Randomly coupled identical nonlinear chemical oscillators presenting Turing instability

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Synchronization of nonlinear chemical oscillators constitutes a recent step forward in analyzing the classical problem of synchronization of oscillators. In fact, these chemical oscillators have demonstrated the capability to exhibit multiple configurations ranging from full synchronization and mobbing state till chimera states. The motivations of this type of study in Nature are numerous.

On the other hand, Turing instability is a very powerful mechanism that introduces differentiation in a very natural way and has been pointed out as the mechanism responsible for differentiation in multiple processes in Nature.

In this contribution we present results aiming to obtain a Turing instability in the context of network-organized chemical oscillators. This phenomenon produces the set of identical oscillators to spontaneously differentiate as it is observed in natural systems. This is introduced in a very simple way even in the absence of oscillations.

We consider a large population of interacting Belousov-Zabotinsky (BZ) oscillators included into a reacting environment. Chemical oscillators are modeled as beads loaded with a catalyst and embedded in catalyst-free BZ solution [1, 2]. Thus, beads and surrounding solution are represented as the network nodes and these nodes are interacting diffusively via the network edges through collisions [3]. The node representing the surrounding solution –the environment– is connected to all the beads and the beads are randomly connected between them. The effect of cross-diffusion is considered in our numerical results and resulted to be of crucial importance in the mechanism described [4, 5].

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