

AbstractID: 4960 Title: Propagation of linac output and fluence discretization error to dose distributions in IMRT

**Purpose:** Linac output variation and the fluence discretization from MLC leaf sequencing are sources of IMRT delivery error. We investigate a theory describing the propagation of fluence errors to dose distributions.

**Method and Materials:** We assume that the fluence from each beam port is the planned fluence plus a gantry angle dependent error. We assume linac output variation contributes to systematic and random error whereas fluence discretization error is purely random. Expressions for the random and systematic dose error distributions were derived with standard error propagation theory. We investigated hepatocellular carcinoma (HCC) and prostate cases planned with step-and-shoot IMRT and tomotherapy. Linac output errors were estimated from measurements from a linac with a malfunctioning magnetron, thus representing higher-than-normal output errors. The maximum relative random and systematic linac output errors were both around 2%.

**Results:** For both patients and both modalities, the relative dose error in the PTV due to systematic linac output variations was around 1% and the random component was negligible. The dose error in the PTV due to fluence discretization was between 0.1% and 0.2% for tomotherapy and about 1% for step-and-shoot. The relative dose error threshold such that 90% of the voxels in the PTV had a 90% chance of error less than the threshold was 1.5% for step-and-shoot and 0.5% for tomotherapy.

**Conclusions:** The relative random dose error at a point decreases as the inverse square root of the number of beams that affect that point, making the relative random dose error orders of magnitude lower than the relative systematic error. Systematic dose error changes little with the number of beams used in the treatment since it is not propagated in quadrature. The dose errors from the malfunctioning magnetron had little effect on the treatment.

Conflict of interest: TR Mackie has financial interest in TomoTherapy Inc.