Surrogate-guided intelligent algorithms

Liang GAO

Abstract

The engineering optimization problems usually involve computationally expensive simulations and massive design variables. How to solve them in an efficient way is still a big challenge. Recently, the surrogate-assisted metaheuristic algorithms are widely studied and considered potential to solve such engineering optimization problems. In our study, an efficient generalized surrogate-guided evolutionary optimization method is proposed to further improve the optimization efficiency for these high dimensional expensive problems. Through analyzing ways of combining surrogates with metaheuristic algorithms in the current surrogate-assisted metaheuristic algorithms, it can be found that the proposed method is clearly different from other surrogate-assisted metaheuristic algorithms. It makes a fusion between the evolutionary algorithms and surrogates and has a reasonable balance between utilizing the predicting ability of surrogates and the global search ability of evolutionary algorithms in the optimization process. Specifically, the proposed algorithm combines the optimums predicted by the global and local surrogates with the key operations of evolutionary algorithms such as mutation and selection operators. To validate the proposed method, it is tested by a lot of commonly used high dimensional numerical benchmark problems whose dimension mainly varies from 20 to 100. And an overall comparison between the proposed method and several typical and recent optimization methods has been made. The results show that the proposed method is very promising for optimizing the high dimensional expensive problems.