Graduate Student Research Seminar

Spring 2023

Newtonian Flow Between Fibers:

Liquid Bridge Patterns and Self-Sustained Sheets

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Advisor: Dr. Joshua Bostwick

Monday, March 3rd

3:00 pm (EST) – 132 Fluor Daniel Building

Abstract

Liquid flowing down a fiber can result in 'bead-on-fiber' patterns that are prevalent in numerous heat and mass transfer applications, such as fog harvesting and desalination. The flow of liquid between closely spaced arrays of fibers has not been explored, despite its relevance in these applications. In this study, we explore the shape evolution of Newtonian flow between fibers and find that the flow takes on two distinct forms: (i) liquid bridge patterns and (ii) self-sustained sheets. For liquid bridge patterns, we reveal a collapse of our large experimental data set onto a single trendline upon scaling. Self-sustained sheets are shown to span the entire fiber length without rupture due to continuous flow replenishment. We reconstruct the sheet profiles using the Beer–Lambert Law to calibrate the luminance of dyed solutions to thickness. We also compare the critical flowrate and fiber gap to form and break a sheet, and identify a hysteric region where sheets only exist if they are formed at a small fiber gap and then stretched. Last, we demonstrate the manipulation of these flows on curved fibers, which enables passive control of sheet thickness.

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