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Stability of gene expression patterns in developmental systems with dynamic morphogen sources

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In developmental systems cells determine their fate by decoding chemical signals, called morphogens. This results in the emergence of gene expression patterns. I will address the problem of gene expression patterns stability in the systems where two interacting and diffusible gene expression products control the size of their own source regions. Such systems are encountered in e.g. spinal cord development, limb formation and many others. The reaction-diffusion equation with threshold-activated production term is employed as a generic model for this problem. It is found that its dynamics is governed by the conservation law, which leads to a range of analytical results. In particular, phase transition is observed, between the phase of indeterminate patterning, where the region of mixed gene expression is ever growing, and the phase of travelling gene expression patterns, where two expression domains form a well-defined contact zone. A sub-class of genuinely stationary patterns is then identified, alongside the exact conditions ensuring this stability. These results allow me to classify all one- and two-gene regulatory motifs by their ability to produce stable patterns.

Author: MAJKA, Maciej

Co-author: ZAGÓRSKI, Marcin (Jagiellonian University)

Presenter: MAJKA, Maciej

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