Generating orbits for quasi-symmetric designs

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Abstract

A (v, k, λ) design is *quasi-symmetric* if every pair of blocks intersect in x or in y points, for some integers $x < y$. Examples are the geometric designs $PG_{n-2}(n, q)$ and $AG_{n-1}(n, q)$. In the affine case the number of non-isomorphic quasi-symmetric designs with the same parameters as $AG_{n-1}(n, q)$ grows exponentially with n, while in the projective case only a few examples are known. It makes sense to try to find new examples by computational techniques relying on automorphism groups.

Finding (v, k, λ) designs with a prescribed automorphism group G is done in two steps:

1. compute the orbits of G on k-element subsets of points,
2. select orbits comprising blocks of the design.

For quasi-symmetric designs, only the *good* orbits need to be considered, i.e. orbits containing k-element subsets intersecting in x or in y points. We will focus on the first step and explore algorithms for generating good orbits. When the group G is large, an approach based on stabilizers is most efficient. For smaller groups we use an orderly algorithm of Read-Faradžev type. In some cases tactical decompositions can be used to make the computation feasible.