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**A GUI FOR COMPUTATIONAL PHANTOM  
WITH FREELY MOVING ARMS AND LEGS**

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# A GUI for Computational Phantom with Freely Moving Arms and Legs

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## INTRODUCTION

A computational phantom with moving arms and legs has been developed [1]. A graphical user interface (GUI) module has been developed to assist the user with the visualization of positioning of the arms and legs and performing the radiation transport computations using MCNP [2]. In this paper, the main features of the GUI will be presented.

## DESCRIPTION OF THE GUI

A GUI module, written in Java [3] using Java3d features [4, 5, 6], has been developed to assist the user with the computation and assessment of organ doses for different exposure geometries. The layout of the GUI is shown in Fig 1. In this layout, a phantom model is shown in the vertical, upright position. The exterior dimensions of the phantom in the GUI are similar to the dimensions of the phantom used in the MCNP input file. The phantom model in the MCNP input file contains all the internal organs, which are based on mathematical equations.

In this configuration, arms can bend from the shoulder and elbow; legs can bend from the hip and knee in two directions. User can move the arms and legs using the slider bars shown in the figure. The phantom can be rotated to view from different directions. An image of the phantom, along with the angles for arms and legs, can be generated using the “Snap Image” button and saved as a JPEG file. A snapshot of an image generated with the GUI is shown in Fig. 1, on the right. This feature is useful if the user wants to compare the posture separately using the generated MCNP input file with a visualization tool, (e.g., VISED [7] or MORITZ [8]) to ensure they are the same.

In addition to arm and leg positioning, the user can specify the problem mode (either photon only or as a coupled neutron and photon problem), source energy, and position. Currently, the GUI has limited features for defining the radiation source. At this time, only a monoenergetic point source can be defined using the interface. However, either the generated input file can be displayed and edited to change the source parameters. The revised file can be saved to perform the computations using the interface, if desired.

The user can use the GUI to perform MCNP computations and display the output files and organ dose values. The user can increase or decrease the number of organs in a tally by changing the reference input file. The layout for the tabulation of the organ dose values is shown in Fig. 2. For photon mode problems, the dose due to photons is displayed. For coupled neutron and photon mode problems, the dose due to neutrons, photons, and total dose are listed separately. The uncertainties in the computed values are also tabulated, as shown in Fig. 2. Additionally, the number of particles, for which the results are based on, is shown. The file can be exported to ASCII, if desired. Further, the user can load multiple output files (i.e., simulation results from previous computations) for displaying organ dose values, when needed.

Currently, there is no surrounding material around the phantom. However, if the user needs to place the phantom in an environment, (e.g., a room in a building or a vehicle) and needs to perform a series of computations, then the user can have a custom input file and load this file to include the specified environment. From that point forward, all the generated input files will have the specified local environment.

Since the GUI is coded in Java, it is operating system independent and can, therefore, be run among others on Windows, Linux, or UNIX.

## SUMMARY AND FUTURE WORK

A GUI for defining a computational phantom with movable arms and legs has been developed. The goal of the GUI is to assist the user in performing dose assessment computations for different exposure postures.

In future work, the options for the source model can be extended to include more features. Further, in the current layout, the user is expected to use judgment to avoid surface crossings of the arms and legs (e.g., moving an arm such that it enters the torso, which would be evident from the image in the GUI) while generating the desired posture. Additional work could include the addition of checks and the user could be restricted and made aware of the possible surface crossings; hence, geometry errors could be avoided before running the code. Additionally, the current phantom is hermaphrodite; gender- and age- specific phantoms can be revised to allow the same of type of movements and can be added to the GUI in a pull-down menu.

