UK Fluids Conference 2023, 17-19th October 2023, Glasgow, UK

Session: Fluid Dynamic Instabilities and Turbulence

Buoyancy-driven flow instabilities in liquid bridges

Ahmed Aljanadi and Marcello Lappa*

Department of Mechanical and Aerospace Engineering, University of Strathclyde James Weir Building, 75 Montrose Street, Glasgow, G1 1XJ, UK

Abstract:

Liquid bridges have attracted much attention over the last four decades as a vehicle for performing experiments on surface-tension-driven flows in well-controlled conditions. The intrinsic advantages of this unique configuration essentially reside in the ability to maximize the ratio between the area of the free surface and that of all the other solid surfaces. As even a cursory perusal of the literature would immediately confirm, however, no experimental works on purely buoyant convective states have been produced to date given the inherent difficulties related to any attempt made to separate buoyancy convection from fluid motion induced by thermocapillary effects. In the present work, an attempt is made to fill this gap by considering water in conditions for which its ability to support Marangoni effects is inhibited. Liquid bridges uniformly heated from below and cooled from above are investigated experimentally by means of a laser-cut technique and the ensuing application of a Particle Image Velocimetry (PIV) technique. The examined imposed temperature differences cover the interval going from the onset of convection from an initial quiescent state up to the development of oscillatory modes of various types. The related analogies and differences with the classical supercritical modes of Marangoni convection are critically discussed.