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A second-order immersed boundary method with near-wall physics RANDALL MCDERMOTT, NIST, CLARA CRUZ[1], University of Puerto Rico, KEVIN MCGRATTAN, NIST — The NIST Fire Dynamics Simulator is a variable-density large-eddy simulation code tuned for low-speed fire dynamics and heat transfer. The gas-phase numerics utilize a Cartesian staggered-grid arrangement and are generally second- order accurate. Until now, complex geometry has been treated with an immersed boundary method in which objects in the flow are forced to conform to the Cartesian grid. This method exactly corresponds to first interpolation method described in Fadlun et al. (J. Comp. Phys. 2000) and has been shown to exhibit zeroth order errors for non-conformal geometries. In the work presented here, we implement a variant on the second-order interpolation scheme of Fadlun et al. and extend the method to include the near-wall stress model of Werner and Wengle (8th Symp. Turb. Shear Flows 1991). To accomplish this we transform the first off-wall velocity into a streamwise coordinate system and update the components based on a momentum equation with a Werner and Wengle wall stress. The streamwise system components are then transformed back to the grid system to form the force terms required in the immersed boundary method. The new approach is tested in laminar and turbulent channel flow with the channel rotated through a range of angles relative to the Cartesian grid.

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