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Eulerian Models for Dilute Sprays using Quadrature Methods RODNEY O. FOX, OLIVIER DESJARDINS, PHILIPPE VILLEDIEU, HEINZ PITSCH, Center for Turbulence Research, Stanford University — Dilute sprays occur in many technical applications and can be described by a kinetic equation for the number density function of the droplet velocity as well as other internal variables such as size or composition. The numerical methods for simulating the kinetic equation fall into two broad categories: Lagrangian tracking techniques and Eulerian multi-fluid models. While more straightforward to implement and generally more accurate in capturing segregation due to finite Stokes number, Lagrangian methods are computationally expensive. In contrast, multi-fluid models provide multi-point statistics as well as a natural extension to dense sprays. However, Eulerian models based on number density and mean droplet velocity cannot reproduce the velocity moments obtained from Lagrangian simulations of canonical flows that involve droplet trajectory crossings. Such flows include impinging jets, elastic rebounds off walls, and turbulent flows where the droplet velocity can be locally multi-valued. In Eulerian models based on quadrature, the kinetic equation is closed at higher-order moments using weights and abscissas that are uniquely determined from transported lower-order moments. The applicability of this method is demonstrated by applying it to the aforementioned canonical flows. The moments obtained from the Eulerian model are validated against Lagrangian results.

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