

|| SEMS: RESEARCH PROJECT DESCRIPTION

Project Background and Description

A project title and description with clear aims (300 words)

The Effect of Surfactants on the Dynamics of Liquids

This project proposes to investigate the dynamics of liquids containing surfactants at diverse time-scales.

Aims:

- 1. This project would use optical methods to study the velocity profiles of surfactant loaded fluids.*
- 2. Contrast results with those obtained from pure liquids and test existing numerical and analytical methods. These studies would first focus on inviscid Newtonian liquids but, we aim at exploring a large range of other fluids, including viscoelastics, at a later stage.*
- 3. Explore and develop methods to quantify and characterize the surface tension at short surface lifetimes.*

Surface tension is a liquid property that arises from intermolecular forces. In a pure liquid, these forces arise from molecules of the same kind, but in solutions these forces are the result of a complex interaction between various molecules. As a result, the surface tension of most liquid solutions depends on both the fluid composition and on their internal dynamics. In particular, in solutions, the liquid surface is dynamic as different molecules arrive to the surface at various rates due to mismatched diffusion speeds. As the surface ages, it approaches diffusion equilibrium, and the surface tension reaches a "static" stable value. Importantly, most methods used to quantify the dynamic surface tension, e.g. bubble tensiometers, operate at speeds that are too slow to represent the fast flows found in industry or in natural problems, i.e. most devices work above tents of milliseconds. As a consequence, the effect of surface dynamics on fast liquid flows is practically unknown. In fact, some numerical approaches fail to predict fluid behavior because liquids are often modelled as pure substances with a homogenous surface tension.

Project Scope

- Understand the effect of the dynamic surface tension on liquid flows.
- Develop a practical method to assess and identify changes of surface tension in liquids due to its inner dynamics.

Desired Skills from the Student

- Basic background in fluid mechanics is desired but not compulsory.
- Experience in Laboratory work (physics or engineering) would be advantageous.
- Interest in experimental physics and instrumentation. A good degree in Engineering, or Physics.
- Experience writing reports and/or scientific papers would be advantageous.

Supervisory Team

- Primary: Jose Rafael Castrejon-Pita (S. Lecturer, PhD).
- Secondary: Yi Sui (Reader, SEMS)