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# MMEC SEMINAR SERIES

Mechanics: Modeling, Experimentation, Computation

## Tuesday, March 10th 2020, 4pm, Room 3-370

# Electric field effects in immiscible multilayer flows


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Multilayer flows such as falling films and coating flows, or pressure-driven flows of immiscible fluids in channels and pipes, are fundamental in applications. Such flows are typically stable if they are slow enough (highly viscous). Such regimes arise in small-scale geometries (e.g. microfluidics), and electric fields can be used to drive the system out of equilibrium to produce patterning, mixing and phase separation. I will begin with some experiments and direct numerical simulations (DNS) that show how electric fields can be utilized in their dual role of inducing instabilities or stability depending on geometry and orientation. I will then review the theoretical models underpinning such phenomena and will use asymptotic theories to derive and study reduced-dimension model equations that describe nonlinear interfacial waves in the presence of fields. Computations predict rich dynamics including spatiotemporal chaos and singularity formation. Some novel inertialess nonlinear interfacial instabilities will also be described - these arise due to flux functions of derived evolution equations changing type from hyperbolic to elliptic. Finally, I will present results on the use of electric fields and/or blowing suction in achieving feedback and optimal control of falling film flows. Comparisons with DNS will be made and these will be used beyond the range of validity of asymptotic models to predict phenomena such as electrostatic suppression of Rayleigh-Taylor instabilities, and electrostatically induced pumping in microchannels.


*Seminar Host:* *Nicolas Hadjiconstantinou (ngh@mit.edu)*

## Please join us for refreshments beforehand, outside Room 3-370


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