AbstractID: 9210 Title: Phase and displacement incorporated model for determination of tumor position with the berathing surrogate (RPM)

Purpose:

Breathing surrogate, such as Real-Time Position Monitor (RPM), is most commonly used to predict internal motion due to the difficulties in directly measuring internal motion. In this study, to account for both linear correlated displacement and possible phase shift between RPM signal and internal organ motion, a new model that incorporates both displacement and phase of RPM signal was proposed and its accuracy was estimated and compared with that of other models.

Methods and Materials:

The diaphragm motion was traced from fluoroscopic lung procedures for 10 patients, with respiratory surrogate signals acquired simultaneously with RPM system which tracks motion of reflective markers mounted on the abdomen with an infrared-sensitive camera. To estimate the diaphragm motion, a general linear function using RPM displacement as the input, a 6^{th} order polynomial using RPM phase as the input, and a new model we proposed as the weighted sum of the previous two, using both RPM displacement and phase as parameters, were used. Least square fitting was applied for all the three models respectively to derive the corresponding parameters. Respiratory gating (30% duty cycle) was performed retrospectively based on the three diaphragm motion trajectories from the three models, and 95^{th} percentile residual motion was evaluated for each patient. Also, deviations of the estimated trajectory from the true trajectory were calculated as 95^{th} percentile tracking error for each model. Paired t-test was performed and $p<0.05$ was determined significant.

Results and conclusions:

All of the 10 patients demonstrated significantly smaller tracking error (~1.5mm, $p<0.05$) and residual motion (~1.2mm, $p<0.05$) when using the new model compared to the other two, indicating that this new model is more effective in estimating the diaphragm motion from breathing surrogate (RPM) signals compared to the models using either RPM displacement or phase as the only parameter.