Development of Three-Dimensional Anisotropic Shell Analysis Based on Domain Decomposition Method for Space Vehicle Engine Nozzle

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Abstract

One challenge in analysis and design for large size structures is related with its tremendous computational cost. Therefore, high-performance computing has been investigated for such large size structures. Space vehicle engine nozzle is one of those size structures. In it, sideward loads generated by fluid-structure interaction phenomena should be examined in order to ensure the structural reliability. In its computational aspect, efficiency of structural analysis should be considered to relieve the computational cost, e.g. domain decomposition approach. This paper presents the development of a computational algorithm based on finite element tearing and interconnecting (FETI) method using localized Lagrange multipliers. The proposed FETI method is to decompose large size structures into non-overlapping sub-domains via Localized Lagrange multipliers and augmented Lagrangian formulation (ALF). In the proposed approach, localized Lagrange multipliers are used to enhance the compatibility of the displacements along the interconnecting sub-domains. Therefore, it is possible to implement in a direct solution procedure. More detail, in order to consider the curved configuration and the laminated wall of the engine nozzle, anisotropic facet shell combined by optimal triangle membrane and discrete Kirchhoff triangle bending plate (OPT-DKT) will be used. Moreover, practical performances of the present OPT-DKT facet shell element will be presented.

Keywords: Domain decomposition method, Localized Lagrange multiplier, OPT-DKT shell element.

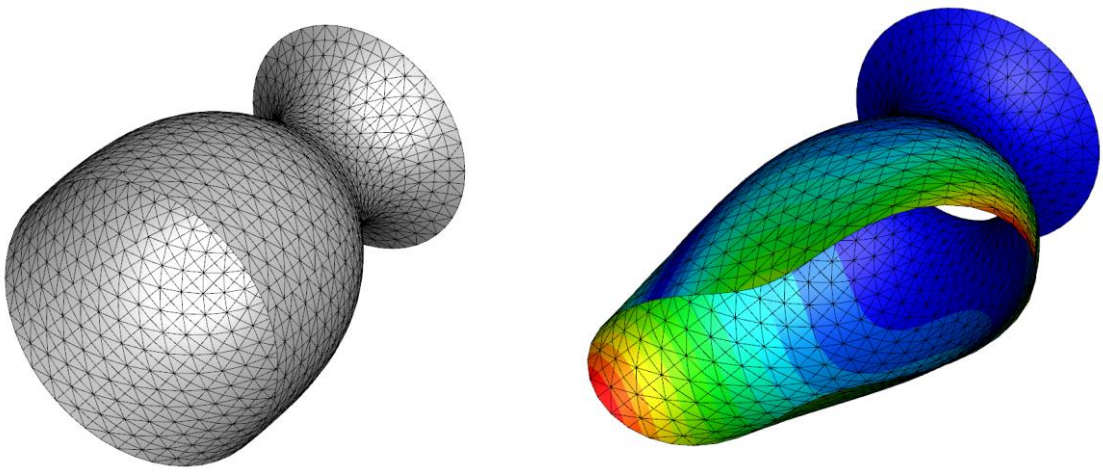

Figure 1. Geometry and modal analysis of the space vehicle engine nozzle.

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