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Modeling the Morphogenesis of Epidermal Tissues on the Surface of a 3D Last W. TYLER MCCLEERY, SARAH M. CREWS, DAVID N. MASHBURN, Vanderbilt University, JIM VELDHUIS, G. WAYNE BRODLAND, University of Waterloo, M. SHANE HUTSON, Vanderbilt University — Embryogenesis in the fruit fly *Drosophila melanogaster* is coordinated by the interaction of cells in adjacent tissues. For some events of embryogenesis, e.g., dorsal closure, two-dimensional models have been sufficient to elucidate the relevant cell and tissue mechanics. Here, we describe a new three-dimensional cell-level finite element model for investigating germ band retraction – a morphogenetic event where one epidermal tissue, the germ band, initially wraps around the posterior end of the ellipsoidal embryo. This tissue then retracts with a mechanical assist from contraction of cells in a second epidermal tissue, the amnioserosa. To speed simulation run times and focus on the relevant tissues, we only model epidermal tissue interactions. Epidermal cells are defined as polygons constrained to lie on the surface of the ellipsoidal last, but have adjustable parameters such as edge tensions and cell pressures. Tissue movements are simulated by balancing these dynamic cell-level forces with viscous resistance and allowing cells to exchange neighbors. Our choice of modeling parameters is informed by in vivo measurements of cell-level forces using laser microsurgery. We use this model to investigate the multicellular stress fields in normal and aberrant development.

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