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Extreme Point Identification and Linear Constraint Classification

The extreme point identification problem is to partition the finite set $\mathcal{S} = \{a_i, i \in I\} \subset R^n$ into its subsets $\mathcal{N}$ of necessary (extreme) points and $\mathcal{N}$ of redundant (non-extreme) points. This problem is important because algorithms to find the convex hull of $\mathcal{S}$ are exponential in set cardinality and the convex hull of $\mathcal{N}$ is the convex hull of $\mathcal{S}$. Since the necessary points of $\mathcal{S}$ are in one-to-one correspondence with the necessary constraints in a representation of the polar dual of $\mathcal{S}$, constraint classification algorithms can be used to determine the partition. We present a hybrid constraint classification algorithm that combines the ability of probabilistic algorithms to quickly detect necessary constraints and the ability of deterministic methods to quickly detect redundant constraints. Numerical experiments establish the effectiveness of this new algorithm.