Viscous Froth and Surfactant Mass transfer - SRV Report

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The SRV happened in July, 2017, from the 16th to the 22nd. I visited the foam research group in the Institute of Mathematics, Physics and Computer Science in Aberystwyth University Wales. I worked directly with Dr Denny Vitasari and Prof Simon Cox, to develop a model for the velocity profile in a thin foam film and for the surfactant mass transfer at the film surface in the case where there is film stretch/contraction coupled with Marangoni flows at the film surface. It is important to understand how the surfactant distribution changes when thin films stretch or contract to incorporate this knowledge into models of applications of foam films travelling in porous media [1]. Films travelling in a channel with variable width will cause stretching/shrinking in the foam films that, when coupled with Marangoni stresses, cause the surfactant distribution in the film surface to change and the surface tension consequently.

The objective set for this week was to define this problem mathematically. The volume of the film was assumed to remain unchanged with the deformation, due to incompressibility. The new problem revealed to be very similar to the one currently being studied by me in my PhD, which couples film drainage with Marangoni flows [2], with very similar expressions for the velocity along the film surface and partial differential equation for the surfactant mass balance at the film surface.

The surfactant mass balance equation for the problem coupling film drainage and Marangoni flows at the film surface was already studied by me, using a numeric spectral analysis technique to solve this equation [3] and obtain the surfactant distribution on the film surface at a given position and instant.

Given the similarity between the two problems, this spectral analysis technique can also be applied to the stretching case, but rescaled variables [4] are needed to deal with the film changing length. This means that results for the new problem can be obtained very easily with minimal changes to model already developed. This is the next step to be performed.

This SRV also allowed me to meet personally with other researchers from the foam research group in Aberystwyth University and get to know a bit more about their work, e.g. Tudur Davies and Francesca Zaccagnino. I also had the opportunity to present the work I developed in the problem coupling fim drainage and Marangoni flows at its surface to the resident research group in a seminar.

To conclude, this SRV was very fruitful and successful and is a great initiative to promote knowledge exchange and relevant collaborations between research groups working in the fluid mechanics field.

References:

[1] Green *et al*, Physical Review E74 (5), 051403, 2006.
[2] Vitasari *et al*, Chemical Engineering Science, vol. 102, 405-423, 2013.
[3] Press *et al*, Numerical Recipes, Cambridge University Press, 2007.
[4] P. Grassia *et al*, Colloids and Surf. A, Physicochem. and Eng. Aspects, 263:184-196, 2005.

Figure 1: Me and the visited research group. From left to right: Prof Simon Cox, me, Ms Francesca Zaccagnino, Dr Denny Vitasari.

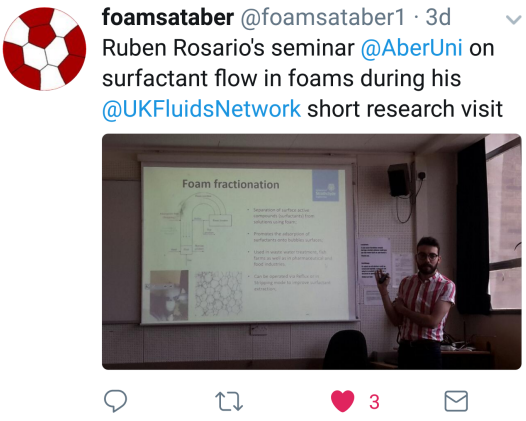

Figure 2: Prof Simon Cox's tweet of my seminar presentation at Aberystwyth University.