VI International Conference on Adaptive Modeling and Simulation
ADMOS 2013
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FROM SEGMENTED MEDICAL IMAGES TO SURFACE AND VOLUME MESHES, USING EXISTING TOOLS AND ALGORITHMS

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Key words: Surface and Volume Meshing, Segmented Images, Finite Element Method.

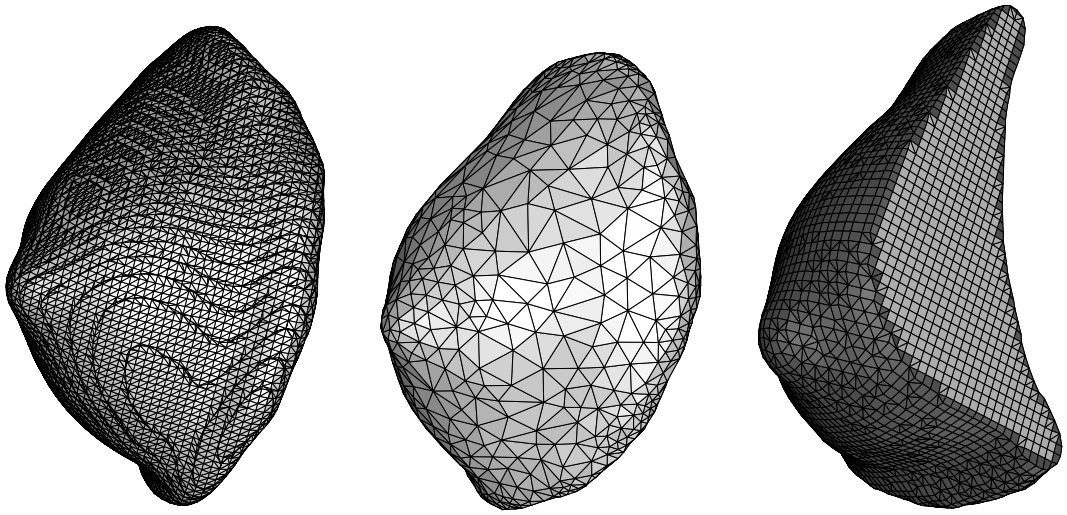
Abstract. In a medical context, one of the most used techniques to produce an initial mesh (starting from segmented medical images) is the Marching Cubes (MC) introduced by Lorensen and Cline in [1]. Unfortunately, the MC presents several issues in the meshing context. These problems can be summarized in three types: topological (presence of holes), of quality (sharp triangles) and accuracy in the representation of the target domain (the staircase effect). Even though there are several solutions to overcome topological and quality issues, the staircase effect remains as a challenging problem.

In the other hand, the Computational Geometry Algorithms Library (CGAL) [2], has implemented the *Poisson Surface Reconstruction* algorithm introduced in [3], which is capable of producing accurate and high quality triangulations based on a point set and its normal directions.

This paper shows how surface meshes can be produced using both, MC and CGAL. Moreover, once a high quality surface mesh is produced, this work also shows how volume meshes can be produced. In particular, tetrahedral and mixed–element meshing techniques are presented to produce a simulation with the Finite Element Method.

Most of the presented tools are open source or easy to implement meshing algorithms, hence, this work presents a complete process to produce surface and volume meshes, starting from segmented medical images, with accessible tools.

In order to illustrate the above, Figure 1 shows the resulting meshes for MC (Figure 1(a)), a surface mesh using CGAL (Figure 1(b)), and a volume mesh using a mixed–element technique (Figure 1(c)) for the breast.



(a) (b) (c)

Figure 1: Meshing the breast: (a) Marching Cubes, (b) Surface mesh using CGAL and (c) Volume mesh (with a cut to see internal elements) using mixed–elements.

REFERENCES

[1] Lorensen, W. and Cline, H. *Marching Cubes: A high resolution 3D surface construction algorithm*. Computer Graphics (1987) **21**(4): 163–169.

[2] Alliez, P., Saboret, L. and Guennebaud, G. *Surface Reconstruction from Point Sets*. In CGAL User and Reference Manual. CGAL Editorial Board, 4.1 edition, 2012 (http://www.cgal.org).

[3] Kazhdan, M., Bolitho, M. and Hoppe, H. *Poisson Surface Reconstruction*. In Symp. on Geometry Processing (2006): 61-70.