AbstractID: 10967 Title: Efficient registration of dose distributions

Purpose: To develop efficient algorithms to compute the optimal alignment between two high resolution 2D dose distributions (usually one calculated, one measured), with one of them as a reference. This will help eliminate 2D dosimeter setup errors and/or misalignments between radiation and light fields, which both affect the integrity of the IMRT-QA process. We feel that these algorithms will also serve as a useful tool for other physics QA procedures involving calculation/measurement of planar dose/fields. **Method and Materials:** The mathematical objective of alignment is to maximize the percentage of points that pass a similarity test. Two commonly used similarity tests, viz., the composite test (DTA/dose difference) and the gamma test are considered. The algorithms work by efficiently and exhaustively examining a search space of alignments that are in a predefined neighborhood (say, 10 mm in each direction) of the initial alignment, for translational transformations that maximize the objective. The resulting alignments are guaranteed to be optimal provided that the optimal solution lies within that neighborhood. Mathematical properties of the objective function are utilized for efficient algorithm design. The program execution time depends on the selection of size of the neighborhood to be searched, which may be reduced by visually or automatically (using image registration) picking a good starting alignment. **Results:** For registering two 140*140 distributions with 1 mm spatial resolution and with the 5%/5 mm gamma criterion, the algorithm executes within a few seconds for a search within 10 mm of the initial alignment on a 1.7 GHz processor. **Conclusion:** We present efficient and optimal algorithms to determine the best alignment of two 2D dose distributions for IMRT-QA. New or enhanced algorithms are needed to correct rotational misalignments and to extend the work to 3D dose distributions that may be measured using 3D diode arrays or gel dosimeters.