AbstractID: 8361 Title: Towards on-line treatment verification using cine EPID for hypofractionated lung radiotherapy

Purpose: To develop a computational algorithm based on an artificial neural network (ANN) that allows treatment verification using an EPID in *cine* mode for hypofractionated lung radiotherapy.

Method and Materials: We developed a novel ANN based technique using *cine* EPID images to verify that the target was within the beam aperture when the beam was on. The first step of using the ANN involved training from a training dataset. We simulated training images, i.e., *cine* EPID images with different tumor locations, by shifting DRRs relative to the beam aperture. With a pre-defined threshold $p\%$, we associated category 1 to the training image if more than $p\%$ of the tumor projection in the beam eye view was within the aperture and category -1 otherwise. The trained network could therefore analyze the *cine* EPID images obtained during the treatment and classify them into the corresponding category 1 or -1.

Results: Two patients, each treated with 5 fractions, were included in our feasibility study. A radiation oncologist read the *cine* EPID images and classified them into category 1 or -1; this served as our ground truth. The ANN was applied to the training images to build the neural network. We set $p\% = 95\%$ for this study. For each treatment field, one neural network needs to be built. Averaging over both patients and all fields, the trained network successfully classified 97.5% of the *cine* EPID images overall.

Conclusion: The proposed ANN based technique can successfully analyze *cine* EPID images to verify whether or not the tumor is within the beam aperture, and it can do so with high accuracy. This technique provides an important clinical safeguard—whenever the tumor moves out of the irradiation field, the treatment beam can be interrupted, so that radiation won't be unnecessarily delivered to normal tissues.