Advancing Parametric Optimization for the Benefit of Multiobjective Optimization

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Talk will take place from 1:00PM - 2:00PM through Zoom.

Abstract: Scalarization methods, which reformulate the original multiobjective optimization problem (MOP) into a single-objective optimization problem (SOP) by means of scalarizing parameters such as weights, right-hand-side values, reference points, etc., make up a common and well-established methodology for computing efficient sets to MOPs. It is expected that the optimal solutions to the SOP are efficient to the MOP. When solving the SOP, the scalarizing parameters may be known and assume specific values for which specific efficient solutions are computed. Otherwise, when these parameters are unknown, the efficient set is parametrized and represented as a set of efficient functions of these parameters. Independently of the scalarizing parameters, other parameters can be included in MOPs to model uncertain data. In this case, the resulting parametric MOP (pMOP) is solved to obtain a parametrized collection of efficient sets, as opposed to a specific efficient set.

We put forward the premise that parametrization of the efficient set can naturally be combined with solving pMOPs because the algorithms performing the former can also be used to achieve the latter. Based on our premise, we first propose new formulations of scalarizations and then focus on algorithmic developments for two classes of pMOPs: convex quadratic and convex. We advance the parametric optimization theory by extending Lagrangian duality to the parametric case. We recast a subgradient algorithm, which has been developed for optimization in a function space, to work in a parametric setting. The performance of the algorithms is examined on synthetic instances of pMOPs. The algorithms are also applied to decision-making problems in portfolio optimization and engineering design, which carry both conflict and uncertainty.