Computational Human Growth Models with Anatomical Structure for EMF Simulations

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Voxel-based anatomical human models based on medical image data such as magnetic resonance imaging (MRI) are a powerful tool for non-ionizing and ionizing dosimetry and developing novel medical devices [1]. Various research groups have previously developed various age models for evaluating age-dependence on a variety of research fields. However, these models, in addition to individual difference, number of tissues, resolution and definition of the tissue name are also difference. On the other hand, there is no the difference of the number of tissues, resolution, individually in the various age models generated by simple scaling original models. However, the body-types and anatomical structures of the scaled models are greatly different from realistic people. In this study, we developed whole-body human growth models in which the body-type and anatomical structure fit realistic people.

The human growth model is developed by applying computer graphics (CG) techniques. First, since the voxel model cannot be handled by the CG software, the voxel model is converted into the mesh model (source model) including anatomical tissues. Next, the source model is deformed to fit some target ages using the wrap deformation. During this adjustment, not only body-type but also anatomical structure is deformed to fit to the target age. We then set up the blend shape animation to deformed models. We can generate the mesh models of various ages other than the deformed models of target ages seamlessly by the blend shape animation. Finally, the generated mesh model is re-voxelized.

We applied our proposed method to Japanese adult models [2]. In this test, we used Autodesk MAYA as CG software. Figure 2 shows the 12 different age models output with voxels. Original Japanese adult male model is composed of voxels of 2 mm x 2mm x 2mm, and consist of 51 different tissue types. The voxel size and the total number of tissues of each age model are the same as the original adult male model. From the result, we found that our proposed method can be developed a seamless growth model from young child to adult with anatomical structure.

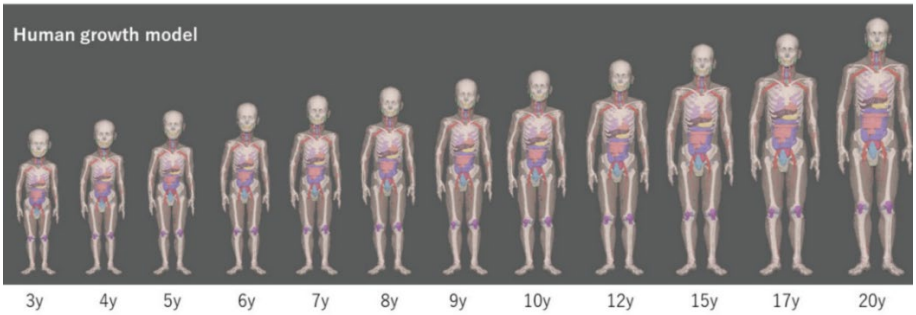

Figure 1. Human growth models with anatomical structure.

References

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[2] T. Nagaoka, S. Watanabe, K. Sakurai , E. Kunieda, S. Watanabe, M. Taki and Y. Yamanaka, “Development of realistic high-resolution whole-body voxel models of Japanese adult and females of average height and weight, and application of models to radio-frequency electromagnetic-field dosimetry,” *Phys. Med. Biol.,* vol. **49,** 2004, pp. 1–15, doi: 10.1088/0031-9155/49/1/001.