AbstractID: 10294 Title: Towards on-line treatment verification using cine EPID images for hypofractionated lung IMRT

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 IMRT.

Method and Materials: We developed a novel ANN based technique that can extract tumor information from *cine* EPID images of each segment in an IMRT field and verify that we are treating the planned treatment area. We simulated training images for ANN using DRRs, by shifting DRRs relative to the beam aperture of the segment. We also carefully related each segment to the entire IMRT field in terms of tumor location. 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 in the corresponding entire treatment field of the training image, and category -1 otherwise. The trained network could therefore analyze the *cine* EPID images of IMRT segments obtained during the treatment and classify them into the corresponding category 1 or -1.

Results: Two patients 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 IMRT segment, one neural network needed to be built. Averaging over both patients and all segments, the trained network successfully classified 97% of the *cine* EPID images.

Conclusion: We are the first who can analyze *cine* EPID images of hypofractionated lung IMRT without implanted fiducial markers. The proposed technique provides an important clinical safeguard—whenever the planned treatment area moves out of the irradiation segment, the treatment beam can be interrupted, so that radiation won't be unnecessarily delivered to normal tissues.