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Noise Sensitivity in Force-inference Techniques DAVID N. MASHBURN, M. SHANE HUTSON, Vanderbilt University, JIM H. VELDHUIS, G. WAYNE BRODLAND, University of Waterloo — Forward finite-element modeling of developmental processes has vastly improved our understanding of morphogenesis; however, determining the model parameters necessary to reproduce in vivo behaviors typically requires either computationally-intensive parameter searches or somewhat arbitrary user selections. To bypass these difficulties, we previously developed an inverse technique called Video Force Microscopy (VFM) that takes positional information from microscopy data and infers the forces necessary to reproduce the observed dynamics. Applying VFM to the output of a forward model produces exact results, but the over-determined solutions for any real data will generally have a nonzero residual error. Applying VFM to real images requires converting the image into a segmented mesh of polygonal cells, a process in which the image resolution creates inherent positional noise and the choice of mesh nodes influences the angles used in the force balance equations. We have investigated the robustness and quality of VFM solutions by analyzing sensitivity to both the unavoidable positional noise and addition/removal of mesh nodes. We have also evaluated the accuracy of both the residual and the matrix condition numbers as predictors of the true error (as measured against a gold standard).

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