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# Analyzing the impact of cell turnover on the plasticity of tissue polarity patterns by cellular automaton modeling: The dynamically diluted alignment model


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Authors: Karl B. Hoffmann, Anja Voss-Böhme, Jochen C. Rink and Lutz Brusch Abstract: Understanding the polarisation of cells and tissues is key for decoding the principles of tissue morphogenesis during biological development and regeneration. We argue that a deeper understanding of biological polarity pattern formation can be gained from the consideration of pattern reorganisation in response to an opposing instructive cue. Considering experimentally inducible body axis inversions in planarian flatworms, we define a dynamically diluted alignment model linking three processes: entrainment of cell polarity by a global signal, local cell-cell coupling aligning polarity among neighbours, and cell turnover replacing polarised cells by initially unpolarised cells. The model is related to an 8-Potts model with annealed site-dilution but explicitely describes the dynamics on the cellular scale. Numerical and theoretical model analysis shows that a persistent global orienting signal determines the final mean polarity orientation at the tissue scale. Neighbour coupling retards polarity pattern reorganisation whereas cell turnover accelerates it. These results can be subsumed in linear dependency relation between the time of polarity reorganisation and some e?ective neighbour coupling strength which integrates both effects. Our results allow to determine neighbour coupling strengths from experimental observations.



Reference: K. Hoffmann, A. Voss-Böhme, J. C. Rink, L. Brusch. (2017) A Dynamically Diluted Alignment Model Reveals the Impact of Cell Turnover on the Plasticity of Tissue Polarity Patterns. Journal of the Royal Society Interface, 14 20170466 (2017)