**CAD- AND IMAGE-BASED MONTE CARLO MODELING FOR COMPUTATIONAL PHANTOM - APPLICATIONS TO RADIATION PROTECTION AND RADIOTHERAPY**

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**Abstract:**

**Purpose:** Description and verification of the total and detailed models for Monte Carlo (MC) particle transport codes, is one of the most important tasks to realize accurate simulations for complex systems. However, manual description and verification of the models for MC simulation are time-consuming and error-prone. Consequently, Monte Carlo Automatic Modeling Program (MCAM) was developed as an interface program to achieve both CAD- and image-based automatic modeling by FDS Team (www.fds.org.cn). The advanced version (Version 6) of MCAM can achieve automatic conversion from CT/segmented sectioned images to computational phantoms as well as bi-directional automatic conversion between CAD models and MC models such as MCNP, TRIPOLI, GEANT4 and FLUKA models. In addition, a nuclear radiation virtual simulation and assessment system named RVIS was developed to support visualization of time-varying 1D/2D/3D data field and mixed rendering with data and geometry. This contribution gives an overview of activities on the development of both CAD- and image-based MC modeling programs by FDS Team.

**Methods:** A whole-body computational phantom of Chinese adult female called FDS-HUMAN was created by using MCAM from sectioned images of a Chinese visible human dataset. FDS-HUMAN contains 46 organs/tissues. The conversion coefficients from kerma free-in-air to absorbed dose of FDS-HUMAN were calculated with Monte Carlo simulation. Volume visualization of organ dose and mixed-rendering with geometry model and 3D dose map were realized by using RVIS based on the Monte Carlo results and FDS-HUMAN phantom.

**Results:** Differences were observed between the conversion coefficients in this contribution and the International Commission on Radiological Protection (ICRP) 74 data, but these conversion coefficients are similar to ICRP 110 data and other Asian phantoms. FDS-HUMAN can be applied to predict and evaluate dose distributions in the Treatment Plan System (TPS), e.g. the Advanced Radiotherapy System (ARTS) developed by FDS team, as well as the assessment of radiation exposure for human body in radiation protection.

**Conclusions:** CAD- and image-based MC modeling programs developed by FDS Team have been benchmarked with the conversion from CAD model to MC model; some benchmark analyses and applications have also been achieved for image-based modeling of patient for radiation treatment.

***KEYWORDS:*** *Monte Carlo automatic modeling program, Accurate radiotherapy, Computational phantom, Monte Carlo, Dosimetry*