Liquid Bridges: Splitting, Motion, and Applications

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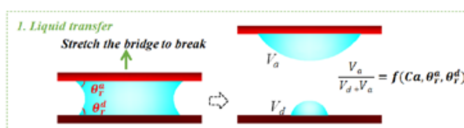
Capillary bridge formed between two solid surfaces is seen in various applications, e.g. in off-set printing, to transfer ink, it is important that the liquid bridge is split in a controlled fashion, see Fig (a); for fog collectors, the liquid transport via a bridge needs to be managed properly for high efficiency; or controlling the shape of a liquid bridge can lead to development of varifocal lenses. In this talk, I start by explaining the role of surface wettability and contact line pinning on the splitting of a liquid bridge. I show that splitting a liquid bridge by stretching it, is only controlled by the receding contact angle (θ_r) for quasi-static systems. When stretching is fast, the capillary number and receding contact angle are the two parameters determining the split ratio between two parallel surfaces. Liquid bridge between two non-paralleled surfaces leads to a lateral motion of a bridge, see Fig. (b). This motion is either due to inherent instability of the liquid bridge between two hydrophilic surfaces, or due to cycling of a stable bridge (i.e. compressing and stretching). I will discuss a model that can be used to predict the minimal amount of non-parallelism that causes a bridge to become unstable between two hydrophilic surfaces. Also, I will show how cycling a stable bridge can result in a controllable movement steps depending on the tilt angle and surface wettability and amount of compression and stretching. Time permitting, I will also briefly demonstrate how a liquid bridge can be used for development of a cylindrical varifocal lens.

(a)



(b)

Bio

Alidad Amirfazli is a Professor at the York University in Toronto, Canada where he founded the Department of Mechanical Engineering in 2013. He formerly held the Canada Research Chair in Surface Engineering at the University of Alberta, Canada. Amirfazli has produced exciting results in wetting behavior of surfaces, drop adhesion and shedding, drop impact, icing, direct laser patterning of self assembled monolayers and super-hydrophobic surfaces. He has had more than 200 scientific contributions, many in prestigious peer reviewed journals; he has also given many invited talks at international level. He is the Editor for the Advances in Colloid and Interface Science, and an Editorial board member for other journals. Dr. Amirfazli has been the recipient of the Martha Cook Piper Research prize, Petro-Canada Young Innovator Award, and Killam Annual Professorship. In 2014 he was inducted into the Royal Society of Canada's College of New Scholars, Artists and Scientists. He also served in the board of Professional Engineers of Alberta, and been a consultant with various companies in USA, Europe, and Canada.