AbstractID: 9031 Title: A real-time feedback control algorithm to compensate 2D target motion with a dynamic multileaf collimator

Purpose:
The aim of the work is to develop a real-time control algorithm for a dynamic dose delivery with a multileaf collimator (MLC) that accounts for 2D target motion and deformation.

Method and Materials:
The multithreaded real-time feedback control receives the target's position and deformation in real-time from an independent localization device and approximates the future target position to calculate the next leaf positions. For lateral shifts, the leaves either include the entire target, exclude any healthy tissue, or utilize a percental trade-off between surrounding tissue and target. Furthermore, the leaves can be placed so that an adjacent organ-at-risk (OAR) is not irradiated. For leaf positions and velocities, the physical constraints of the 160 MLC, Siemens, were obeyed. Theoretical simulations with different motion models were first performed to test the feedback algorithm. Experiments with a modified MLC demonstrate the feasibility of the method and the delay times within the feedback control loop were assessed.

Results:
The adaptive sequencer allows to compensate in real-time for anatomically feasible target motion by adapting the radiation field to the new target position. Simulations indicate a significant improvement in conformity. Depending on the selected tracking mode, either an underdosage of the target edges, an overdosage of the adjacent tissue or a percental trade-off occurs. First experiments proved the feasibility of the tracking algorithm combined with the dynamically adapted MLC though further developments to reduce the MLC control system latency are required to improve the feedback control loop.

Conclusion:
The simulations indicate an accurate application of the dose to moving targets if the real-time feedback control is applied. The developed sequencer provides in real-time the required new leaf positions to the MLC control system which then adapts the treatment field to the target motion.

Conflict of Interest:
Research supported by Siemens Medical Solutions.