A low-cost alternating projection approach for a continuous formulation of convex and cardinality constrained optimization

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We consider convex constrained optimization problems that also include a cardinality constraint. In general, optimization problems with cardinality constraints are difficult mathematical programs which are usually solved by global techniques from discrete optimization. We assume that the region defined by the convex constraints can be written as the intersection of a finite collection of convex sets, such that it is easy and inexpensive to project onto each one of them (e.g., boxes, hyper-planes, or half-spaces). Taking advantage of a recently developed continuous reformulation that relaxes the cardinality constraint, we propose a specialized penalty gradient projection scheme combined with alternating projection ideas to solve these problems. To illustrate the combined scheme, we focus on the standard mean-variance portfolio optimization problem for which we can only invest in a preestablished limited number of assets. For these portfolio problems with cardinality constraints we present a numerical study on a variety of data sets involving real-world capital market indices from major stock markets. On those data sets we illustrate the computational performance of the proposed scheme to produce the effective frontiers for different values of the limited number of allowed assets.