

Multi-Parameter Optimization Study on the Crashworthiness Design of a Vehicle by Using Global Sensitivity Analysis and Dynamic Meta-model

ZHANG Weigang¹, ZHANG Yang², MA Tao³, TANG Ting⁴

¹ State Key Laboratory of Advanced Design & Manufacturing for Vehicle Body, Hunan University, Changsha, China, zhangwg@hnu.edu.cn

² Hunan University, Changsha, China, zhangyanghndx@163.com

³ Hunan University, Changsha, China, mataobetter@126.com

⁴ Hunan University, Changsha, China, tangtingxyz@126.com

Abstract

In a vehicle's concept design stage, there are usually a lot of design parameters need to be defined and optimized. For such a complex and non-linear system of a vehicle, multi-parameter optimization not only has a great computation, but also face the difficulty to obtain optimum solutions. This paper aimed at an optimization problem of a vehicle's crashworthiness with 20 design parameters, and presented a new method which uses global sensitivity analysis and dynamic meta-model. First, vehicle crash simulation model was constructed and design parameters were simplified by using global sensitivity analysis, then, the sensitive parameters were used to construct an initial meta-model. During the optimization solving process, the design domain and meta-model were updated continually until the accuracy of the solutions met the requirement of the convergence criteria. Final results showed that the presented method in this paper could not only successfully solve the multi-parameter optimization problem, but also significantly reduce the computation time and cost.

Keywords: Multi-parameter Optimization, Vehicle Crashworthiness, Concept Design, Global Sensitivity Analysis, Dynamic Meta-model.