AbstractID: 5865 Title: Topographic Leaf-Sequencing using a Genetic Algorithm

Purpose: To develop a leaf-sequencing algorithm for fixed-gantry (*non-rotational*) treatment delivery on a commercial helical tomotherapy system (*HI-ART, TomoTherapy, Inc., Madison, WI*).

Method and Materials: A genetic algorithm was used to determine the multileaf collimator (MLC) leaf open times for a series of fluence test maps generated from a tomotherapy machine with a fixed gantry angle of 0 degrees (IEC scale). A series of wedge shapes (15, 30, 45, and 60-degree) were mathematically created to test the algorithm's ability to produce simple modulations, similar to those which would be encountered in breast radiation therapy.

Results: In general, the topographic treatment delivery yielded reasonable dose distributions. The agreement for the wedge cases was within ±2%, or 2-mm distance-to-agreement (DTA) in the high dose gradient regions. The central axis measured dose was between 3.6 and 4.2 percent higher than the expected dose for the wedge cases. For double peaks, the agreement was within ±2%, or 2-mm DTA across the entire measured film. For quadruple peaks, the agreement was within ±2%, or 2-mm DTA in the high dose gradient regions. At the first peak, calculated and measured agreed to within ±0.5%. The dose gradient between the first peak and the first valley was 5 percent per centimeter. The dose in the first valley agreed to within ±1.6% of the prescribed dose (at the first peak). The maximum error in the quadruple peaks occurred at the second peak, where the measured dose was 3.8% low (relative to the prescribed dose at the first peak).

Conclusions: The developed algorithm produced calculated deliverable distributions that agreed well with the artificially constructed distributions. This delivery technique could be used for treatment of a whole intact breast. Additional work is needed to optimize the algorithm to improve agreement between the calculated doses and deliverable dose distributions.