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A Novel Constraint Handling Strategy for Expensive Optimization Problems

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Abstract

Constraints are inherently present in any real world problem. In the context of multidisciplinary design optimization problems, such constraints arise out of physical laws, statutory requirements, user preferences etc. and are often computed using computationally expensive analysis e.g. FEM, CFD, CEM etc. While population based stochastic optimization algorithms are a preferred choice for the solution of such class of problems (often with the aid of approximations), they typically adopt a full evaluation policy i.e. all constraints and objective functions for all solutions are evaluated. Recent studies have highlighted the possibility of selected constraint evaluation (i.e. a subset of relevant constraints are only evaluated), although learning the sequence (or the subset) of constraints is far from trivial. In this paper, we introduce an approach for selective evaluation based on Support Vector Machine (SVM) models, wherein promising solutions are identified and evaluated based on the trade-off between need to learn and cost to learn. The performance of the proposed scheme is compared with other state-of-the-art constraint handling methods using a set of well-studied engineering design optimization problems. The aspect of selective evaluation has rarely been investigated in literature and the results clearly indicate the benefits selective evaluation which is of immense value in the context of computationally expensive optimization problems.

Keywords: Constraint Handling, Classifiers, Selective evaluation.