SPATIAL PATTERN FORMATION IN TURING SYSTEMS **82.40.Ck**

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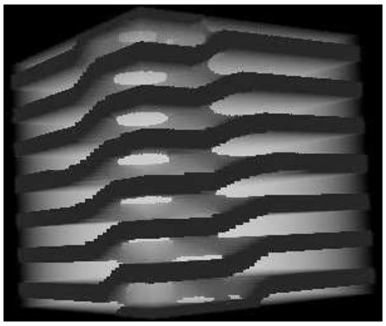
In the 1950s British mathematician Alan Turing proposed a simple reaction-diffusion system describing chemical reactions and diffusion to account for morphogenesis [1]. Due to the complexity of nature, researchers have not yet succeeded in developing a Turing system based model that would describe morphogenesis in essence, although specific examples such as the skin coloring of animals have been modeled using Turing systems.

Turing systems show a very rich behavior from the pattern formation point of view, which means that by numerically solving these mathematically defined systems we obtain a variety of spatial patterns in two dimensions and structures in three dimensions, varying from spots to stripes and from lamellar to chaotic structures. In this study we have obtained results for a three-dimensional system, which, to the authors' knowledge, has never before been studied using numerical simulations [2]. We have also studied the basic characteristics of a three-dimensional Turing system and compared them with those of a two-dimensional one. In 3D the morphological development becomes more interesting and complex. We have also studied the transition between two and three dimensional morphologies. In addition, the robustness of Turing structures has been investigated against Gaussian random noise.

Our motivation for studying the Turing systems is biological. We have shown how connections between certain points can be grown by using a Turing system with sources of chemicals. The resulting connected network has many interesting properties, and in the future work we will concentrate on a Turing system and an active random walker model combined to explain some of the features of neural patterning, i.e., how neurons establish connections to other neurons.



[1] A.M. Turing: The chemical basis of morhogenesis, *Phil. Trans R. Soc. Lond.* **B237**, 37-72 (1952).

[2] T. Leppänen, M. Karttunen, K. Kaski, R.A. Barrio, and L. Zhang: A new dimension to Turing patterns, *to be published in Physica D.*