AbstractID: 7769 Title: How to evaluate dose errors in IMRT from Random Leaf-Positional Errors

In d-MLC based IMRT, leaves move along trajectories that lie within a user-defined tolerance (TOL) about an ideal trajectory specified in d-MLC motion file. MLC controller measures leaf positions multiple times per second and corrects them if leaves deviate from ideal positions by a value greater than the tolerance value. The magnitude of random leaf-positional (RLP) errors associated with such motions depends on the wear-out of the MLC motors executing leaf. These random errors can be diminished by decreasing TOL. Decreasing the leaf tolerance results in considerably longer delivery time. To aid IMRT quality assurance we introduce a method to determine the dosimetric effects of RLP errors for IMRT plans. We model distribution of RLP errors with a truncated normal distribution, with the cut-off value of TOL. We show that an average dose error of an IMRT field is proportional to TOL / ALPO, where ALPO is an Average Leaf Pair Opening. Therefore, dose errors associated with RLP errors are larger for fields requiring small leaf openings. For an N-field IMRT plan, we demonstrate that dose error is proportional to 1/SQRT(N), where N is the number of fields, which slightly reduces the impact of RLP errors of individual fields on the total dose error. The analytically derived relationship between dose error with RLP errors is confirmed by numerical simulations, in which for each d-MLC field, we introduce RLP errors and calculate resulting RLP fluence. The RLP fluences are compared with the original fluences generated by unperturbed leaf motions.