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Large-size Structural Computing by Local and Mixed Type Finite Elements

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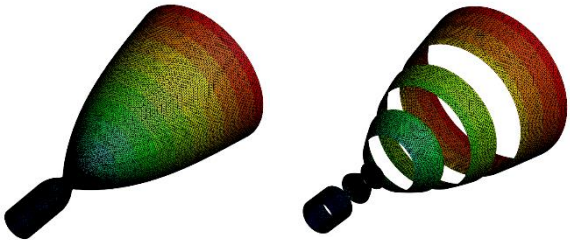
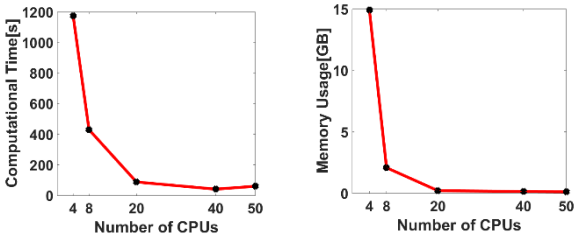
One challenging problem in large-size structural analysis is related with its tremendous computing time. In that aspect, efficiency of structural analysis can be improved by using the parallel computing, e.g. domain decomposition method. This paper presents development of the computational algorithm based on the finite element tearing and interconnecting (FETI) method using both "localized" and "mixed" Lagrange multipliers. The continuity conditions can be enforced by classical Lagrange multipliers, "localized" Lagrange multipliers, or combination of both. By using the classical Lagrange multipliers, continuity of the displacement field across sub-domain boundaries is enforced by imposing linear constraints, equal number of the degrees of freedom (DOFs) of corresponding nodes in adjacent sub-domains. Localized Lagrange multipliers are used to impose two kinematic constraints in adjacent sub-domains, twice larger number of DOFs. Finally, "mixed" Lagrange multipliers are used to take advantage of two different Lagrange multipliers. Practical performance of the proposed methods is evaluated by going through static and dynamic analysis. Finally, parallel computation is implemented for the proposed approach using the message passing interface (MPI) and compressed row storage (CRS) format in order to reduce computational time and its memory usage.



Decomposed sub-domains for space vehicle engine nozzle



Computational time and its memory usage

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