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Adaptive precision floating-point arithmetic and fast robust geometric predicates. (English)
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Summary: Exact computer arithmetic has a variety of uses, including the robust implementation of
geometric algorithms. This article has three purposes. The first is to offer fast software-level algorithms
for exact addition and multiplication of arbitrary precision floating-point values. The second is to propose
a technique for adaptive precision arithmetic that can often speed these algorithms when they are used
to perform multiprecision calculations that do not always require exact arithmetic, but must satisfy some
error bound. The third is to use these techniques to develop implementations of several common geometric
calculations whose required degree of accuracy depends on their inputs. These robust geometric predicates
are adaptive; their running time depends on the degree of uncertainty of the result, and is usually small.

These algorithms work on computers whose floating-point arithmetic uses radix two and exact rounding,
including machines complying with the IEEE 754 standard. The inputs to the predicates may be arbitrary
single or double precision floating-point numbers. C code is publicly available for the two-dimensional
and three-dimensional orientation and incircle tests, and robust Delaunay triangulation using these tests.
Timings of the implementations demonstrate their effectiveness.

MSC:
68U05 Computer graphics; computational geometry (digital and algorithmic aspects)

Keywords:
exact computer arithmetic; geometric algorithms

Software:
Hull

Full Text: DOI