AbstractID: 8910 Title: A Mesh-Based Anatomical Deformation Method for Creating Size-adjustable Whole-body Patient Models.

Purpose: Whole-body patient models are needed for the assessment of organ doses in various CT imaging and external-beam radiation treatment procedures. The Boundary REPresentation (BPRE) type of geometry offers greater control over the anatomical shapes and tissue/organ surfaces could be flexibly deformed. Currently tedious and time-consuming manual adjustment is necessary. This paper discusses an automatic modeling method recently developed to create two adjustable adult male and female mesh models with dynamically deformable organs.

Method and Materials: The algorithm for the development of the deformable RPI Adult Male/Female phantoms was implemented by MATLAB® 7.4. The anatomical mesh models were based the Anatomium™ 3D models whose organ geometries were morphed to agree within 0.5% with the ICRP reference male and female organ volume/mass data. These mesh morphing algorithms were used to automatically pre-modify the dataset to have unique mesh information in each of organ boundaries and deform the whole meshes based on the ICRP volume/mass reference without unwanted surface overlapping through the special mesh overlap avoiding process. After the deformations, the RPI Adult Male/Female mesh models were transformed to the solid geometries through the voxelization process with 3.2 mm and 3.0 mm, respectively.

Results: These phantoms have been used by transforming the solid geometries into the voxel domain that is compatible with well-validated Monte Carlo radiation transport simulations such as MCNP, EGSnrc and GEANT4codes. Through these mesh deformation algorithms, complicated bone (cavity, spongiosa, and cortical bones) and muscle structures have been described in the RPI Adult Male/Female mesh models.

Conclusion: This study has demonstrated the feasibility to create deformable RPI Adult Male/Female phantoms. These phantoms will be applied to various applications of including person specific adjustments depended on age, weight, and height changes.