Accurate, Conservative Data Transfer between Nonmatching Meshes in Multiphysics Simulations

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In multiphysics simulations using a partitioned approach, each physics module solves on its own mesh, and the interfaces between these meshes are in general nonmatching. Simulation data (e.g., jump conditions) must be exchanged back and forth across the interface surface between components. It is highly desirable for such data transfers to be both numerically accurate and physically conservative. We have developed accurate, conservative, and efficient data transfer algorithms for exchanging data between nonmatching surface meshes. Our method constructs a common refinement of nonmatching meshes [3]. By utilizing the common refinement, we minimize errors in the the L_2 or energy norm while achieving strict conservation. We demonstrate significant advantages of our methods compared with traditional interpolation methods and other conservative schemes in the literature (e.g., [1]), especially for repeated transfers [2]. Our algorithms are implemented in a scalable parallel software component, *Rocface*, which supports multi-block structured and unstructured hybrid surface meshes, and can transfer node- or element-centered data. This software is used in the current generation of an integrated rocket simulation code developed at the Center for Simulation of Advanced Rockets, which has demonstrated significant improvements in generality and accuracy compared with previous generations of the code. We also report some progress on generalization of our data-transfer algorithms to nonmatching volume meshes and to adaptively changing interface meshes.

References

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