Orbitwise polyhedral representation conversion via fundamental domains

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Converting between the inequality and finite-generator representations of a convex polyhedron is both a fundamental problem in algorithmic geometry and a useful subroutine in various optimization techniques. Unfortunately many problems of interest remain out of reach for current conversion methods. In certain applications the output is both large and symmetric. This has motivated study of the problem of *orbitwise* representation conversion: instead of producing all of the output, one looks for at least one element in each orbit (under some natural symmetry group).

One common theme in efficient implementations of orbitwise methods is the use of invariants to avoid expensive isomorphism tests. Another approach to avoiding isometry tests, and also permitting a more straightforward use of perturbation, is to construct a fundamental domain for the given symmetry group. Explicitly constructing the fundamental domain turns out to be a challenging representation conversion problem in its own right. I will discuss two approaches to avoiding some of this complexity, namely using some outer approximation for the fundamental domain, and using only the inequality representation to bound a local search.