New LS[3][2, 3, 2^8] Geometric Large Sets

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Let V be an n-dimensional vector space over the field of q elements. By a *geometric* $t-[q^n,k,\lambda]$ design we mean a collection $\mathcal{D}$ of k-dimensional subspaces of V, called blocks, such that every t-dimensional subspace T of V appears in exactly λ blocks in $\mathcal{D}$. A large set LS$[N][t,k,q^n]$ of geometric $t-[q^n,k,\lambda]$ designs is a decomposition of the collection of all k-dimensional subspaces (k-spaces) of V into N mutually-disjoint $t-[q^n,k,\lambda]$ geometric designs. In this work we compute the Kramer-Mesner incidence matrices between the orbits of 2-spaces and 3-spaces under G, construct geometric large sets of parameters LS$[3][2,3,2^8]$, using the L^3 algorithm for lattice basis-reduction as was used by Braun, Kohnert, Östergard, and Wasserman in 2013. We also construct geometric large sets of the same parameters using linear programming, prove that these large sets are all non-isomorphic to each other, and prove the automorphism groups of all these geometric large sets is G alone.