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Order in Chaos: an Algorithmic Approach to Flocking Behaviour

GARETT BROWN, MANUEL BERRONDO, Brigham Young University — Clusters of organisms have a tendency to exhibit emergence from seemingly chaotic behaviour. Emergence is the process wherein coherent patterns arise out of the simple, smaller interactions of its chaotic entities that do not exhibit such behaviour themselves. Using a simple, two-dimensional algorithmic approach, we can show that antagonistic forces - consensus and frustration - lead simple, self-driven particles (boids) to group together and exhibit emergent, flocking behaviour reminiscent of starling murmurations. The cohesive, consensus motion of the boids is manifested in three different types of global, dynamic phase transitions. When frustration is introduced in the form of boundary conditions, these transitions go beyond simple movements as local group phases occur, alternating through the three phase transitions found in consensus. We present visuals and animations that were created using Wolfram Mathematica. We also show how we were able to interpret the emergence using order parameters. Thus using these simple, algorithmic techniques, we are able to produce realistic replicas of complex biology-like interactions.

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