Development of numerical method for vehicular structure dynamics for large-scale parallel simulations

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We propose a novel numerical method suitable for large-scale parallel simulations of vehicle structure dynamics.

For the last several decades, a Lagrangian finite element method has been the de facto standard for structure simulations. This method can track the surface of structures with high accuracy and compute constitutive relation of structure with ease, since a geometric domain of the structure is spatially discretized using unstructured mesh which conforms to the deforming structure. However, compared to structured/unstructured Cartesian meshes, the parallel efficiency of the unstructured meshes is limited. With the growing interest in and need of large-scale parallel simulations of vehicle dynamics, there has been a renewed interest in structured/unstructured Cartesian meshes. Furthermore, unstructured mesh generation for complex geometries is a time-consuming process and requires special know-how in general.

Considering the above background, we propose a novel simulation technique for vehicle structure dynamics. Our method is based on a hierarchical Cartesian mesh called the building cube method (BCM)[1], which is capable of achieving high parallel efficiency and generating meshes for complex geometry without special know-how. In our method, the basic equations of structure are computed in the Eulerian frame because computational mesh is fixed in space. In my presentation, some simulation examples of vehicular structure will be demonstrated to validate the proposed approach.

[1] Kazuhiro Nakahashi: Building-cube method for flow problems with broadband characteristic length, Computational Fluid Dynamics 2002, pp.77-81, Springer Berlin Heidelberg, 2003.