Olivier Desjardins is a Professor in the Sibley School of Mechanical and Aerospace Engineering at Cornell University, which he joined in 2011 after three years on the faculty at the University of Colorado Boulder. He received an M.S. in Aeronautics and Astronautics from ENSAE (Supaero) in Toulouse, France, and an M.S. in Mechanical Engineering from Stanford University in 2004. He earned his Ph.D. in Mechanical Engineering from Stanford in 2008, conducting his doctoral research at the Center for Turbulence Research under the guidance of Prof. Heinz Pitsch.

His research focuses on multiphase turbulence, with an emphasis on liquid–gas and particle-laden flows. His group develops advanced numerical methods and physical models to enable accurate simulations of these complex systems. He received an NSF CAREER Award in 2014 for work on turbulence modeling around liquid–gas interfaces and the Junior Award from the International Conference on Multiphase Flow in 2016. He recently led a Navy Multidisciplinary University Research Initiative (MURI) project on spray control.

Desjardins currently serves as Associate Editor for Atomization and Sprays, and as a board member for the International Conference on Multiphase Flow, the Institute for Liquid Atomization and Spray Systems, and the APS Division of Fluid Dynamics.

Webinar

Making a Computational Splash: An Enhanced Volume-of-Fluid Framework for Multiscale Atomization Modeling

Liquid sprays surround us and play important roles in our daily lives, in obvious ways (taking a shower), in more subtle ways (drinking instant coffee produced via spray drying or driving a car powered via liquid fuel injection), or in more profound ways (with sea sprays playing a key part in ocean-atmosphere transfers impacting climate change). As such, we need to understand sprays better and for that we need to be able to predict how they form.

Unfortunately, computational prediction of turbulent multiphase flows presents enormous challenges. This is especially true whenever break-up and topology changes happen, such as in spray formation, in part because of the wide range of length and time scales involved in the spray break-up process.

In this work, we propose to tackle the challenge of high-fidelity modeling of liquid atomization with a novel multi-scale framework. New developments to the geometric volume of fluid method are presented that enable the tracking of sub-grid scale interfacial features. By reconstructing the liquid-gas interface with multiple planar surfaces, with paraboloids, or with cylindrical surfaces, we show that the small-scale ligaments and sheets that abound in spray formation can be represented accurately independently of mesh resolution while preserving exact conservation, excellent computational efficiency, and easy integration with finite-volume-based flow solvers.

A consequence of such strategies is that lack of mesh resolution no longer induces topology change, which then need to be reintroduced explicitly using physics-informed models. We discuss various flavors of such models in the context of the break-up of thin liquid films, which are common features in aerodynamic liquid atomization, and show that this approach can accurately predict the size distribution of spray droplets even with limited resolution.