University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Science

of

PARTO SAHBAEI

BSc (Payame Noor University, 2010)

"Implicit Representation of Inscribed Volumes"

Department of Computer Science

Wednesday, April 12, 2017
1:30 P.M.
Engineering and Computer Science Building
Room 468

Supervisory Committee:
Dr. Brian Wyvill, Department of Computer Science, University of Victoria (Co-Supervisor)
Dr. David Mould, Department of Computer Science, Carleton University (Co-Supervisor)
Dr. Andrea Tagliasacchi, Department of Computer Science, UVic (Outside Member)

External Examiner:
Dr. Marcelo Laca, Department of Mathematics and Statistics, UVic

Chair of Oral Examination:
Dr. Martin Farnham, Department of Economics, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

We present an implicit approach for constructing smooth isolated or interconnected 3-D inscribed volumes which can be employed for volumetric modeling of various kinds of spongy or porous structures, such as volcanic rocks, pumice stones, Cancellus bones*, liquid or dry foam, radiolarians, cheese, and other similar materials. The inscribed volumes can be represented in their normal or positive forms to model natural pebbles or pearls, or in their inverted or negative forms to be used in porous structures, but regardless of their types, their smoothness and sizes are controlled by the user without losing the consistency of the shapes. We introduce two techniques for blending and creating interconnections between these inscribed volumes to achieve a great flexibility to adapt our approach to different types of porous structures, whether they are regular or irregular. We begin with a set of convex polytopes such as 3-D Voronoi diagram cells and compute inscribed volumes bounded by the cells. The cells can be irregular in shape, scale, and topology, and this irregularity transfers to the inscribed volumes, producing natural-looking spongy structures. Describing the inscribed volumes with implicit functions gives us a freedom to exploit volumetric surface combinations and deformations operations effortlessly.

*For the definition, refer to Glossary section of this document.