Spreading of an insoluble surfactant at the surface of a visco-elastic fluid

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Project Outline and Objectives

The spreading of a layer of insoluble surfactact on the surface of a fluid is of interest in various problems in environmental science such as the spreading of oil slicks on water. A theory has been worked out by Jensen [2] which reduces to solving a simple nonlinear diffusion equation for the slick thickness in the limit of a very extended film. This equation can be solved using self-similarity methods [1]. The objective of this project is to extend the theory to describe the spreading of a layer of surfactant on the surface of a viscoelastic fluid. This has some applications in biology apparently but I don't know what they are. In this project we will focus initially on the rotationally symmetric cases of a spreading droplet and a collapsing void.

Required Background and Methodology
This project requires and interest in fluid dynamics and soft matter and a familiarity with PDEs. It is likely the resulting equations will require numerical solution so some computer skills would help.

Research Outcomes

The results of the project will, at some point, be compared to some experiments to be done in the laboratory of Dr. M.M. Bandi at the Collective Interactions Unit at the Okinawa Institute of Science and Technology and if it works we will get a publication.

PhD prospects

This project is probably only suitable for MSc since I will be away next year although there is some possibility to continue to do a PhD in OIST for anyone who is interested in moving to Japan.

References

[1] J. Gratton and F. Minotti. Self-similar viscous gravity currents - phase-plane formalism. *J. Fluid Mech.*, 210:155–182, 1990.

[2] O. E. Jensen. The spreading of insoluble surfactant at the free surface of a deep fluid layer. *J. Fluid Mech.*, 293:349–378, 1995.

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