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Computational sensitivity analysis of geometric parameters in laminar superhydrophobic microchannels ASGHAR YARAHMADI, MEREDITH METZGER, University of Utah — This talk presents 3-D numerical simulations of laminar flow through a microchannel of height h containing superhydrophobic surfaces (SHS) along the top and bottom walls. The SHS is modelled as an array of longitudinal shear-free surfaces having width w and inclination angle α. The simulations allow for a phase offset ℓ between the shear-free surfaces on the top and bottom walls. The sensitivity of velocity, wall shear stress, and slip-length with respect to infinitesimal changes in the geometrical design parameters (w, α, ℓ, and h) was examined using the Sensitivity Equation Method and Complex Step Differentiation. These techniques differ from traditional parametric studies in that sensitivities are obtained more accurately by direct numerical solution of a separate set of PDEs for the sensitivity derivatives. In this manner, the present sensitivity results can be used to reliably predict the percent drag savings achievable for a unit increase in w and h. Sensitivity results also indicate that an increase in α translates into enhanced mixing, albeit with a drag penalty. Finally, the talk discusses how the present sensitivity results may be incorporated in to a gradient-based optimization algorithm toward improved microchannel design.

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