ABSTRACT

Development of Digital Image Based Finite Element Modeling System

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In simulation-based design finite element analysis process is required to evaluate the design specifications and it is usually time-consuming to generate an analysis model since finite elements are created from an existing geometric model. It is, however, difficult to represent even geometry if the object is geometrically complex and/or heterogeneous. To overcome the problem the digital image is employed to identify both geometries and material properties and the objective of this work is to develop finite element modeling system using digital images.

An industrial CT scanner is utilized to obtain digital images of an object and a complete set of 3D image data is classified by the intensity value to identify the geometry. Bits grouping method is applied to distinguish different materials in which the region is determined by a specific bit and the average value of regional intensity is utilized to smooth noises from measurement. It provides a basis for voxel model generation and finite element modeling by converting each 3D voxel into a 3D FEA element is an efficient way to minimize errors in prediction of mechanical properties. The software is developed to implement the whole procedure from loading digital images to preview and export the finite element model.

To substantiate the proposed method a human molar with extreme complexity, a vibrator brush in a mobile phone with small scale, and a jumper of hard disk drive with heterogeneous materials are tested to generate a finite element model and it turns out that digital image-based modeling has the ability to represent and analyze extremely complex and heterogeneous 3D structures with a minimum of effort. It is expected that the integrated design system using digital image-based modeling provides tools to design structures of any complexity and reduces the total turn around time for the product development.