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ESTABLISHMENT OF THE RELATIONSHIP BETWEEN THE COMPUTED TOMOGRAPHY (CT) NUMBER AND RELATIVE ELECTRON DENSITY

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The main objective in radiotherapy is to maximize the dose to the planned target volume while minimizing the dose to the normal tissue surrounding it. Therefore, accurate localization of the tumor and the normal sensitive area is essential. Imaging plays an important role in the process of planning radiotherapy as it identifies the tumor area and the critical normal structures. An ideal imaging modality will improve the accuracy of radiation dose calculation for patients by incorporating the tissue inhomogeneity corrections. The computed tomography (CT) is widely used in image based radiotherapy treatment planning due to its ability in incorporating the tissue inhomogeneity corrections in to the dose calculations. The tissue inhomogeneity is derived by converting the CT number in each voxal into a radiological parameter. The radiological parameter is the relative electron density or the physical density. Therefore, it is necessary to establish the relationship between the CT number and the relative electron density or the physical density of the tissue. The present study involves the establishment of the relationship between the CT number and the relative electron density for the Siemen Somatom Sensation Open CT simulator at the Ceylinco Healthcare Centre, Colombo, Sri Lanka.

Computerized Image Reference System (CIRS) Model 062 was the phantom used in the study. Each insert of the reference phantom represents a tissue in the human body. The electron density reference phantom was positioned on the CT simulator couch, the Patient model dialog was set as adult with head first supine position and a scan was done for the special organ mode thorax. The scanning parameter was set as 120 kV and 5 mm slice thickness. The reconstructed images of the phantom were transferred to the Nucletron Oncentra Master Plan *v*3.3 SP1 treatment planning system. At the treatment planning work station a Region of Interest (ROI) was drawn on the central portion of each insert. The CT numbers at five points inside the selected area were obtained for each insert. This process was repeated over five central slices to obtain an average result. The average CT values of each tissue equivalent insert were plotted against their relative electron densities. Two relationships were obtained, one for CT numbers from -1000 to 0 and one for CT numbers from 0 to 1000. The behavior of the plots were predicted to be of two linear relationships as the fitted equations showed a correlation coefficients (R^2) greater than 0.99.

With the wide usage of CT data in image based radiotherapy, it is important that a calibration is done for all the CT scanners that are used for a treatment plan. CT data are the basic input for radiotherapy treatment planning system which takes in to account the tissue inhomogeneities. Once the relationship is established between the CT number and the electron density of tissue the information is stored in the computer. The planning system uses this relationship automatically to convert the CT data to electron density. And then the necessary correction factors are calculated and the most accurate dose calculation is obtained.