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Abstract for an Invited Paper
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Stanley Corrsin Award Talk: From Microstructure to Models – Fluid Mechanics of Suspensions[1]

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Suspensions of particles in Newtonian liquids are simple complex fluids. Describable by just a handful of macroscopic variables, suspensions are in one sense simple; but the microscopic state is responsive to variation of these variables, making the flow properties non-Newtonian, and hence these are complex fluids. Our work is motivated by the scientific goal of developing a fluid mechanics of the bulk suspension behavior, toward a framework allowing analysis and computation; the hope is that this will expand understanding of suspensions found in engineering and the environment. Progress toward this goal often benefits from examination of the microscopic mechanics. Particle migration and its basis in rheological properties will be discussed, along with the microstructure of particles leading to these properties. Phenomena in extremely dense suspensions – shear thickening and jamming – will be discussed with an emphasis on how these motivate a shift in focus, from the particles to the force networks developed under flow. The prior Stokes-flow examples will be complemented by presentation of inertial transitions observed in Taylor-Couette flow of suspensions, to illustrate challenges faced in developing a true fluid mechanics of these mixtures.

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