Reaction-diffusion model for the arrest of oscillations in the somitogenesis segmentation clock

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Abstract

The clock and wavefront model is one of the most accepted models for explaining the embryonic process of somitogenesis. According to this model, somitogenesis is based upon the interaction between a genetic oscillator, known as segmentation clock, and a moving wavefront, which provides the positional information indicating where each pair of somites is formed. Recently, **?** reported a conceptually different mathematical model for somitogenesis. The authors called it a progressive oscillatory reaction-diffusion (PORD) model. In this model, somitogenesis is driven by short-range interactions and the posterior movement of the front is a local, emergent phenomenon, which is not controlled by global positional information. With the PORD model, it was possible to explain some experimental observations that are incompatible with the clock and wavefront model. However the PORD model has the disadvantage of being quite sensitive to fluctuations. In this work, we propose a modified version of the PORD model in order to overcome this and others inconveniences. By means of numerical simulations and a numerical stability analysis, we demonstrate that the modified PORD model achieves the robustness characteristic of somitogenesis, when the effect of the wavefront is included.