Post-doc job offer

Instability development at the interface of viscous heterocharged fluids

Location: Institut PPRIME, Futuroscope, France
Keywords: Fluid dynamics, electrical discharge, flow control
Local contact: N. Benard (nicolas.benard@univ-poitiers.fr)

An interface composed of two reactive and/or non-reactive fluids moving parallel to each other and having different velocities, densities or temperatures is common in many practical applications related to aerodynamics, combustion and thermal flows. These two fluids may have identical physico-chemical properties, in which case they are referred to as a homogeneous mixing layer, or they may have different flow properties, in which case the flow is of a heterogeneous nature. In most cases, the differences in physico-chemical properties are mainly reflected in differences in density and/or kinematic viscosity. At the interface of these two convective flows, an hydrodynamic instability called Kelvin-Helmoltz instability develops and dominates the growth rate and mixing characteristics of the flow. At maximum amplification, the instabilities form coherent structures that are crucial for the flow dynamics and performances correlated with a quality mixing.

The proposed studies will focus on a two-dimensional mixing layer of a highly viscous dielectric fluid at low-Reynolds number. The fluid/fluid interface will be studied experimentally under different conditions. As such, mixing layer situations with homogeneous and heterogeneous physico-chemical properties will be implemented in an existing hydrodynamic loop within the Institute. The heterogeneity will be produced by a charge injection in one of the convected layers. Therefore, the aim of the study is to determine the amplification or damping characteristics of an initially 2D interface under the effect of a gradient of electrical charge between the two convective flows. It is expected that a manipulation of the coherent structures will be feasible by a reinforcement of the primary instability under the effect of the charge heterogeneity at the interface. In a second step, the use of local energy deposition by high-voltage alternating or pulsed discharge will be evaluated with the objective of modifying the properties of the most amplified natural instability and thus manipulating (amplification or damping) the high-energy large scale flow structures.

This subject is part of action 5.1 of the labex INTERACTIVE. This research effort concerns the manipulation of internal flow by electrical discharge and charge injection. The aim of this work is to explore a new research field for the aeronautics and space industry, particularly in the intensification of heat exchanges. It also intends to develop the partnerships in progress with the WPI, NASA and the IIT in Kharagpur. The funding covers a period of 12 months as a contract research engineer for the University of Poitiers. The candidate must hold a PhD in one of the following specialties: fluid mechanics, electrical engineering, plasma physics. Skills in optical metrology such as particle imaging velocimetry would be appreciated.

Applications in the form of a CV and a cover letter should be sent to nicolas.benard@univ-poitiers.fr by 31 October 2020 at the latest. Application on the fly, funding available right now.