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**Development of Computational Phantom with Moving Arms and Legs for
Radiation Dose Assessment**

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Development of a Computational Phantom with Moving Arms and Legs for Radiation Dose Assessment

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ABSTRACT

The Oak Ridge National Laboratory (ORNL) computational phantom has been revised to add the capability of freely moving arms and legs. In the original phantom model, the arms were rigid and attached to the torso. In order to allow the movement, first the arms were separated from the torso and then divided into parts that are connected at the shoulder and elbow. Similarly, the legs have been reshaped and divided into parts that are connected at the hip and knees. Therefore, in the revised phantom, the arms have the capability of bending from the elbow and shoulder and the legs have the capability of bending from the hip and knee. While modifying the phantom, attention was given to retain the original volumes and masses for the arm and legs. The revised phantom model is called **PIMAL** (**P**hantom **w**ith **M**ovable **A**rms and **L**egs). For the computation of organ doses, the Monte Carlo radiation transport code, MCNP5, has been used. The MCNP input file has been revised accordingly and structured to allow freely moving capabilities when needed. For a given movement, instead of using transformation cards, the surface cards for the arms and legs are redefined in the input file. In order to ensure there is no statistically significant change in the computed organ doses for the same posture (vertical-upright position), a series of benchmark computations for the original and modified phantom have been performed. There is good agreement in the computed organ doses for both phantoms. Furthermore, in order to assist the user with the visualization of positioning of the arms and legs and performing radiation transport computations, a graphical user interface (GUI) for PIMAL has been developed. Using this interface, the user can run MCNP and extract and display the organ doses from the computed output. In this paper, PIMAL—phantom with moving arms and legs—and the user interface are presented.