World Wide NeuRise

Talks by rising stars of neuroscience

Gene-free landscape models for development
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Fate decisions in developing tissues involve cells transitioning between a set of discrete cell states. Geometric models, often referred to as Waddington landscapes, are an appealing way to describe differentiation dynamics and developmental decisions. We consider the differentiation of neural and mesodermal cells from pluripotent mouse embryonic stem cells exposed to different combinations and durations of signalling factors. We developed a principled statistical approach using flow cytometry data to quantify differentiating cell states. Then, using a framework based on Catastrophe Theory and approximate Bayesian computation, we constructed the corresponding dynamical landscape. The result was a quantitative model that accurately predicted the proportions of neural and mesodermal cells differentiating in response to specific signalling regimes. Taken together, the approach we describe is broadly applicable for the quantitative analysis of differentiation dynamics and for determining the logic of developmental cell fate decisions.

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