

# **ABSTRACT**

## **Polygon and Finite Element Model Construction using Digital Image**

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A digital image is the image that represents two-dimensional or three-dimensional real object as a set of discrete region (PIXEL in 2D or VOXEL in 3D) recorded as numerical quantity (such as binary, grey and color). In this study, VOXEL based 3D digital image generated from CT scanner and element based 3D digital image come from the result of topology optimization are considered to construct a computational model for visualization and simulation to verify geometric and functional requirements of digital image based object. The conventional modeling process requires sequential steps with engineer's own judgment to construct a finite element model using digital image and results in elements in low quality and irregular surfaces.

The new automatic and efficient algorithm is proposed to construct a smooth finite element model with high quality and a polygon model using finite element surfaces. The concept of node density and virtual grid is introduced to be element-type independent algorithm and ten unique patterns equivalent to the improved marching cubes are suggested to construct HEXA, TETRA and PENTA finite elements. Laplacian smoothing method of 3D volume mesh is applied to improve the boundary smoothness of finite element surfaces. A polygon model composed of one normal vector and three points is generated from finite element surfaces. The effects of grid size and the iteration number of smoothing are investigated to substantiate the proposed algorithm. Several modeling examples demonstrate that this modeling technique can provide an efficient means for constructing both a finite element model and a polygon model and eventually reduce the time and cost.