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## **Multi-scale hybrid model of cell differentiation propagation as traveling waves**

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### **Abstract**

Multi-scale and hybrid models are well adapted for the description of complex physiological processes. They represent an interesting class of models whose properties are not yet sufficiently well studied. In particular, they can show unusual nonlinear dynamics. In this work we will study propagation of reaction-diffusion waves in the medium composed of unmovable cells. Dynamics of cell population is determined by complex intracellular and extracellular regulations. If cell differentiation is initiated locally in space in the population of undifferentiated cells, it propagates as a travelling wave converting undifferentiated cells into differentiated ones. We suggest a model of this process which takes into account intracellular regulation, extracellular regulation and different cell types. They include undifferentiated cells and two types of differentiated cells. When a cell differentiates, its choice between two types of differentiated cells is determined by the concentrations of intracellular proteins. Differentiated cells can either stimulate differentiation into their own cell lineage or into another cell lineage. Periodic spatial patterns can emerge behind the propagating wave.

*Key words:* multi-scale, hybrid, models, traveling waves, extracellular, intracellular, cells, differentiation.