High-accuracy Analysis of Finite Element Electromagnetic Field Using Anatomical Human Models

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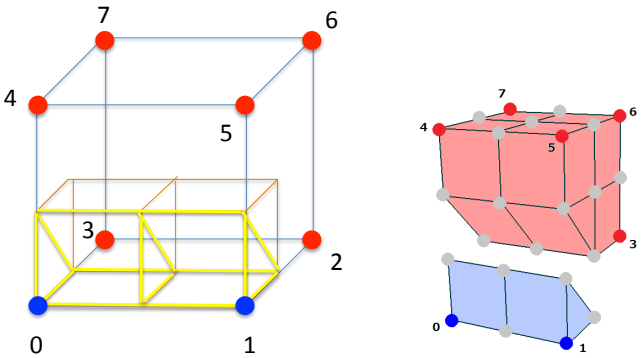
ABSTRACT

For a high-accuracy analysis of the full-wave electromagnetic field using the numerical human models[1] where the voxel discretization is employed, boundaries between different materials should be expressed by curved surfaces. In the case of direct use of the voxel base mesh model, the boundaries become stepped shape. This causes reflection and scattering of the electric fields, which in turn generate to noise in the numerical analysis. To reduce this noise, we developed a mesh smoother applied for smoothing the stepped shapes on the boundary of different materials. This smoother is featured by insertion of triangular prisms. In this method, boundaries between different materials are identified automatically. Then, trianglar prisms are placed on these boundaries to smooth boundary shapes. Hence the smoothing algorithm is relatively simple. The algorithm is robust for large-scale and complicate shape model. Fig. 1 shows the concept of the smoothing. In the algorithm, eight center points 0, 1, 2, .. , 7 of voxels are considered as vertices of a cube. These center points have a material ID. The cube made by the eight center points is divided into eighth small cubes. If two material IDs are found in a small cube, it is cut in two trianglar prisms. Then, tetrahedra are generated in the trianglar prisms and the small cubes.

The parallel computer enployed in this paper is the Fujitsu FX10 supercomputer at the Information Technology Center of the University of Tokyo[2]. Thanks to mesh smoothing, reflection and scattering of the electric fields are not observed.



(a) Generation of trianglar prisms (b) Cutting of voxel by prism
Fig. 1. Schematic illustration of the mesh smoothing proecdurel

REFERENCES

[1] A. Takei, K. Murotani, S. Sugimoto, M. Ogino, T. Yamada, S. Yoshimura, "Performance Evaluation of Parallel Finite Element Electromagnetic Field Analysis using Numerical Human Models," Journal of Advanced Simulation in Science and Engineering (Submitted)

[2] The University of Tokyo, Information Technology Center Home Page: http://www.itc.u-tokyo.ac.jp/index-e.html