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Adaptive multi-point sequential sampling methodology for highly nonlinear automotive crashworthiness design problems

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Abstract

Automotive crashworthiness design is a highly expensive and non-linear problem. In metamodel-based crash design problem, the prediction error of the metamodel may induce a local or a wrong optimum. In the past few years, the multi-point objective-oriented sequential sampling methods have been demonstrated an efficient way to improve the fitting accuracy and find the true optimum. However existing infilling criteria are restricted to specify the number of the sequential samples obtained in each iteration. It is not practical for complex engineering design problems. In this paper, a new adaptive multi-point sequential sampling method is developed. The sequential sample size is determined by the prediction states of the fitting metamodels. To demonstrate the benefits, the new proposed method is applied to a highly nonlinear crashworthiness design problem. Results show that the proposed method can mitigate the effect of the prediction error, and more efficiently identify the crashworthiness design solution compared to the conventional approach.

Keywords: Metamodel-based optimization, objective-oriented sequential sampling method, adaptive multi-point strategy, crashworthiness design.