

**Purpose:** To track lung tumor in cine MR images.

**Methods:** 5 healthy volunteers underwent sessions of a single sagittal-slice cine-MRI with image acquisition frequency of 4Hz. A slice with a visible vascular structure (target) was imaged, and the field of view was adjusted so that the diaphragm was visible in all the slices. Volunteers were asked to breathe under 4 different breathing patterns, each one of 5-minute duration: free breathing; normal inspiration followed by elongated expiration; irregular breathing; and inhale through the nose and impeded exhale through the mouth. Target's location was manually identified in all the frames. Two tracking algorithms were implemented and evaluated: a template matching (TM) algorithm in combination with surrogate tracking using the diaphragm (surrogate was used when the maximum correlation between the template and the image in the search window was less than specified); and an artificial neural network (ANN) model based on the principal components of a region of interest that encompasses the target motion. Mean tracking error  $e$  and error at 95% confidence level  $e_{95}$  were evaluated for each model.

**Results:** The ANN model led to  $e=1.5\text{mm}$  and  $e_{95}=4.2\text{mm}$ , while TM led to  $e=0.6\text{mm}$  and  $e_{95}=1.1\text{mm}$ . A series with out-of-plane motion was considered separately to evaluate the benefit of using surrogate tracking in combination with TM. For this series, the mean error was 7.2mm using only TM and 1.7mm then the surrogate was used in combination with TM (due to out-of-plane motion, the ground truth in this has an inherent error component).

**Conclusions:** As opposed to tracking with other imaging modalities, ANN does not perform well in MR-guided tracking. TM, however, leads to highly accurate tracking results. Preliminary results suggest that out-of-plane motion could be addressed by surrogate tracking using the diaphragm, which is easily identified in the images.