ICTS | INTERNATIONAL CENTRE for THEORETICAL SCIENCES

TATA INSTITUTE OF FUNDAMENTAL RESEARCH

ICTS Fluid Weekly Seminar (Online)

Title : Mesoscale Modelling of Multiphase Flow and Wetting

Speaker : Thejas Hulikal Chakrapani (University of Twente, Netherlands

Date : Friday, 04th November 2022

Time : 02:00 pm (IST)

Abstract : Ink-jet printing has gained prominence for its versatility to print functional materials onto a variety of substrates. During my PhD I worked on the computational modelling of ink penetration in paper, which is relevant to the ink-jet printing industry. Jetting ink is a complex formulation composed of a solvent like water, co-solvent such as glycerol, surfactants, dye molecules, nanoparticles and polymers. On the other hand, print paper is equally complex due to the disordered arrangement of cellulosic fibres, thus giving rise to complex pore shapes and a wide distribution of their sizes. Tackling these complexities at once deem the problem intractable. Thus, we start with the simplest model of a solid and fluid and systematically elevate their complexities. A mesoscale computational technique called Many-body Dissipative Particle Dynamics (MDPD) is chosen based on the length and time scales pertinent to imbibition in porous paper. Simulations are first benchmarked against Lucas and Washburn's theory describing imbibition of a pure fluid (simple fluid) into a cylindrical nanopore (simple solid). A second fluid is added to investigate imbibition of binary mixtures in a nanopore. When the liquids differ in their affinity to nanochannel, the mixture segregates and allows the non-wetting fluid to penetrate deeper. Next, we investigate pure fluid flow through a forest of rigid micro pillars arranged in irregular patterns. Simulation results agree well with experiments, thus proving the capability of MDPD to handle complex flow geometries. Finally, imbibition simulations of a dye like liquid into a stack of disordered fibres generate deposition patterns and penetration rates that qualitatively resemble experimental observations.

Venue : Please click on the below link to join the meeting

https://icts-res-in.zoom.us/j/88103424109?pwd=TzFKRkRaSTVyeDFQaXF5UWIyeWgvZz09
Meeting ID: 881 0342 4109
Passcode: 967873