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Large-Scale Simulations of Realistic Fluidized Bed Reactors using Novel Numerical Methods JESSE CAPECELATRO, OLIVIER DESJARDINS, PERRINE PEPIOT, cornell University, NATIONAL RENEWABLE ENERGY LAB COLLABORATION — Turbulent particle-laden flows in the form of fluidized bed reactors display good mixing properties, low pressure drops, and a fairly uniform temperature distribution. Understanding and predicting the flow dynamics within the reactor is necessary for improving the efficiency, and providing technologies for large-scale industrialization. A numerical strategy based on an Eulerian representation of the gas phase and Lagrangian tracking of the particles is developed in the framework of NGA, a high- order fully conservative parallel code tailored for turbulent flows. The particles are accounted for using a point-particle assumption. Once the gas-phase quantities are mapped to the particle location a conservative, implicit diffusion operation smoothes the field. Normal and tangential collisions are handled via soft-sphere model, modified to allow the bed to reach close packing at rest. The pressure drop across the bed is compared with theory to accurately predict the minimum fluidization velocity. 3D simulations of the National Renewable Energy Lab's 4-inch reactor are then conducted. Tens of millions of particles are tracked. The reactor's geometry is modeled using an immersed boundary scheme. Statistics for volume fraction, velocities, bed expansion, and bubble characteristics are analyzed and compared with experimental data.

Jesse Capecelatro
Cornell University

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