INTERNSHIP PROGRAM FOR INTERNATIONAL STUDENTS

INTERNSHIP SUBJECT FORM

Name of the Host Laboratory	LadHyX
Website of the Host Laboratory	www.ladhyx.polytechnique.fr
Research Group	
Internship Supervisor	Sébastien Michelin
Internship Subject	Marangoni flows, instability and complex patterns at a free surface
Student's level	☒ Advanced Undergraduate Students (3rd or 4th year) ☒ Master's students (1st or 2nd year) ☒ PhD students
Proposed Duration	☒ 3 months ☒ 4 months ☒ 5 months ☒ 6 months
Prerequisites	Viscous flows, advection-diffusion, partial differential equations, some Matlab/Python/… experience
Internship description (max. 15 lines)	Surfactants stabilize an interface between two fluids and lower the interfacial tension. The complex interplay of hydrodynamics and transport of these surfactants result in flow patterns, known as Marangoni flows, at the surface of soap films or in the migration of droplets in another liquid. Surfactant molecules are typically very large and hence diffuse slowly at the interface between the two fluid phases. In the presence of a flow, their transport is therefore dominated by convection, which introduces a non-linear coupling between the dynamics of the surfactant (i.e. their concentration) and the fluid dynamics resulting from their non-homogeneous distribution (i.e. Marangoni flows). Recent experiments performed at the University of Bordeaux identified an instability in the axisymmetric flow generated by a vertical jet near a free surface in a cylindrical container, leading to complex dipolar and quadrupolar flow patterns, whose origin remains so far elusive. Preliminary analysis has suggested the existence of an instability associated with the transport of surfactants at the free surface. The goal of this internship will be to identify the fundamental origin of this instability and to characterize it, by performing the linear stability analysis of the base flow. This project will combine theoretical stability analysis and numerical simulations.