Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Simulation of Thin Film Equations on an Eye-Shaped Domain with Moving Boundary[1] JOSEPH BROSCH, TOBIN DRISCOLL, RICHARD BRAUN, University of Delaware — During a normal eye blink, the upper lid moves, and during the upstroke the lid paints a thin tear film over the exposed corneal and conjunctival surfaces. This thin tear film may be modeled by a nonlinear fourth-order PDE derived from lubrication theory. A major stumbling block in the numerical simulation of this model is to include both the geometry of the eye and the movement of the eyelid. Using a pair of orthogonal and conformal maps, we transform a computational box into a rough representation of a human eye where we proceed to simulate the thin tear film equations. Although we give up some realism, we gain spectrally accurate numerical methods on the computational box. We have applied this method to the heat equation on the blinking domain with both Dirichlet and no-flux boundary conditions, in each case demonstrating at least 10 digits of accuracy.. We are able to perform these simulations very quickly (generally in under a minute) using a desktop version of MATLAB.

[1]This project was supported by Grant 1022706 (R.J.B., T.A.D., J.K.B.) from the NSF

Joseph Brosch
University of Delaware

Date submitted: 06 Nov 2015 Electronic form version 1.4