

## AbstractID: 1858 Title: Determination of Maximum Leaf Velocity and Acceleration of a Dynamic Multi-Leaf Collimator: Implications for 4D Radiotherapy

The features of a dynamic multileaf collimator (DMLC) can be used for 4D, or tumor tracking radiotherapy. 4D radiotherapy requires measurements of the leaf velocity and acceleration to determine the ability of the DMLC to respond in near real-time to respiration signals. The aim of this research was to measure maximum DMLC leaf velocity, acceleration, and deceleration in order to characterize mechanical response times and determine the overall suitability of the DMLC for 4D radiotherapy. DMLC files were developed to insure that the leaves reach the maximum acceleration and velocity during motion. Actual leaf position information was acquired in 50ms intervals from which velocity and acceleration were derived. Additional parameters investigated included: comparison of leaf banks, inner vs. outer leaves, inter-comparison of DMLCs, influence of gravity and friction, and the stability of measurements over time. The results demonstrate that both leaf banks behave similarly, however inner and outer leaves have significantly different maximum leaf velocities, with variations of 10%. The MLC intercomparison variations, and the dependence of gravity on maximum leaf velocity are statistically significant (variations of 12%). Inter-leaf friction was determined to have a negligible effect on the results, and the DMLC parameters remained stable with time. Equations of motion were derived to determine the ability of the DMLC to respond to fluoroscopy-measured patient respiration. Given the present DMLC capabilities, 4D radiotherapy is feasible for 97% of respiratory motion data. For large positional changes a beam hold may be required.

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