AbstractID: 10191 Title: A gamma dose distribution evaluation technique using the kd-tree for nearest neighbor searching

Purpose: In the γ evaluation algorithms reported so far, the exhaustive search for minimum distance over a certain maximum radius in the spatial-dose space is required. The purpose of this work is to propose an algorithm based on the kd-tree for nearest neighbor searching instead of using the sorted list to improve computational time for the γ evaluation of multi-dimensional dose distributions. **Method and Materials:** The adaptive mesh data structure in our previous work was modified into the kd-tree, which is essentially a binary tree structure. A kd-tree was built from the evaluation distribution in which every leaf node is a *k*-dimensional point in the spatial-dose space, and every non-leaf node has a splitting hyperplane that recursively divides the space into two subspaces. More spatial-dose points were inserted into the kd-tree based on the local dose gradient in the evaluation distribution by interpolation. To compute the gamma index, the nearest Euclidean distance was searched globally in the kd-tree constructed from the evaluation distribution for each position-dose point in the reference distribution. **Results:** Simulated 2D and 3D dose distributions similar to which described in Low *et al.* were used to evaluate the performance of our algorithm. We found that the building time for a kd-tree is proportional to O(log*N*), where *N* is the pixel number of the evaluation distribution. The nearest neighbor searching time, i.e., the gamma calculation time, is proportional to $O(N^{1/k})$, comparing to the exhaustive searching time (O(*N*)) based on a sorted list as demonstrated in this work and other's. **Conclusions:** The γ evaluation algorithm based on the kd-tree nearest searching is more efficient than the sorted list based exhaustive searching. The algorithm could be used in the one-time preprocess for all nearby simplexes in the geometric method proposed by Ju *et al.*.