FILLING THE GAP IN BOUNCING DYNAMICS

R. Cimpeanu[1], L. Alventosa[2], I. Bauman[2], D. M. Harris[2], C. A. Galeano-Rios[3] and P. A. Milewski[3]

[1]Mathematical Institute, University of Oxford, Oxford, UK; [2]School of Engineering, Brown University, Providence, Rhode Island, USA; [3]Department of Mathematical Sciences, University of Bath, Bath, UK

Radu.Cimpeanu@maths.ox.ac.uk

Depending on physical parameters, impacting bodies on a liquid surface have been shown to sink, become trapped or rebound off the interface [1]. Here we focus on the latter of these scenarios (see Fig. 1 below), when surface tension plays an important role, driving the dynamics towards non-trivial regimes of relevance to many drop-bath and fluid-structure interaction contexts.

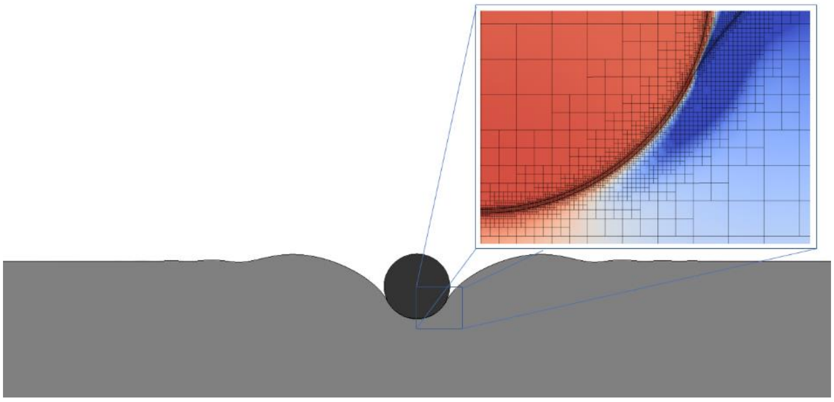

Figure 1. Direct numerical simulation of the impact process, with the inset highlighting the vertical velocity and underlying adaptive mesh structure.

A partial differential equation model starting from the Navier-Stokes equations can be derived to represent the motion of the free surface [2]. This reduced linear model is coupled to the motion of the impactor (a superhydrophobic solid sphere in the first instance), yielding promising results when compared to experiments without the need for fitting parameters. By construction however the model ignores nonlinear effects and air cushioning.

In this work we present a synergistic approach between a generalised modelling framework, state-of-the-art direct numerical simulations based on the volume-of-fluid method, as well as recent experimental advances in drop generation [3]. These allow us to explore a wide parameter spectrum and characterise the dependence of the normal coefficient of restitution and contact time on the impact velocity, radius, and relative densities of the impactor and liquid pool in both solid-liquid and liquid-liquid cases. The combined efforts are directed towards enhancing predictive capabilities and gaining a detailed understanding of this challenging multi-scale impact problem.

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