averaging filter (3 pixels diameter). The 3D location of seed j was projected onto the first projection image as a suggested position, $P_{1,j}^s$ for

the initial location to search for a marker. The initial search locations were inspected for each individual scan and could be shifted manually to new locations. The first projection image was cropped using a window (6×6 pixels) centred at the chosen location. The cropped image was segmented using the *graythresh* operation in MATLAB. The centroid of the residual pixels was used as the location, $p_{1,j}$ of the seed. The shift, $S_{1,i} = p_{1,j} - p_{1,j}^s$ from the suggested position was calculated for each seed and the average value, s_1 , over all n seeds noted. In a subsequent projection image, i , the location to search for seed j was the position suggested from the projection of the 3D location, $p_{i,j}^s$ plus the average shift, s_{i-1} , in the previous image $i-1$. The pixel size of the projection image was $0.8 \times 0.8 \text{ mm}^2$ at the image plane and $0.52 \times 0.52 \text{ mm}^2$ at isocentre.