Abstract Submitted
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Single-Equation Models for the Tear Film in a Blink Cycle with Realistic Lid Motion[1] A. HERYUDONO, R.J. BRAUN, T.A. DRISCOLL, K.L. MAKI, L.P. COOK, University of Delaware, P.E. KING-SMITH, The Ohio State University — We model the tear film using two limits of the strength of the Marangoni effect for an insoluble surfactant: either it is completely ineffectual (stress free case) or very strong (uniform stretching limit). A single nonlinear partial differential equation (PDE) arises in either case from lubrication theory that governs film thickness over multiple blink cycles. Slip on the film bottom, viscosity and surface tension and a time-varying domain that mimics realistic movement of the upper eyelid are included. Dirichlet and third order boundary conditions are applied. The realistic lid motion, together with new choices for flux functions at the end ends and the ability to apply them, extends prior sinusoidal results. Numerical experiments indicate that a spectral collocation method based on the method of lines together with a backward differentiation-style ODE solver is more accurate and more efficient than our prior uniform grid finite-difference method. Numerical computations also yield results that agree in many respects with in vivo observations of the tear film under partial blink conditions. Partial blinks are shown to be effectively equivalent to a full blink by looking for periodic solutions as a function of closure fraction.

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