11th World Congress on Structural and Multidisciplinary Optimisation
07th -12th, June 2015, Sydney Australia

An efficient constraint handling method using a polynomial regression model

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Abstract

Many practical optimization problems in the real-world are constrained optimization problems (COPs), and these problems increase the difficulty of searching the global optimum. Recently, developing a good method for solving COPs is one of the most demanding research areas in the field of evolutionary computation. Differential evolution (DE), a kind of metaheuristic algorithms, has been used to efficiently solve global optimization problems. DE is very simple to implement, but developed to solve unconstrained problems. To solve COPs using DE, DE has to be coupled with various constraint handling methods such as penalty functions, decoder functions, feasibility preserving representations and operators, and multiobjective approaches. But these methods search infeasible design space too much and thus become inefficient due to superfluous function evaluations.

To enhance efficiency, a polynomial regression (PR) model is locally employed to predict the boundary between feasible and infeasible design spaces in this study. Around each infeasible solution, a PR is generated using nearby solutions already obtained in order to represent the boundary locally. Based on the piecewise boundary predicted by local PR models, we mostly search the feasible design space to obtain the global optimum, which reduces excessive function evaluations in the infeasible design space and thus improves the optimization efficiency. We applied the proposed method to 22 mathematical problems and demonstrated efficiency enhancement in all the problems.

Acknowledgements

This work was supported by the Technology Innovation Program (10048305, Launching Plugin Digital Analysis Framework for Modular system Design) funded by the Ministry of Trade, Industry & Energy (MI, Korea).