Boolean operations on arbitrary polygonal and polyhedral meshes.

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Abstract

A linearithmic floating-point arithmetic algorithm designed for solving usual boolean operations (intersection, union, and difference) on arbitrary polygonal and polyhedral meshes is described in this paper.
This method does not dis-feature the inputs which can be two volume meshes, two surface meshes or one of each. It provides conformal meshes upon exit. It can be used in many pre- and post-processing applications in computational physics (e.g. cut-cell volume mesh generation or conservative remapping).
The core idea is to consider any configuration as a polygonal cloud. The polygons are first triangulated, the intersections are solved, the polyhedral cells are then reconstructed from the conformal triangles cloud and finally their triangular faces are re-aggregated to polygons. This approach offers great flexibility regarding the admissible topologies : non-planar faces, concave faces or cells and some non-manifoldness are handled. The algorithm is described in detail and some current results are shown.

Keywords: Boolean Operations, Polyhedral Meshes, Polygonal Meshes, Mesh Intersection, Cell Reconstruction, Conformity, Conservative Remapping, Cut-cell Meshing, Constrained Delaunay Triangulation, Flood Fill Algorithm.

1. Introduction

Considering two arbitrary polyhedral meshes M_1 and M_2 that are partially or fully overlapping (e.g. one is fully immersed in the other one, or both

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