

CAD/CAE integrated reanalysis assisted optimization system for vehicle design

Hu Wang¹, Enying Li², Guanxin Huang¹, Guangyao Li¹

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

² Collage of Transportation and Logistics, Central South University of Forestry and Technology, enyasteven@hotmail.com

Abstract

In this study, a CAD/CAE integrated reanalysis assisted optimization system is developed. Compared with popular isogeometric analysis (Hughes, et.al, 2005), the CAD model used in this system is based on triangle elements. To smooth the surface and improve the efficiency of triangle element based simulation system, subdivision surface and weakened weak form (W2) using the generalized gradient smoothing technique proposed by Liu (G.R.Liu, 2010a,b) are integrated. Commonly, the integrated system can be used for optimization directly. However, most of engineers like adjusting design by their experience and “online” analysis results. Therefore, the major distinctive characteristic of this analysis system is “Seen is solution” and thereby called SIS system. The designer only needs to input the CAD file, define constraints, modify the design and check analysis results again and again till design satisfy the requirement. The CAD and FE model do not need to be reconstructed and remeshed during entire design cycle. The user can adjust structure of product based on current model instead of redrawing the CAD again. Therefore, the design cycle can be shortened significantly. Now, the SIS system has been applied to vehicle design and can also be integrated with popular optimization methods seamlessly.

References

- [1] Hughes, T. J., Cottrell, J. A., & Bazilevs, Y. Isogeometric analysis: CAD, finite elements, NURBS, exact geometry and mesh refinement. *Computer methods in applied mechanics and engineering*, 2005;194(39), 4135-4195.
- [2] Liu, G. R. AG space theory and a weakened weak (W2) form for a unified formulation of compatible and incompatible methods: Part I theory. *International Journal for Numerical Methods in Engineering*, 2010a;81(9), 1093-1126.
- [3] Liu, G. R. AG space theory and a weakened weak (W2) form for a unified formulation of compatible and incompatible methods: Part II applications to solid mechanics problems. *International Journal for Numerical Methods in Engineering*, 2010b; 81(9), 1127-1156.
- [4] Kirsch, U. Combined approximations—a general reanalysis approach for structural optimization. *Structural and Multidisciplinary Optimization*, 2000;20(2), 97-106.
- [5] Gao, G., Wang, H., & Li, G. An adaptive time-based global method for dynamic reanalysis. *Structural and Multidisciplinary Optimization*, 2013;48(2), 355-365.
- [6] Huang, G., Wang, H., & Li, G. A reanalysis method for local modification and the application in large-scale problems. *Structural and Multidisciplinary Optimization*, 2014;49(6):915-930.