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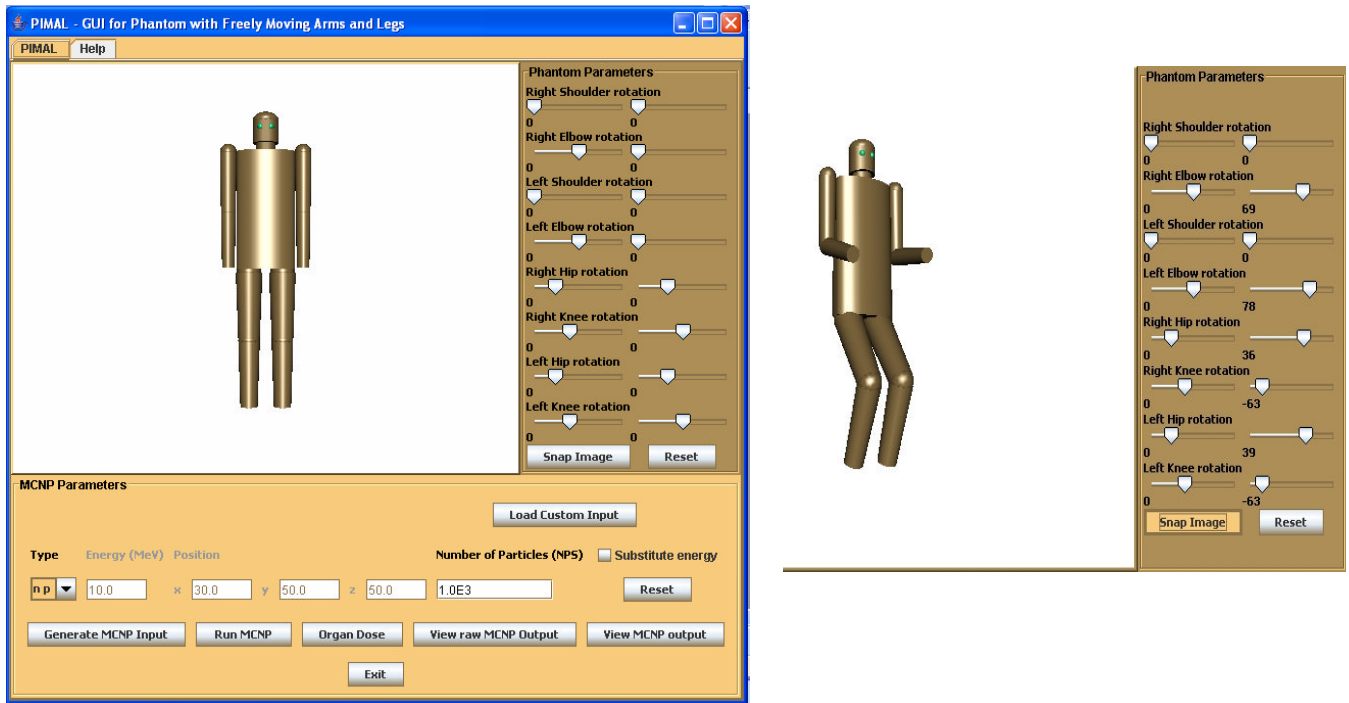


Fig. 1. The layout of the GUI for the computational phantom model, on the left. The user can change the angles for arms and legs using the sliders and save a snap image of the phantom, including the angles, as shown on the right.

Mcnp5213.o

Absorbed Dose (Gy/Source Particle) for NPS=1.0E7

Organs	Neutron Dose	Relative Error (1 sigma)	Photon Dose	Relative Error (1 sigma)	Total Dose	Relative Error (1 sigma)
gonads	2.0084E-16	0.0391	2.3685E-17	0.0640	2.0084E-16	0.0391
lungs	1.2419E-15	0.0034	7.0592E-17	0.0076	1.2419E-15	0.0034
stomach	9.9092E-16	0.0084	9.0854E-17	0.0160	9.9092E-16	0.0084
breast	5.8888E-16	0.0090	4.2424E-17	0.0179	5.8888E-16	0.0090
liver	6.6714E-16	0.0060	6.4628E-17	0.0101	6.6714E-16	0.0060
esophagus	1.2071E-15	0.0093	9.4167E-17	0.0211	1.2071E-15	0.0093
thyroid	7.1070E-16	0.0229	5.3995E-17	0.0517	7.1070E-16	0.0229
ovaries	7.2031E-16	0.0277	7.3319E-17	0.0507	7.2031E-16	0.0277
kidneys	1.5464E-15	0.0062	9.2796E-17	0.0153	1.5464E-15	0.0062
pancreas	1.1335E-15	0.0095	1.0130E-16	0.0193	1.1335E-15	0.0095
thymus	6.7294E-16	0.0221	5.9755E-17	0.0439	6.7294E-16	0.0221
uterus	5.9958E-16	0.0193	6.3168E-17	0.0290	5.9958E-16	0.0193
colon	6.6669E-16	0.0065	6.6343E-17	0.0117	6.6669E-16	0.0065
urinary bladder	3.8159E-16	0.0170	4.4724E-17	0.0266	3.8159E-16	0.0170

Export to ASCII Close

Fig. 2. The layout of the organ dose display. In addition to the organ dose values, the corresponding relative errors are also tabulated.