

Purpose: The ideal way of treating left breast DIBH is through direct breast surface matching. Many DIBH techniques, however, rely on a surrogate—external point/marker motion. We try to quantify the predictability of the breast surface motion using external point/marker.

Methods: AlignRT Beam Hold system is applied to perform real-time surface matching and the external point/marker tracking simultaneously. The skin rendering of breath hold CT scan is served as the reference. During the treatment, the patient surface is monitored and registered to the reference to calculate the corresponding distance ($S(t)$). Radiation beam is turned on when this distance is within a preselected threshold. The external point/marker tracking is implemented by tracking the vertical amplitude of a point in the center part of the left breast skin. The real-time distance ($P(t)$) of the selected point to the corresponding reference point is calculated. A model is built to predict $S(t)$ using $P(t)$. Statistical and computational complexity analyses are conducted.

Results: 5 patients are included in this study. Based on our statistical analysis, $S(t)$ can be modeled as a proportioned $P(f)$. For each patient, the ratio is calculated for the first treatment day and applied on the subsequent days. The difference between the prediction and the true $S(t)$ is calculated. The average standard deviations of the difference over all the treatment days are 1.69-2.85mm for different patient, which corresponds to 3.8%-14.6% error rate for 3mm threshold. The biggest standard deviation is from the patient with the largest breast. The computational complexity of the fast ICP based surface matching algorithm is $O(N)$, and of the point/marker tracking is $O(1)$.

Conclusions: The breast surface motion and external point/marker tracking result do have strong correlation. Surface matching is more accurate at the price of higher computational complexity.