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A high-order 3D spectral difference solver for simulating flows about rotating geometries BIN ZHANG, CHUNLEI LIANG, The George Washington University — Fluid flows around rotating geometries are ubiquitous. For example, a spinning ping pong ball can quickly change its trajectory in an air flow; a marine propeller can provide enormous amount of thrust to a ship. It has been a long-time challenge to accurately simulate these flows. In this work, we present a high-order and efficient 3D flow solver based on unstructured spectral difference (SD) method and a novel sliding-mesh method. In the SD method, solution and fluxes are reconstructed using tensor products of 1D polynomials and the equations are solved in differential-form, which leads to high-order accuracy and high efficiency. In the sliding-mesh method, a computational domain is decomposed into non-overlapping subdomains. Each subdomain can enclose a geometry and can rotate relative to its neighbor, resulting in nonconforming sliding interfaces. A curved dynamic mortar approach is designed for communication on these interfaces. In this approach, solutions and fluxes are projected from cell faces to mortars to compute common values which are then projected back to ensures continuity and conservation. Through theoretical analysis and numerical tests, it is shown that this solver is conservative, free-stream preservative, and high-order accurate in both space and time.

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