The impact of environmental noise on animal communication: pattern formation in a class of deterministic and stochastic hyperbolic models for self-organised biological aggregations

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The collective movement of animals occurs as a result of communication between the members of the community. However, inter-individual communication can be affected by the stochasticity of the environment, leading to changes in the perception of neighbours and subsequent changes in individual behaviour, which then influence the overall behaviour of the animal aggregations. To investigate the effect of noise on the overall behaviour of animal aggregations, we consider a class of nonlocal stochastic and deterministic hyperbolic models for the collective movement of animals. We show numerically that strong noise does not seem to influence the spatio-temporal pattern (i.e., travelling aggregations) observed when all neighbours are perceived with the same intensity (i.e., the environment is homogeneous). However, when neighbours ahead/behind are perceived differently by a reference individual, noise can lead to the destruction of the spatio-temporal pattern. Moreover, we show that the increase in noise can lead to different transitions between different spatio-temporal patterns, and these transitions are relatively similar to the transitions between patterns when we perturb deterministically some parameters.