TUAT Fluid Dynamics Seminar

Characterising the dynamics of a drop bouncing on a smooth hydrophobic surface

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Date : Thursday, September 26th, 2019

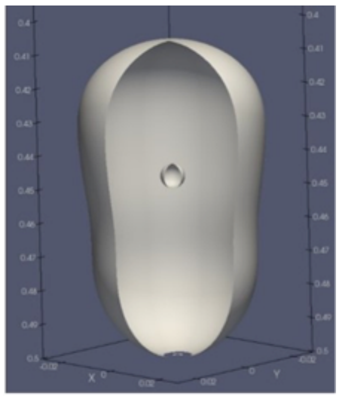
Place: Building 6 - Room 501

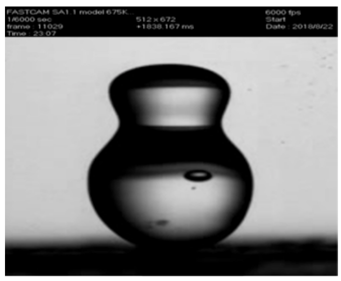
Time : 11:00 am - 12:00 pm

organized by: Assoc. Prof. Y. Tagawa (tagawayo@cc.tuat.ac.jp)

Abstract

In the present work we focus on a single bouncing event of a drop on a solid surface. The dynamics of drop depends on three important non-dimensional numbers namely Reynolds number ($Re = \rho U R_0/\mu_l$), Weber number ($We = \rho_l U^2 R_0/\sigma$) and capillary number ($Ca_g = \mu_g U/\sigma$ based on gas viscosity). To facilitate bouncing, we set $We \sim O(1)$, $Re \sim O(100)$ and contact angle $\theta = 170^o$. We find that in these range of parameters, drop undergoes a complete rebound.





Using axisymmetric simulations and a few experiments, several different bouncing regimes are found which can be depicted in the form of a *phase diagram*. For all Weber numbers and moderate values of *Re*, bouncing of the droplet occurs without any assistance of the surface characteristics such as super-hydrophobicity. This is referred to as *wettability independent* bouncing. For relatively higher Reynolds number, the droplet makes physical contact with the surface making the process *wettability dependent*. For wettability independent bouncing process, the drop is supported a thin cushion of gas underneath it. Using high resolution simulations, a detailed characterization of the gas film has been carried out revealing that the entire bouncing process can be divided into five regimes. The talk will shed light on scaling laws for gas film thickness, the shape of the gas film in each of the five regimes and the energetics of the bouncing process. The work rationalises many of the earlier experiments carried out in this area.

If time permits, other problems of interest currently being pursued in my research group will also be briefly highlighted.

Biographical Sketch: Dr. Dixit obtained a M.S. in Mechanical Engineering from the Indian Institute of Technology Madras and Ph.D. from the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, India. He spent three years at the Department of Mathematics, University of British Columbia, Vancouver working with Prof. George Homsy working on interfacial flows. He then moved to IIT Hyderabad in October 2013. His research interests lie in interfacial flows, hydrodynamic stability theory and fluid dynamics of biological systems.