P.40 From wound healing to artificial muscles: Modelling bio- and biomimetic materials with polar and nematic order parameters

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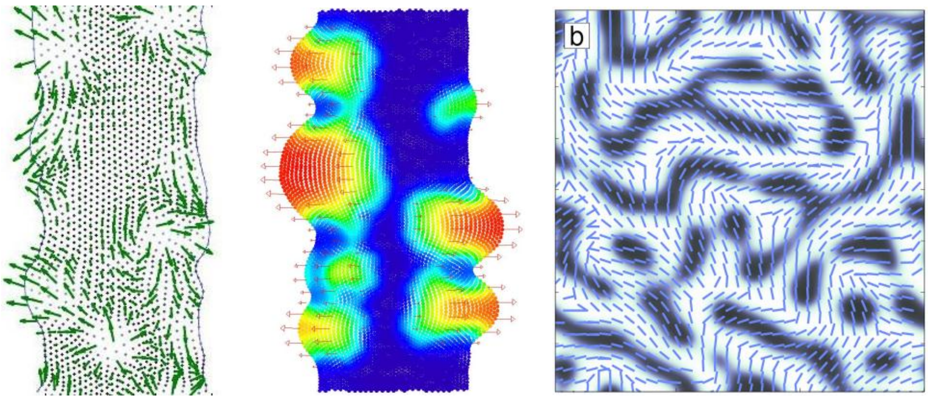
Many biological and biomimetic materials can be described using continuum models with polar or nematic order parameters and nonlinear elasticity. Several examples will be given in this talk.

During unconstrained spreading as occurs for example in wound healing, epithelial cell monolayers can be described as polarizable and chemomechanically interacting layers with weakly nonlinear elasticity. Our model reproduces the experimentally observed self-organized formation of finger-like protrusions due to the collective action of a large number of cells [1,2]. Statistics of the velocity orientation shows a strong alignment in the fingers opposed to an isotropic distribution in the bulk, in agreement with measurements by Reffay et al. [3]. The model further captures the stress accumulation within the tissue that proceeds in form of a “mechanical wave”, originating from the wound edge [4].

A very similar model can be used to describe liquid crystal elastomers. These materials, whose flexibility and mechano responsiveness mimics biological tissues, can be used to construct actuators operating as artificial muscles. We focus on the case of elastomers doped with isotropic components and show how the coupling between the dopant concentration and the nematic order parameter influences the shape and orientation of domains formed during the demixing process [5].



[1] Köpf, Pismen, *Physica D* 259 (2013) 48-54
[2] Köpf, Pismen, *Soft Matter* 9 (2013) 3727-3734
[3] Reffay et al., *Biophysical Journal* 100 (2011) 2566-2575
[4] Serra-Picamal et al., *Nature Physics* 8 (2012) 628-634
[5] Köpf, Pismen, *Eur. Phys. J. E* 36 (2013) 121