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Constructing mechanochemical patterns using geometric singular perturbation theory

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Mechanochemical models present a new paradigm for biological pattern formation, where the interaction between domain curvature and pattern shape replaces the activator-inhibitor mechanism. Numerical simulations of a mechanochemical model formulated by M. Mercker & A. Marciniak-Czochra reveal a wide spectrum of novel patterning phenomena, which are as yet poorly understood from an analytical point of view. Our aim is to develop more analytical insight into the pattern formation process in mechanochemical models of this type. As a first step towards this goal, we show that one can employ methods from geometric singular perturbation theory to construct nonlinear, far-from-equilibrium patterns in a general class of mechanochemical models. This analysis reveals a direct relation between the biology –as encoded in the nonlinear interaction of model componens– and the type of (multiscale) patterns that can arise.

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