PLENARY SESSION

Mesoscale Simulations of Fluids and Droplets

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ABSTRACT

Major progress in experimental microfluidics in the last decades has spawned the opportunity to explore and realize new states of droplet-based soft flowing matter, such as foams, high-density disordered and hierarchical emulsions, as well as various types of soft granular flows. Besides their numerous applications in science, engineering and life sciences, these novel states of matter raise new challenges to non-equilibrium statistical physics because their mechanical and rheological properties cannot be traced back to those of liquids, gases and solids. In this talk, we shall present computer simulations and machine-learning algorithms which help shedding light into these complex states of soft flowing matter and assist/inspire the design of new soft materials [1]. In particular, data analysis obtained by microfluidic experiments remains a bottleneck to this day due to the need for a reliable interface converting raw observations to informative data fast enough and at low operating costs. The difficulty arises even in an apparently simple task of tracking droplets in a typical microfluidic experiment. Recently we combined two state-of-the-art computer vision algorithms (YOLO and DeepSORT) in a single tool (DropTrack) to infer trajectories of the droplets and other physical observables from videos of microfluidic experiments [2]. The image analysis is faster than the image capture rate of a typical camera, opening the prospect of a real-time feedback control mechanism to achieve desired results. We shall highlight the DropTrack tool's main features, the droplet tracking results in dense emulsion experiments, and key steps to adapt the tool for other applications of multiple particle tracking.

REFERENCES

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