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Evaluating Epithelial Mechanics with Laser Hole-drilling[1] M. SHANE HUTSON, DAVID N. MASHBURN, XIAOYAN MA, HOLLEY E. LYNCH, Dept of Physics & Astronomy, Vanderbilt University — During the development of an organism, sheets of epithelial cells expand, contract and bend due to intra- and intercellular forces. We have previously developed laser hole-drilling as a technique to probe such epithelial mechanics – with a focus on the ms-to-s dynamic recoil of single, directly adjacent cell edges. Here we extend the analysis to consider ablation-induced deformations for the entire field of surrounding cells. We treat each epithelium as a homogeneous, linearly elastic, thin sheet. This simplification provides analytical solutions for the expected strain relaxation after hole-drilling (under either plane stress or plane strain). We have developed routines that use these analytic mappings (plus potential rigid body motions) to warp and match pre- and post-drilling images. These mappings account for the majority of the observed deformations and allow one to estimate the epithelium's Poisson ratio and pre-drilling average strain tensor (which yields the anisotropy and direction of principle stress/strain). The unaccounted, residual displacements provide clues to how each epithelium deviates from a homogeneous sheet.

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