RECONSTRUCTIVE DOSIMETRY OF RADIATION ACCIDENT FOR HAND EXPOSURED PATIENT

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This study was performed for suggesting a simulation method that can create accurate virtual models of objects with free curved surfaces and perform distortion-free MCNPX simulations. The virtual models acquired by using 3D scan equipment with an accuracy of approximately ±0.025 mm in length, compared with actual objects and are comprised of 11104 polygons. Dose estimation was successfully performed after converting the virtual model into an MCNPX input. With this in mind, a voxelized model was constructed for comparison purposes. The dose estimation functions of the two models were found to be similar, showing a similar amount of computing time by using the mesh tally option with 2e7 histories: for the tetrahedralized model, 729.67 minutes; for the voxelized model, 720.11 minutes.

I. INTRODUCTION

It is often necessary to perform MCNPX[1)] simulations for objects with free curved surfaces when performing a dose estimation with respect to radiation exposure incidents and a precise design at inhomogeneous radiation fields. However, in general, there are two obstacles when it comes to performing such simulations. One is to measure or imitate objects with free curved surfaces, and the other is how to define simulation input mathematically.

I.A. METHOD

A piece of Flexscan 3D[2)] equipment was used for imitating objects with free curved surfaces The equipment with a single light source and two cameras has an accuracy of ±0.025 mm and the range of scanning time is from 5 to 10 seconds.

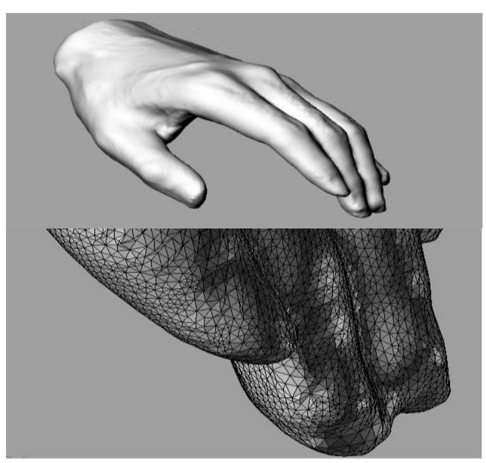

Fig.1. A polygon model imitating an object with free curved surfaces was produced using a piece of Flexscan 3D equipment (above: the entire hand was rendered; below: a magnified image of the fingertips)

Conventional MXNPX simulation methods are not applicable to polygon models, as it is polyhedron with a large number of sides. However, in this study, simulations in which polygon models are expressed as sets of tetrahedrons are to be performed using the property that all polyhedrons can be expressed as sets of tetrahedrons in which all polygons can be expressed as sets of triangles.

For tetrahedralization, a program called "TetGen"5) can be used for converting a polygon model into a set of tetrahedrons in a short time. However, as TetGen only supports specific polygon formats, a specific process of conversion into the PLY format is required using a commercial 3D program.

II. CONCLUSIONS

This study proposed a method that can imitate the geometry of a target object as closely as possible in a simplified way using a piece of 3D scanning equipment, at the same time implementing the imitated geometry in MCNPX without making any changes. However, the restrictions of MCNPX gave rise to some drawbacks, such as a decrease in the number of sides and the occurrence of distortions at the time of graphically interpreting doses. Such drawbacks can be overcome and distortion-free dose information can be expressed, provided that the MCNPX source code is modified in such a way as to allow one to use a larger number of sides and to use the texture mapping of polygon models based on the ptrac information of MCNPX without using a mesh tally.

In the reference section below, Refs. 2, 3, and 4 provide examples of the formats for books, journal papers, and proceedings papers, respectively. Listing paper titles is not mandatory; however, it is encouraged as an additional help to readers.

REFERENCES

1. Pelowitz, D. B. *MCNPX^{TM} User's Manual, Version 2.1.5.* LANL Report No. LA-CP-05-0369 (LosAlamos, NM: Los Alamos National Laboratory) (2005).
2. 3D3 Solutions, *Flexscan3D 3.0 User's Guide*, http://www.3d3solution.com