Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Solution Methods for the Liquid-Gas Adjoint Equations with Applications to Spray Control LAM VU, Cornell University, ALEXANDRU FIKL, DANIEL J. BODONY, University of Illinois Urbana-Champaign, OLIVIER DESJARDINS, Cornell University — Atomization appears in important engineering applications such as fuel sprays for combustion engines. The capability to control sprays has the potential to create new technologies as well as improve existing devices. An efficient way to achieve computational spray control is to formulate the control problem as a minimization exercise that can be solved using a gradient-descent algorithm. The gradient can be calculated by solving an auxiliary set of differential equations known as the adjoint equations. In our proposed formulation, the adjoint equations for liquid-gas flows comprise the adjoint Navier-Stokes equation and the adjoint level set equation. Both pose numerous challenges such as the surface-bound nature of the adjoint level set equation, non-trivial jump conditions and complex two-way coupling. In this study, we describe a tailored surface transport method for solving the adjoint level set equation. We then verify and validate the two-way coupled adjoint equations by performing a gradient checking exercise of model liquid-gas flow problems.

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Date submitted: 10 Aug 2020 Electronic form version 1.4