Advanced Body in White Architecture Optimization

Jiang Xin, Chen Yong, Shi Guohong, Jiang Feng

（Pan Asia Technical Automotive Center Co.,Ltd. Shanghai 201201）

Abstract: During the BIW concept developing phase, some key design variables, such as rails and pillars width and position, shell thickness, etc, and multi-attribute responses from safety, NVH, and durability are considered to explore the design space. Isight DOE design drive is used to assess the impact of the variables on the objectives, and this helps the engineer to better understand the design space and give design recommendation. Approximations component is used sequentially to create fast-running surrogate models to replace the real CAE simulations. Finally, the Optimization tool is used to perform a trade-off study, and this helps engineer to know what is the minimum cost for the design to meet all design targets, or when the BIW weight is fixed, what is the potential maximum design performance.

Keywords: BIW(Body in White) , design variable, multi-objectives, DOE, Approximation, Optimization, Trade-off

Introduction

Low cost and high quality is now a new question for every automotive center to meet the fast growing market's requirement. For BIW development, we need minimize BIW mass based on the performance requirements. This paper explains an acceptable process of the advanced BIW architecture optimization in the early stage of vehicle development.

1.   Project definition and DOE

1.1 Loadcase and design variables

For a new architecture development, we should analysis the feasibility of the representative loadcases in the early stage of the development, and make a clear loadcase list for the optimization process. In this BIW architecture optimization, we defined five loadcases: BIW static stiffness, mode, 100% RGB, 40% ODB and Side Impact. Then, the BIW architecture design variables are selected from the rail position, rail angle, section size, panel thickness and material based the engineering experience and the design direction of this vehicle. The design variables' range is restricted by the package protection and benchmark compare. At last we defined the output responses according to the loadcases' evaluation factors. Sum up this optimization process, we have 58 design variables and 37 responses.

1.2 Parametrical BIW CAD model

According to the package key points and design variables inputs, we created a parametrical BIW CAD model by SFE-Concept. Use this model, we can automatically change the BIW structural parameters as the engineering requirements input and export FE meshes and spot welds in formats compatible with several finite element solvers such as MSC.Nastran, LSDyna, Abaqus, PAM-Crash etc. After we integrated this model into Isight loop, we can use this model to do multidisciplinary optimization. The parametrical BIW CAD model is shown in Figure 1.