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A Quadrature-Free Conservative Level Set RKDG for Simulating Atomization[1] ZECHARIAH JIBBEN, MARCUS HERRMANN, Arizona State University — We present an arbitrary high-order, quadrature-free, Runge-Kutta discontinuous Galerkin (RKDG) method for the solution of the conservative level set equation (Olsson et al., 2007), used for capturing phase interfaces in atomizing multiphase flows. Special care is taken to maintain high-order accuracy in the reinitialization equation, using appropriate slope limiters when necessary and a shared basis across cell interfaces for the diffusive flux. For efficiency, we implement the method in the context of the dual narrow band overset mesh approach of the Refined Level Set Grid method (Herrmann, 2008). The accuracy, consistency, and convergence of the resulting method is demonstrated using the method of manufactured solutions (MMS) and several standard test cases, including Zalesak's disk and columns and spheres in prescribed deformation fields. Using MMS, we demonstrate $k+1$ order spatial convergence for k-th order orthonormal Legendre polynomial basis functions. We furthermore show several orders of magnitude improvement in shape and volume errors over traditional WENO based distance function level set methods, and $k-1$ order spatial convergence of interfacial curvature using direct neighbor cells only.

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