AbstractID: 7408 Title: High Efficient Gamma Index Calculation using Euclidean Distance Transform

Purpose

It is clinically essential in IMRT to compare two dose distributions for dose quality assurance (DQA). The gamma index (Low *et al*, 1998), which combines both dose difference and distance to agreement, provides a quantitative measure of acceptability in DQA. However, its calculations can be time-consuming and limit its applications to 2-dimensional dose distributions. In this work, we propose an efficient calculation method.

Method

By embedding the k-dimensional reference dose distribution in the $(k+1)$-dimensional spatial-dose space, we then use the Euclidean distance transform to find the distance to the reference dose distribution, regarded as a feature set, for every point in a range of the spatial-dose space. This leads to a table of gamma indices. And the evaluation of the gamma indices for any dose distribution with respect to the reference dose distribution is simply table-lookup. Our implementation uses a fast Euclidean distance transform, which was developed in Maurer *et al*, 2003 and proved to have only linear complexity.

Results

Using simulated 2-D dose distributions of size 400×400, the pre-calculation of the Gamma index table takes 26 sec and the table lookup to evaluate the Gamma index for each test dose distribution takes less than 0.1 sec in a 3GHz PC. On the other hand, it takes about 2400 sec using the exhaustive search on the same PC to evaluate the Gamma index for each test distribution. The speedup for 3D Gamma index calculation is expected to be 10^4~10^5.

Conclusion

Numerical simulations demonstrate the efficiency of our proposed method. Thus, the clinical usage of 3D Gamma index becomes feasible. In addition, the Gamma index table can be used to determine the derivative of Gamma index over the dose distribution, which facilitates the inclusion of Gamma index in treatment planning and/or machine parameters optimization.