

Investigation of HU-Electron Density Relationship for 3D Conformal Treatment Planning

While commissioning a 3D treatment planning system, we have encountered a task to establish the conversion of Hounsfield Units (HU) and relative electron densities (RED). To achieve this, an electron density phantom (Computerized Imaging Reference Systems, Model-62) was used for the study. The phantom consists of 17 holes to accommodate segments of different tissue types, ranging from lung to hard-bone, all of known electron densities. The scans were repeatedly performed in our two GE HiSpeed CT/i scanners under different kVp, mA, thickness, DFOV, and protocols. Two images were selected from each scan. The average of HU and its standard deviation within each segment were computed. Calculations were done for all segments in all selected images from different scans.

Our results show that the variation in HU from different scans using different mA, slice-thickness, DFOV for the same tissue type is minimal. Hence, HUs in all scans under the same kVp are further averaged across different scans to derive the final HU-RED conversion, which is best represented by a poly-line in each CT scanner. In addition, it is found that the HU-RED conversion of hard-bone is 18% higher if scanned at 100 kVp, and 9% lower at 140 kVp, compared to that at 120 kVp. This is understandable, as photoelectric interaction becomes more dominant at lower kVp in high Z material. Therefore, we suggest that the kVp setting for CT scans used in 3D treatment planning shall be kept consistent.