

Simulating Organogenesis in COMSOL Multiphysics®: Tissue Mechanics During Organ Growth

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Abstract

During growth, tissue expands and deforms. Given its elastic properties, stresses emerge in an expanding and deforming tissue. Cell rearrangements can dissipate these stresses and numerous experiments confirm the viscoelastic properties of tissues. On long time scales, as characteristic for many developmental processes, tissue is therefore typically represented as a liquid, viscous material and is then described by the Stokes equation. On short time scales, however, tissues have mainly elastic properties. In discrete cell-based tissue models, these properties are realized by springs between cell vertices. In contrast to this, we focus on a continuous approach where we use COMSOL Multiphysics® to model the viscoelastic behavior of tissue in terms continuum mechanics. Thereafter, we test and parameterize the models with published tissue deformation experiments.