AbstractID: 8845 Title: Markerless gating for lung radiotherapy based on Machine learning algorithms

Purpose: To develop computational algorithms based on machine learning techniques that allow high precision respiratory gated lung radiotherapy without implanted fiducial markers.

Method and Materials: First, 15 seconds of fluoroscopic images are taken before the treatment. These images serve as training images. We apply machine learning techniques to analyze these training images and classify them into two classes—images corresponding to beam on (ON class) and off (OFF class) based on a preset gating window. From the classified training images, machine learning techniques can learn what features indicate beam on and what features indicate beam off. The trained machine learning technique can therefore analyze the fluoroscopic images obtained during the treatment, classify them, and thus generate correct gating signals. The accuracy of the proposed methods is assessed by comparing the results with the reference gating signals manually determined by an expert observer.

Results: Two machine learning techniques are considered—artificial neural network (ANN) and support vector machine (SVM). 12 sequences of fluoroscopic images have been studied retrospectively. Results are reported in terms of precision, which represents the target coverage. For ANN, the precisions vary from 90% to 99%, with mean of 96.5%. For SVM, the range is in 96% and 100%, with mean of 98.8%. SVM achieves higher precisions at the cost of longer training time. For both ANN and SVM, their performances are better than the best method published in the literature—template matching method where the precision is from 88% to 99% with mean of 94.7%.

Conclusion: We applied ANN and SVM to classify fluoroscopic images. Based on the classification results, treatment beam can be turned on and off correspondingly. This work provides an important clinical tool for fluoroscopic gating without implanting fiducial markers.