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In-silico organogenesis: Reconciling Turing and Wolpert in limb development

ABSTRACT:

It remains a challenge to understand how thousands of cells in the early embryo, which are initially in the same state, can organise themselves into complex spatial arrangements of different cell types, creating functional organs and organisms. Much progress has been made in understanding some of the "building blocks" of this process, for example interpretation of morphogen gradients, lateral inhibition, cell sorting, etc. However, an understanding of how these processes combine together to sculpt specific arrangements of cells is still lacking. Due to the multi-scale nature of this question (from genes, through cells, up to tissues) we believe computer modelling, driven by experimental quantitative data, is an essential tool, and we are thus building computer simulations of vertebrate limb development - a particularly tractable example of organogenesis. This approach has allowed us to address one of the long-standing debates in the field between two central paradigms of patterning: self-organising Turing systems, versus positional information. By experimentally testing the predictions from the computer model, we have been able to propose the molecular components of the Turing network which underlies digit specification.
