Georgia Institute of Technology
The George W. Woodruff School of Mechanical Engineering

WOODRUFF COLLOQUIUM

Simulations of Wetting Phenomena, with Application to Microfluidics

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MARC Building Auditorium
11:00am

Abstract:

Simulations of problems with free boundaries and several phases still present great challenges. One example of a generic free boundary problem is the growth of a crystalline solid. A seemingly distant example is wetting and capillarity in liquids. In both these cases however, the interplay between heat and mass transfer around the free boundaries, and the surface energy, will determine the outcome of the process. In the growing area of microfluidics, capillary and surface phenomena are often crucial.

Diffuse interface methods for simulating free boundary problems have been gaining popularity over recent years. In this methodology the free surface is represented as a steep but continuous transition in a phase field variable, which is obtained as a solution to a particular partial differential equation. In many cases this equation can be conveniently derived from basic thermodynamic considerations. Solidification, phase change, surface tension and wetting, etc, can be treated this way.

In this talk I will show some quick examples of various problems that I have been working on in recent years, such as surface tension driven thermocapillary flow, dielectrophoretic separation and phase change problems and crystallization. I will cover in some more detail simulations and experiments of a specific microfluidic problem of depositing picoliter droplets on a substrate. Our diffuse-interface simulations capture all the relevant phenomena of dynamic wetting, droplet breakup, etc.

Biosketch:

Gustav Amberg received his doctoral degree in 1986 from the Royal Institute of Technology in Stockholm (KTH). He received the degree of Docent in 1990, and served as Senior Lecturer until 1999, when he was appointed Professor of Fluid Mechanics. He has been a guest researcher at MIT, Stanford University, and the Science University of Tokyo. He is presently serving as the Dean of the School of Engineering Sciences at KTH. Most of his recent research deals with convective heat and mass transfer phenomena in materials processes of different kinds, ranging from more fundamental aspects of solidification and phase change, to particular processes. He has also worked on thermocapillary convection, i.e. fluid motions induced by surface tension variations over a free surface. He has recently begun to work on fluid mechanics related to microsystems and microfluidics, in particular dielectrophoretic separation, wetting and capillary effects. He has also developed symbolic computation tools to generate finite element code for general systems of partial differential equations, which are used to simulate problems in the areas above.

Refreshments will be served.

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