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An anisotropic interaction model for simulating fingerprints

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Motivated by the formation of fingerprint patterns we consider a class of interaction models with anisotropic interaction forces whose orientations depend on an underlying tensor field. This class of models can be regarded as a generalization of a gradient flow of a nonlocal interaction potential which has a local repulsion and a long-range attraction structure. In contrast to isotropic interaction models the anisotropic forces in our class of models cannot be derived from a potential. The underlying tensor field introduces an anisotropy leading to complex patterns which do not occur in isotropic models. This anisotropy is characterized by one parameter in the model. We study the variation of this parameter, describing the transition between the isotropic and the anisotropic model, analytically and numerically. We analyze the steady states and their stability by considering the particle model and the associated mean-field equations. Besides, we propose a bio-inspired model to simulate fingerprint patterns (and more general any desired pattern) as stationary solutions by choosing the underlying tensor field appropriately.

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