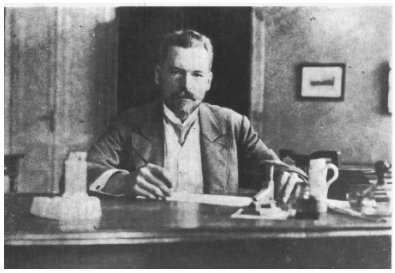

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Achieving robustness and precision in the developing spinal cord with system-level feedback

Wednesday, 29 September 2021 10:50 (5 minutes)

Spinal cord development is a complex process due to the interplay of signaling molecules over varying length and time scales. Despite the intrinsic stochasticity of signaling events, the resulting pattern of gene expression domains is remarkably precise and reproducible between individuals. How this patterning precision is achieved is still poorly understood. By investigating formation of source region (floor plate, FP) that secrets signaling molecules (morphogen, Shh), the spread of these molecules across growing tissue and the interpretation of resulting cellular signaling by gene network we want to identify the system-level feedback driving precise pattern formation. We use a thermodynamic model coupled with reaction-diffusion equation to describe inter-regulation of FP, target genes and spreading of Shh molecules. We define a success criteria for simulations, and examine the robustness, size of FP, and time evolution of these successful simulations to make predictions for the biological system. We find that the system development can be divided into two phases, and we then attempt to delineate which model parameters most affect which of these two phases. We also find that longer FP is associated with lower robustness to stochastic noise but greater robustness to changes in initial conditions suggesting the existence of an interesting trade-off.

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