

Hybrid Computational Phantoms – New Tools for Reporting Patient Doses in Diagnostic Imaging Procedures

In its Report No. 160, the National Council on Radiation Protection and Measurement (NCRP) reported that the average value of the effective dose to exposed individuals has increased by a factor of 1.7 over the time period 1982 to 2006, with the contribution of medical exposures correspondingly increasing by a factor of 5.7. At present, medical contributors to the effective dose include computed tomography (50% of total medical exposure), nuclear medicine (25%), interventional fluoroscopy (15%), and conventional radiography and diagnostic fluoroscopy (10%). The assignment of organ doses to patients has increasingly relied on the use of computational anatomical phantoms. In this presentation, we review the various phantom format types – stylized, voxel, and hybrid – as well as phantom morphometric categories – reference, patient-dependent, patient-sculpted, and patient-specific. Specific emphasis is given to hybrid phantoms – those defined through the use of combinations of polygon mesh and NURBS surfaces. The concept of a patient-dependent phantom is reviewed in which phantoms of non-50th percentile heights and weights are designed from population-based morphometric databases and provided as a larger library of phantoms for patient matching and lookup of refined organ doses. Specific examples of the use of hybrid phantoms are given for nuclear medicine (MIRD schema), computed tomography, and interventional radiology dose assessment.