AbstractID: 6988 Title: Gamma-test equivalent error margins for dosimetry analysis

Purpose: The γ-test evaluates the difference between two dose distributions in dose-spatial domain. Previous methods employing the γ-test at a point to translate spatial variation to acceptable dose difference involve a test distribution and a reference dose. This work developed a method for dose comparison using pre-calculated acceptable error margins based on one dose distribution.

Method and Materials: The expected uncertainty for a reference dose distribution is predetermined without making relevance to another distribution. The error margin at a point is calculated using the γ-index formula over a sphere of a radius being the maximum distance-to-agreement (MDAT). All dose values within the sphere, evaluated using a set of evenly distributed points, are acceptable, whereas appropriate dose margins, up to a maximum dose difference (MDD), are included. Comparison with another distribution is to check against the upper and lower bound of the error margins separately, so γ-test equivalent failure can be discerned to hot and cold regions. The degree of failures can be analyzed quantitatively for determining how an agreement between the two distributions can be improved globally. For an application, we calculated the error margin of dose measurement for IMRT QA using the distribution of volume-averaged chamber response.

Results: The error margin for IMRT phantom measurement using an IC-10 chamber was about ±4% for MDD=3% and MDAT=3 mm in a flat region. Asymmetric error margins were found in gradient regions. Expected range for the output measurement with a 1cm×1cm field was (-18.6%, 2.5%) for MDD=2%, MDAT=2 mm, and a measurement was -13.3% off.

Conclusion: Using predetermined error margins for a reference distribution is equivalent to the γ-test in dose comparison. The error margins are not skewed by another distribution and interpretable as expected uncertainty for statistical analysis. The expected values for a reproduced distribution can be different from the reference.