**Ternary Dewetting: The Flow Physics of Cleaning using Limited Resources**

**Supervisors:**

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**Project Description:**

The removal of liquids, or dewetting, from rough, heterogeneous and structured solid surfaces is central to many engineering and industrial processes, from oil spill cleanup to the cleaning of fabrics and surfaces at home. This is typically achieved by excess surfactants and polymers used to induce dewetting and liquid removals. Driven by the current stark reality of water shortages and environmental pressure to substantially reduce surfactant and polymer use, this project’s key overarching motivation is to understand how wettability alteration can be achieved locally and under resource-constrained environments (limited water, polymers and surfactants).

To date, the majority of studies on dewetting have been limited to binary fluid systems: a droplet removal in the presence of a surrounding bath of gas or liquid. In contrast, this project is concerned with achieving dewetting in ternary-fluid systems. For example, Fig. 1 illustrates the removal of an unwanted droplet through the introduction of a low-volume formulation film. To develop efficient cleaning technologies and mechanisms under constrained resources, the research questions this project aims to answer include:

* How can the dewetting outcome (e.g. Fig. 1) be manipulated by controlling the solid surface properties, the fluid interface and the bulk liquid properties?
* How may the cleaning efficacy depend on the protocols by which the formulation liquid is introduced to the system?
* How can external perturbations, such as mechanical agitations, be harnessed to enhance the dewetting process?

The PhD student will use a combination of simulations and experiments in this project, the balance of which can be adjusted depending on the interest of the student. Computationally, the student will exploit an innovative lattice Boltzmann simulation method that can capture three (or more) fluid components and complex surface geometries. Experimentally, the student will develop expertise in numerous surface texturing/coating and characterization techniques, including lithography, high-speed video imaging, contact angle goniometry, and scanning electron microscopy. The project will also involve an industrial placement with Procter and Gamble to accelerate the applications of ternary dewetting concepts and setups to solve industrially relevant cleaning problems.