
Body-attitude alignment : link with rodlike polymers, quaternions and phase transition

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Résumé

We present a model of alignment of individuals based on body attitude (birds aligning their heading and wings directions for instance). The kinetic model in consideration is a BGK-type model for which the velocity variable is a rotation matrix of dimension 3. We present an interesting link between this model and a generalization of the Maier-Saupe model for alignment of diluted rodlike polymers in dimension 4, due to the fact that a rotation can be represented by a unit quaternion (or its opposite, which relates to the fact that a rodlike polymer is unoriented). We obtain the phase diagram of this model : when the alignment strength is low, the uniform distribution is the only equilibria, when the strength is sufficiently large, there exists a unique family of stable (concentrated) distributions, and in between, we have stability of both non-aligned and aligned states. This comes from works in collaboration with Pierre Degond, Antoine Diez, Sara Merino-Aceituno and Ariane Trescases.

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