Simulating Surface Tension of Oscillating Droplet with Smoothed Particle Hydrodynamics

***N. N. Ehigiamusoe, and Y. C. Lee**

School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh, EH14 4AS, United Kingdom

*Presenting author: nne30@hw.ac.uk

*****Corresponding author: nne30@hw.ac.uk

Abstract

Surface tension plays an important role at the dynamic interface of free-surface flows, especially at small length scales, resulting in the significant interplay of forces between the fluid properties and its shape. This phenomenon is observed naturally in everyday life, such as in tear films in the eye and wetting of water drops on leaf surfaces. The above effects are also observed in many man-made functional devices and industrial processes found in printing and surface coating applications.

A model for simulating surface tension dominant flows that consist of fluid–fluid and fluid-solid interactions using Smoothed Particle Hydrodynamics (SPH) [1] is presented to accurately predict formation, evolution and interaction of thin liquid films and droplets on non-porous substrates. The methodology employed is Lagrangian in nature where the equations of motion and conservation are solved numerically. The effects of surface tension forces are implemented using a modification of inter-particle interactions [2] to provide the required flexibility and accuracy for fluid-fluid and fluid-solid interaction controls.

Validation test cases with free surface flows are performed and compared against mesh-based solutions and analytical one showed good agreements. The present research focuses on surface tension dominated flows, with emphasis on oscillating droplets where the formation and stability of these droplets are analysed. Recent work on more complicated surface tension dominated flows will be presented and explored.

References

[1] J. J. Monaghan, Smoothed Particle Hydrodynamics, Annual review of astronomy and astrophysics. Vol. 30 (A93-25826 09-90), p. 543-574.

[2] A. Tartakovsky and P. Meakin, Modelling of surface tension and contact angles with smoothed particle hydrodynamics, Physical Review E72, 026301-9, 2005.