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Reaction Force of Micro-scale Liquid Droplets Constrained Between Parallel Plates through CFD ROBERT FREE, HAIDER HEKIRI, TAKUMI HAWA, School of Aerospace and Mechanical Engineering, The University of Oklahoma — Micro-scale liquid droplets responding to depression between parallel plates are investigated analytically and numerically. The functional dependence of the reaction force accrued in such droplets on droplet size, surface tension, depression amount, and contact angle is explored. For both the 2D and 3D case, an analytical model is developed based on first principles. Computational fluid dynamics is then utilized to evaluate the validity of these models. The reaction force is highly nonlinear, initially increasing very slowly with increasing depression of the droplet, but eventually moving asymptotically to infinity. The force scales linearly with both the droplet free radius and surface tension of the liquid, but has a much more complicated dependence on the contact angle and depression. Explicit expressions for the reaction force have been determined, showing these dependencies. The 3D model has been largely supported by the CFD results. It very accurately predicts the reaction force on the upper plate as the droplet is crushed, accounting for the effect of contact angle, surface tension, and droplet size.

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