USTUR Case 0102 CT Image Processing Techniques For Voxel Phantom Development

George Tabatadze[1], Richard Brey[1], Anthony James[2], David Theel[3], Steven Todd[3]

[1]Idaho State University, Department of Physics/Health Physics, Pocatello, ID; [2]United States Transuranium & Uranium Registries, College of Pharmacy, Washington State University, Richland, WA; [3]Portneuf Medical Center, Pocatello ISU

A 3D voxel model of the United States Transuranium and Uranium Registries' (USTUR) Case 0102 ^{241}Am phantom (first whole body donation case in 1979) is described. Half of the donated skeleton is encased in tissue equivalent plastic and serves as a unique "human phantom" to calibrate external counting systems at United States Department of Energy (USDOE) and other laboratories world-wide. The resolution of the original CT (Computed Tomography) images of the USTUR Case 0102 Phantom is high (0.5 millimeters) which provides the physical basis for defining precisely the internal structure of the bones. Dicom images of the phantom (head, torso, arm, and leg) have been segmented using the Eclipse® radiotherapy planning software. This has a powerful automatic segmentation feature. The three-step segmentation procedure involved: defining the regions of interest as well as CT numbers for different anatomical structures; auto-segmenting the Dicom images, and; checking manually and correcting any errors in the auto segmentation results. Each Dicom image was segmented into the following regions of interest: air pockets, cortical bone, bone cavities (marrow/tabecular spongiosa), and soft tissue subdivided into 'light' and 'regular' regions to represent inhomogeneities (artifacts) that occurred when the case 102 phantom was cast in nominal ICRU tissue equivalent plastic. The range of CT numbers in each region of interest was replaced by a single characteristic CT number. The 3D surface models for each phantom (Non-Uniformal Rational B-Spline, NURBS) were created with Rhinoceros® software. Finally, these images were voxelized using MATLAB® into virtual (computational) phantoms. The application of these virtual phantoms to simulate the experimental response of external planar germanium detectors is discussed.

USTUR-0263A-09