ÉCOLE POLYTECHNIQUE
UNIVERSITÉ PARIS-SACLAY

# INTERNSHIP PROGRAM FOR INTERNATIONAL STUDENTS

# INTERNSHIP SUBJECT FORM

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| 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)<br>☒ Master's students (1st or 2nd year)<br>☒ PhD students |
| Proposed Duration | ☒ 3 months<br>☒ 4 months<br>☒ 5 months<br>☒ 6 months<br>Ideally this internship will last 6 months. Shorter internships (3-5 months are also possible) |
| Prerequisites | Fluid Mechanics, numerical analysis, some experience with Matlab or FreeFEM++ |
| Internship description (max. 15 lines) | Surfactant molecules can stabilize an interface between two fluid media by lowering the surface tension of that interface. A gradient in their concentration generates a differential capillary stress at the interface which cannot be balanced: as a consequence, a flow is generated which is known as a Marangoni flow. Among other classical examples, this well-known phenomenon is responsible for the migration of droplets in thermal or chemical gradients, or for complex flow patterns at the surface of soap films.<br><br>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).<br><br>Recent experiments performed at the University of Bordeaux have shown the existence of 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. The goal of this project 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 and numerical analysis (simulations in FreeFEM or Matlab). |