AbstractID: 3443 Title: Octree Based Compression Method of DICOM Images for Voxel Number Reduction and Faster Monte Carlo Simulations

Purpose: Diminish the number of voxels created from a set of DICOM images. Keep critical information at tissue interfaces needed in a Monte Carlo simulation without compromising the physical quality of the voxelized image.

Method and Materials: An algorithm was developed to apply an octree compression to DICOM images. The algorithm work as follow: the whole set of DICOM image is assumed as a cube. It is then split in eight equal smaller cubes. Each of the cubes is check for density homogeneity. . If a high density gradient is encountered in a cube, it is also split in height equal parts. This goes on until minimum voxel size is reach. The resulting image is composed of various voxels size. To test this approach, images from a CT calibration phantom which contains various densities were used. To verify precision, Monte Carlo simulation with GEANT4 using a narrow beam passing through several high density gradient was done..

Results: The resulting number of voxels range from 5 to 20% of the original size depending on configurations. The voxel area on a typical slice is 1 square voxel (i.e. no compression) at high density gradient to 64 square voxel for homogeneous sections. Mean volume was about 5.4^3 voxels for the phantom used. The octree has the particularity to smooth digital noise present in homogenous area. The density difference between the original and the octree images are directly related to this noise. Monte Carlo simulation shows less then 1% difference in dose at the high gradient interface.

Conclusion: The octree compression is an excellent method to compress DICOM information for Monte Carlo treatment planning without losing precision at the interfaces in homogeneous regions. Given good parameters the algorithm also has the particularity to smooth digital noise in homogenous area.