An Accurate, Efficient Overset Approach Using High-Order Methods
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The overset approach to computational fluid dynamics (CFD) allows each body of interest to be meshed independently, greatly simplifying the mesh generation process for complex geometries. It has long been used to great success to simulate difficult dynamic problems, such as the flow around a helicopter, or any other situation with multiple bodies in relative motion. It has a number of benefits over the mesh deformation approach to moving bodies, but on the other hand, the inter-grid interpolation required for the method is a constant source of error. In particular, the interpolation process typically causes a simulation to no longer be fully conservative due to errors at the overset boundaries. Conservation errors for overset CFD have long been known about, and prove particularly troubling when attempting to simulate high-speed flows with shock waves. These errors also introduce numerical dissipation, making the accurate capture of vortex-dominated flows through overset boundaries difficult.

This presentation will address our current work to apply high-order methods to the overset CFD approach, in particular the Direct Flux Reconstruction (DFR) method under development in the Aerospace Computing Lab. Recent work has led to a DFR implementation on modern hardware that is fast and efficient, and by interfacing with an external domain-connectivity library, is now capable of running on static and moving overset grids. By adapting the overset domain-connectivity algorithms for use on modern hardware as well, significant speedup has been obtained over the previous CPU-based implementation. We will show not only that this approach retains high-order accuracy on moving overset grids, but also that the overhead involved in the approach is low enough to be useful for large, complex simulations.