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COMPUTATIONAL MODELLING OF NEURAL TISSUE GROWTH

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Biological tissue often exhibits extraordinary complexity. For example, neural tissue comprises large numbers of neurons with cell-type specific axonal and dendritic arborisation, highly structured synaptic connectivity, and fine-tuned electrical activity. A better understanding of how such tissue complexity develops is often essential for tissue engineering purposes. To this end, author will present some of his computational models of neural tissue development, demonstrating how complex structure and function can be generated based solely on simple genetic rules. These multi-scale models comprise intracellular as well as extracellular dynamics in a detailed, physical 3D environment. In particular, author will elaborate on computational models of cortical and retinal structure and function, ranging across different spatial scales. By modelling the biological self-organization of such tissue, predictions are made and so novel hypotheses are generated, which can be experimentally validated. Moreover, these models can inform and guide tissue engineering protocols. Finally, author will discuss modern computational approaches, including the BioDynamo software, which is a collaborative project with project partner CERN Openlab. Overall, author will emphasize the importance of computer models as a tool to advance tissue engineering approaches.

Biography

Roman Bauer is an MRC Research Fellow at Institute of Neuroscience-Newcastle University, with joint affiliation with the School of Computing. His research involves computational models to better understand how neural tissue evolves during development. He received his Bachelor's and Master's Degree in Computational Science and Engineering from ETH Zurich, Switzerland. Afterwards, he did his Doctoral studies at Institute for Neuroinformatics (INI)-ETH and University Zurich, working on simulations of cortical development. After Postdoctoral work at Newcastle University from 2013 to 2016, he took up a prestigious MRC fellowship. His research interests include "Neural development, neural degeneration, neural disorders, gene regulatory networks and cryopreservation".

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