Quantitative Assessment of 4D Cone-beam CT based Image Guidance for Patient Positioning in Precision Radiotherapy

The accuracy of 4D-CBCT image registration was evaluated as a surrogate for overall image quality by comparing the calculated shifts with the actual phantom positions in its motor controlled simulated breathing pattern. The overall motion amplitudes reflected in the 4D-CBCT registration were in good overall agreement (1 – 3 mm) with the known phantom motion for typical breathing patterns. However, individual phases were found to differ by up to 8 – 10 mm, limiting its potential for respiration gated radiotherapy. It was also found that the quality of registration for larger field size settings (M20 or medium field) with full or partial projection arcs was comparable for the default 4D-CBCT scan acquisition (S20 or small field). The use of M20 fields that can encompass the entire patient geometry (i.e. chest or abdomen) is preferable to S20 fields to limit imaging artifacts due to partial volume imaging.