Metamodeling in Evolutionary Multi-Objective Optimization for constrained and unconstrained Problems

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ABSTRACT

One of the main difficulties in applying an optimization algorithm to a practical problem is that the evaluation of objectives and constraints often involve computationally expensive procedures. To handle such problems, a metamodel (or surrogate model, or response surface approximations) is first formed from a few exact (high-fidelity) solution evaluations, and then optimized by an algorithm in a progressive manner. However, there has been lukewarm interest in finding multiple trade-off solutions for multi-objective optimization problems using surrogate models. The literature on surrogate modeling for constrained optimization problems is also rare. The difficulty lies in the requirement of building and solving multiple surrogate models, one for each Pareto-optimal solution.

In this study, we propose a taxonomy of different possible metamodeling frameworks for multi-objective optimization and provide a comparative study by discussing advantages and disadvantages of each framework. Also, we argue that it is more efficient to use different metamodeling frameworks at different stages of the optimization process. Thereafter, we propose a novel adaptive method for switching among different metamodeling frameworks. Moreover, we observe the convergence behavior of the proposed approaches is better with a trust regions method applied within the metamodeling frameworks.

The results presented in this study are obtained using the well-known Kriging metamodeling approach. Based on our extensive simulation studies on proposed frameworks, we report new and interesting observations about the behavior of each metamodeling framework, which may provide salient guidelines for further studies in this emerging area within evolutionary multi-objective optimization. Results of this study clearly show the efficacy and efficiency of the proposed adaptive switching approach compared to three recently-proposed other metamodeling algorithms on challenging multi-objective optimization problems using a limited budget of high-fidelity evaluations.
**Publications**

**Journals**


**Conferences**


