An Anisotropic Interaction Model for Simulating Fingerprints

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Motivated by the formation of fingerprint patterns we consider a class of interacting particle 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 equilibria of the corresponding mean-field partial differential equation and investigate pattern formation numerically in two dimensions by studying the dependence of the parameters in the model on the resulting patterns. 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.

References

[1] M. Burger, B. Düring, L. M. Kreusser, P. A. Markowich, C.-B. Schönlieb, *Pattern Formation of a Nonlocal, Anisotropic Interaction Model*, (to appear in) Mathematical Models and Methods in Applied Sciences

[2] B. Düring, C. Gottschlich, S. Huckemann, L. M. Kreusser, C.-B. Schönlieb, *An Anisotropic Interaction Model for Simulating Fingerprints*, submitted