Title: Direct multisearch for multiobjective optimization

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Abstract: In practical applications of optimization it is common to have several conflicting objective functions to optimize. Frequently, these functions are subject to noise or can be of black-box type, preventing the use of derivative-based techniques. We propose a novel multiobjective derivative-free methodology, calling it direct multisearch (DMS), which does not aggregate any of the objective functions. Our framework is inspired by the search/poll paradigm of direct-search methods of directional type and uses the concept of Pareto dominance to maintain a list of nondominated points (from which the new iterates or poll centers are chosen). The aim of our method is to generate as many points in the Pareto front as possible from the polling procedure itself, while keeping the whole framework general enough to accommodate other disseminating strategies, in particular, when using the (here also) optional search step. DMS generalizes to multiobjective optimization (MOO) all direct-search methods of directional type. We prove under the common assumptions used in direct search for single objective optimization that at least one limit point of the sequence of iterates generated by DMS lies in (a stationary form of) the Pareto front. However, extensive computational experience has shown that our methodology has an impressive capability of generating the whole Pareto front, even without using a search step. Two by-products of this paper are (i) the development of a collection of test problems for MOO and (ii) the extension of performance and data profiles to MOO, allowing a comparison of several solvers on a large set of test problems, in terms of their efficiency and robustness to determine Pareto fronts.

Author Keywords: Multiobjective Optimization; Derivative-Free Optimization; Direct-Search Methods; Positive Spanning Sets; Pareto Dominance; Nonsmooth Calculus; Performance Profiles; Data Profiles

KeyWords Plus: Derivative-Free Optimization; Test Problem Toolkit; Direct Search; Evolutionary Algorithms; Generation

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