AbstractID: 13405 Title: Feasibility of markerless 3D tumor trajectory tracking in CBCT projections using digital subtraction method

Purpose: To evaluate feasibility of markerless 3D tumor trajectory tracking in CBCT projections using a digital subtraction technique for tumor enhancement in low contrast lesions.
Method and Materials: 3D tumor position was estimated in CBCT measured projections (MP) by registering digital subtraction projections with templates. A fan beam 4DCT scan served as the planning CT (pRCCT), from which two sets of DRRs were generated using an in-house GPU-based algorithm. Tumor templates (TT) were generated by masking the GTV+0.5cm and projecting at the MP view angles for each 4D phase image. Subtraction templates (ST) were generated by first removing the GTV+0.5cm from the pRCCT, positioning the pRCCT at the pose of the patient during CBCT acquisition, and projecting at the MP angles for each 4D phase image. The ST was subtracted from the corresponding MP to create subtraction projections (SP). The 2D tumor position in each SP was calculated by matching with the corresponding TT using a robust correlation metric, and transformed to 3D positions by backprojection with a prior depth estimate. 3D position error was assessed by comparing to 3D positions of implanted markers, estimated with a separate algorithm, in a clinical scan.
Results: The mean absolute error for the conventional method was 2.1mm, 2.5mm, and 2.9mm in mediolateral, anterior-posterior, and superior-inferior. The 90% error level was 4.1mm, 6.4mm, and 4.5mm. For the digital subtraction method, the mean errors were 0.8mm, 0.5mm, and 0.6mm and 90% errors were 1.4mm, 0.9mm, and 1mm.
Conclusions: Digital subtraction is feasible for tumor enhancement to reduce error in tumor trajectory measurement. A framework for validation of markerless tracking algorithms using implanted markers was developed.
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