Simulating Organogenesis in COMSOL Multiphysics®: Parameter Optimization for PDE-based Models

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Abstract

Morphogenesis is a tightly regulated process that has been studied for decades. Previously we developed data-based mechanistic models for a range of developmental processes with a view to integrate the available knowledge and to better understand the underlying regulatory logic. In our previous papers on simulating organogenesis in COMSOL Multiphysics® (German et al COMSOL Multiphysics® Conf Procedings 2011; Menshykau and Iber, COMSOL Multiphysics® Conf Proceedings 2012) we discussed methods to efficiently solve such models on static and growing domains. Another challenge in modeling morphogenesis is the parameterization of the models. Here we discuss COMSOL Multiphysics®-based methods for parameter optimization. These routines can be used to determine parameter sets, for which the simulations reproduce experimental data and constraints. Such data is often image based, but may also come from classical biochemical or genetic experiments.