Detecting Degeneracies in Robust Geometric Modeling

John Keyser, Koji Ouchi
Department of Computer Science
Texas A&M University

Abstract

Detecting degenerate configurations is an important part of a robust geometric modeling system. We focus specifically on the exact boundary evaluation problem. Most efficient methods currently available for exact boundary evaluation rely on a general position assumption, and fail in the presence of degeneracies. We describe a method for detecting degeneracies based on the Rational Univariate Reduction.

A dominating computation within boundary evaluation is finding common roots of systems of polynomials that describe the boundary of solids. Most degeneracies can be found as degenerate configurations of this system of polynomials. We propose the use of the *Rational Univariate Reduction* (RUR), also referred to as the Rational Univariate Representation, as an exact method for finding the zero sets of polynomial systems without multiplicities.

In the RUR, every coordinate of every point in the zero set of a system of polynomials is represented as some univariate polynomial evaluated at some root of the other univariate polynomial. Together with the classical root-bound approach to sign determination of algebraic numbers, we can perform exact computation over the points and curves, enabling us to detect and handle degenerate situations smoothly.

In this talk, we will present our algorithm, along with implementation issues, examples, and performance characteristics.