

Effects of CT Number Conversion on Monte Carlo Dose Calculations

Forthcoming improvements in clinical dose calculation models will incorporate some form of the Monte Carlo method. The main benefit of using the Monte Carlo method as a clinical dose calculation engine is that it can accurately recover dose perturbations caused by heterogeneities within a patient's body. Such patient specific heterogeneities are specified from computed tomography (CT) scans of the anatomical region where dose needs to be calculated. The purpose of this work is to investigate the effects of converting patient specific CT data sets to relevant data for the purpose of Monte Carlo dose calculation. In particular, we consider the problems of material identification and conversion to mass density. It has been found that combining pixels of a CT scan to reduce its size for Monte Carlo simulation has the effect of systematically reducing the largest CT numbers and creating new, lower, CT numbers. This leads to incorrect material identification for CT number conversion to mass density for simulation. Depending on the materials used to determine the CT calibration curve of CT number to mass density, significant errors can result. We have found errors as large as 20% for high mass density material like bone in the conversion process. It is found that these conversion processes can produce calculated dose discrepancies of 9% (or 2 mm) in the final dose distribution under some circumstances.