

AbstractID: 12753 Title: Surface based distance measures with treatment technique specific gradient factor for IMRT QA tolerances determination

Purpose: To investigate surface based distance measurement method with prior knowledge of dose gradient for dose comparison and IMRT QA.

Method and Materials: A dose distribution can be viewed as a surface in the hyper-space. The generalized distance between two dose surfaces can be calculated by introducing a dose gradient factor α , which is defined as the multiplicative inverse of the average gradient of a dose distribution. Ten regular IMRT and 5 spine IMRT SRS patient plans were studied to determine the average dose gradient factors for these two applications. Spatial and dose shifts were applied to 10 regular cases, distance and γ – index between the original and shifted distributions were calculated. The distance between plans and measurements were then calculated for all test cases. The distribution of distance was analyzed and patient statistics were evaluated, and 90 percentile (D90) results were used to determine the pass criteria for γ – index method.

Results: The mean of dose gradient factors for 10 regular plans and 5 SRS plans are 1.031 mm/% and 0.337 mm/%, respectively. 48% of the shifted distributions that satisfy $\gamma < 1$ with 3mm and 3% criteria in 90% pixels have a true distance > 3 mm. The 95% confidence interval (CI) of D90 was [2.43, 3.73] mm for regular cases, and [0.80, 1.42] mm for SRS cases. The DTA and DD limits for γ – index were determined to be 3.73 mm and 3.73% for regular IMRT, and 1.42 mm and 4.73% for SRS respectively.

Conclusion: Distance and dose gradient information can be used to quantify the difference between two dose distributions and determine the tolerance for a specific treatment delivery technique. The current use of γ index underestimates the difference between two dose distributions. Tolerance values should be determined for different applications based on patient statistics and population studies.