Poster session:

Emergence of a collective steady state and symmetry breaking in plexus of two and three identical cells

by Rui Dilão

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Abstract:

We consider systems of two and three identical coupled cells. The dynamics of the isolated individual cells are the same, and the coupling is proportional to the differences in the concentration of its chemical components. Without coupling, all the cells have a unique and identical stable steady state the quiescent state. Under these conditions, we show that the coupled system of cells can have a new collective stable steady state, not shown in the individual cells. We obtain the conditions for the emergence of this collective steady state. When the collective stable steady state exists, the concentrations of the (two) morphogens assume different values inside the cells, introducing a symmetry breaking in the chemical characterization of the cells. The bifurcation analysis with the Brusselator model shows that the collective steady state appears by a pitchfork bifurcation associated with an equivariant symmetry of the system.

This is a hypothetical mechanism of developmental differentiation in systems with a small number of identical cells. This approach aims to describe the classical embryological observations of Hans Hans Driesch at the end of the nineteen century and of Hans Spemann (1901; Nobel of Physiology and Medicine 1935).

Ref:
R. Dilão, Emergence of a collective steady state and symmetry breaking in systems of two identical cells. In "BIOMAT 2006, International Symposium on Mathematical and Computational Biology", R. P. Mondaini & R. Dilão (ed.), pp. 25-36, World Scientific, 2007.