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Competitively Coupled Maps and Spatial Pattern Formation

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Spatial pattern formation is a key feature of many natural systems in physics, chemistry and biology. The essential theoretical issue in understanding pattern formation is to explain how a spatially homogeneous initial state can undergo spontaneous symmetry breaking leading to a stable spatial pattern. This problem is most commonly studied using partial differential equations to model a reaction-diffusion system of the type introduced by Turing. We report here on a much simpler and more robust model of spatial pattern formation, which is formulated as a novel type of coupled map lattice. In our model, the local site dynamics are coupled through a competitive, rather than diffusive, interaction. Depending only on the strength of the interaction, this competitive coupling results in spontaneous symmetry breaking of a homogeneous initial configuration and the formation of stable spatial patterns. This mechanism is very robust and produces stable pattern formation for a wide variety of spatial geometries, even when the local site dynamics is trivial.

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