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MADALGO seminar by Peter Hachenberger, Eindhoven University of Technology

Boolean Operations on Polyhedra and 3D Minkowski Sums

Boolean Operations on polyhedra are a basic building block of many geometric applications such as the visual hull, robot motion planning, computer-aided design and packing problems. Since exact geometry is considered to be slow, industrial applications usually rely on data structures and algorithms that are neither complete nor robust.

We implemented Boolean operations on Nef polyhedra as a part of the Computational Geometry Algorithm Library (CGAL). The implementation is complete, exact and still fast enough to compete with industry products. In comparison to the widely used ACIS CAD kernel our CGAL implementation is about 4-7 times slower, while ACIS does not always supply correct results. In scenarios that are (close to) degenerate our Nef polyhedra can be faster than ACIS.

Based on Nef polyhedra we present the first robust implementation of the Minkowski sum of two non-convex polyhedra.