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Surfactant-induced Marangoni effects in turbulent jets

Lyes Kahouadji[1*], Cristian R. Constante-Amores[1] and Omar K. Matar[1]

[1] Department of Chemical Engineering, Imperial College London, South Kensington Campus, London SW7 2AZ, United Kingdom
* l.kahouadji@imperial.ac.uk

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Surface-active-agents (surfactants) can be present in many multiphase flows either as undesirable contaminants or desirable additives. Gradients in interfacial surfactant concentration generate surfactant tension gradients and therefore Marangoni stresses. Here, we study the effect of surfactant on the complex interfacial dynamics associated with a turbulent jet [1, 2]. We use three-dimensional direct numerical simulations and a hybrid front-tracking/level-set method[1] to capture the dynamics of the complex topological changes in this flow. The numerical method allows the natural tracking of the concentration of interfacial surfactant species and the faithful modelling of its spatio-temporal evolution. Our model also accounts for surfactant solubility and bulk-interface mass exchange. We perform a parametric study of the effect of surfactant properties on the dynamics. The effect of Marangoni stresses is analysed in terms of the mechanisms giving rise to droplet size distributions depending on the surfactant elasticity number. An attempt to understand the interaction between the observed vortical structures accompanying the flow and the regions of elevated surfactant concentration will also be presented.

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