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Many-objective Optimization in Engineering Design: Case Studies Using a Decomposition Based Evolutionary Algorithm

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Abstract

Engineering design often involves simultaneous minimization/maximization of multiple conflicting objectives. The optimum solution of such problems comprises a set of designs representing best-tradeoff among objective values, known as Pareto optimal front (POF). It is well known that the existing multi-objective optimization algorithms can find POF for 2-3 objective problems successfully, but their performance deteriorates significantly for problems with 4 or more objectives, which are termed as "many-objective" optimization problems. There has been a significant recent interest in solving them. In this paper, we present a decomposition based approach for solving manyobjective optimization problems. Further, we demonstrate that this improved capability can be exploited to solve various other intractable classes of problems. Two such classes presented are robust design optimization and "re-design" for robustness. In addition to the above, we also illustrate the benefits of multiobjective formulation for a special class of problems, where an user is interested in solving single objective optimization problems with different parameter values. We present numerical examples from various domains including mechanical, civil and aerospace industry to demonstrate the approaches and corresponding benefits.