

## SPONTANEOUS STRUCTURALIZATION OF DISCRETE BIOLOGICAL SYSTEMS WITH DIFFUSION

Július Krempaský<sup>1</sup> and Vladimír Scholtz<sup>2</sup>

<sup>1</sup>Department of Physics

Slovak University of Technology in Bratislava, Faculty of Electrical Engineering and  
Information Technology, Ilkovičova 3, 812 19 Bratislava, Slovak Republic

<sup>2</sup>Department of Physics and Measurements

Institute of Chemical Technology in Prague, Faculty of Chemical Engineering, Technická  
5, 166 28, Praha 6, Czech Republic

Corresponding author email: [scholtzv@vscht.cz](mailto:scholtzv@vscht.cz)

**Abstract.** In this paper we introduce the possibilities of spontaneous self-organization of auto-reproducing biological systems with discrete diffusion and partially describe its behaviour. Those possibilities are studied by the mathematical apparatus using the auto-catalysis and the diffusion process. The auto-catalysis is fitted by the logistic map and the diffusion process is fitted by the transport of elementary subjects based on the Fick's law in non continuous space with potential effect of an external force included. This system was analysed in one- and two-dimensional space for various input conditions: reproduction speed, diffusion intensity and external influence. It is shown that for proper control parameters and initial conditions the system exhibits spontaneous self-organization, what may be used for the description and prediction of the behaviour of real inorganic, organic or biological systems in e.g. microelectronics or biosensors.

**Keywords.** Biological system; Evolution; Self-organization; Bioelectronics; Viral system; Viral microelectronics; Biosensor.

## 1 Introduction

It is generally known that inorganic, biochemical, biological or social systems for some levels of evolution enter the non-stable state and the creation of several time-space structures may arise. These processes are discussed in wide synergetic literature e.g. [6, 3, 10].

There are plenty of works engaged in the problem of self-organization, a process in which the internal organization of a system increases in complexity without being guided or managed by an outside source. The phenomenon of macroscopically spontaneous self-organization in microbiology is described e.g. [2, 12], in work [1] the dynamics of a predator-prey model with diffusion is discussed. The possibility of microelectronic application is discussed e.g.