Abstract Submitted
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Laser Hole-Drilling as a Probe of Morphogenetic Stresses in Embryonic Epithelia: Finite Element Models[1] M. SHANE HUTSON, XIAOYAN MA, Vanderbilt University, JIM VELDHUIS, G. WAYNE BRODLAND, University of Waterloo — During the development of an organism, sheets of epithelial cells expand, contract and bend due to forces generated within the cell sheets. These forces can be probed by laser hole-drilling; however, the observed recoil dynamics (or strain relaxations) depend strongly on the local cellular geometry. To better understand this dependence and help interpret our experimental observations, we have conducted a series of laser hole-drilling simulations using cell-level finite element models. Even the simplest of these simulations (i.e. homotypic cell sheets with constant cell boundary tensions) produce a wide range of initial recoil velocities. The velocities are correlated with particular aspects of the local geometry – most notably the aspect ratio and orientation of cells adjacent to the ablated cell edge. These simulations also produce biphasic recoils; however, the two phases are not as distinct as those observed experimentally. To more closely reproduce the experimental recoils, the cell edges must include an elastic component. We will discuss using such finite element models to inversely determine local stresses in an epithelial sheet from the observed strain relaxations after laser ablation.

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