AbstractID: 3042 Title: On probabilistic treatment planning: a novel concept for including organ motion into IMRT optimization

Purpose: We investigate an offline strategy to incorporate interfraction organ motion into IMRT treatment planning. In order to improve the sparing of healthy tissue it was suggested that regions where both, tumor and an organ at risk can be located is irradiated with a lower dose than the dose prescribed to the tumor. This has to be compensated for by irradiating neighboring regions with a higher dose. The approach potentially allows for better sparing of healthy tissue but on the other hand, delivering inhomogeneous dose distributions per fraction is associated with higher risks. In order to make such a treatment planning approach robust and safe, one has to quantify and minimize the associated risks.

Method and Materials: Practically, such an inverse planning approach can be realized when the optimization of the dose distribution is based on the expectation value of the dose. As a surrogate for the associated risks, we calculate the variance distribution by applying Bayesian inference. The variance term is added to the objective function and is hence minimized in the treatment planning process. Treatment planning is demonstrated for a prostate patient.

Results: The inverse planning method yields three 3D distributions: a) the expectation value of the dose, b) its standard deviation in each point and c) a dose distribution that maps the dose delivered in a single fraction. The latter shows characteristic dose inhomogeneities within the CTV which are likely to be leveled out when the prostate is in different positions from day to day. However, this may not always be the case. The standard deviation quantifies the average uncertainty of the dose prediction. The dose delivered in a single fraction represents to some extent a worst case szenario.

Conclusion: Finally, the treatment planner has to find a reasonable tradeoff between potential benefit and risks.