

Organ Dose Calculations Using Monte Carlo Method and Realistic Voxel Phantom

Accurate organ dose assessment is extremely important in radiotherapy and nuclear medicine. Monte Carlo method today allows the simulations of radiation interaction with extremely small uncertainties (e.g., less than 1%). On the other hand, the representation of the body (i.e., a phantom) has been relatively simplified, and this has inevitably caused errors in the organ dose results. MIRD mathematical models were based on anatomical data used to develop the ICRP Reference Man in late 1960's and have since been used in organ dose calculations for many purposes. Although several revisions have been developed over the years, MIRD-based models remain relatively simplified. Many researchers worldwide are now exploring the possibility of developing new models by utilizing modern medical imaging techniques. At Rensselaer Polytechnic Institute, an adult male whole-body voxel phantom has been developed using CT, MRI, and photos of real persons from the Visible Human Project, which are of resolutions as high as 0.3 mm x 0.33 mm x 1 mm. This model has been adapted into a Monte Carlo code, EGS4, to calculate organ doses for photons and electrons under different source-target geometries. Preliminary results indicates that organ doses for 80 keV photons in PA geometry obtained from the voxel phantom differ from those obtained from MIRD mathematical phantom up to 50%. This paper presents the latest development in this area and a comparison of this new voxel phantom with existing MIRD mathematical phantom.