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CFD predictions of confined turbulent swirling flows in a microscale multi-inlet vortex reactor MICHAEL OLSEN, Iowa State University, YANXIANG SHI, Massachusetts Institute of Technology, GIANLUCA IACCARINO, Stanford University, RODNEY FOX, Iowa State University — Turbulent swirling flows have proven to be an efficient way of promoting mixing for chemical reactions. Accordingly, a multi-inlet vortex reactor was designed for use in the synthesis of nanoparticles. LES and RANS simulations have been applied to understanding the underlying fluid dynamics in this reactor. Both simulations are performed with the open-source platform, OpenFOAM, and the validity of the chosen models are verified against μ-PIV data. For the LES framework, the simplest and yet the most commonly chosen model, Smagorinsky-Lilly model, is used. For the RANS simulations, however, the k–ε model is not capable of capturing the swirling motions. Instead, the four-equation v^2–f model is formulated to account for the velocity fluctuations perpendicular to the streamlines and is therefore chosen in this work. Comparisons of the simulation results with the experimental data show both approaches accurately predict the mean velocity fields. Considering the computational cost, the RANS with the v^2–f model is recommended for obtaining statistical quantities whereas the LES simulations are more suitable for understanding transient flow behaviors. Based on the validation, the velocity field as well as the turbulence field is also analyzed.

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