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Synthetic Biology and engineering multicellular systems.

Synthetic Biology is an emerging field that employs engineering principles for constructing genetic systems. It is providing a conceptual and practical framework for the systematic engineering of gene expression and behaviour in microbes, but also shows great potential for the engineering of multicellular systems. We have used populations of Escherichia coli cells, which exhibit little or no intrinsic coordination of growth, as a model system to study physical interactions in multicellular systems. This system effectively isolates the effects of cell shape, growth, and division on spatial self-organization. Even these very simple systems show emergent properties, and give rise to striking fractal patterns. Large-scale cellular biophysical models demonstrate that local instabilities are responsible for generating the observed self-organising properties of the system, and confirm the need for multi-scale physico-genetic models of cell growth for understanding and engineering mu lticellul ar systems. We are now exploring a similar approach using a simple plant system, the liverwort Marchantia polymorpha. Marchantia is characterised by morphological simplicity, matched by simple underlying genome structure. Its ease of culture, transformation and analysis make it an ideal system for plant development and synthetic biology. We have developed a battery of computational, imaging and genetic tools to allow clear visualisation of individual cells inside living plant tissues, and are developing a common syntax for plant DNA parts that can be used to reprogram metabolism and development.

Biography: Jim Haseloff is a plant biologist working at the University of Cambridge. His scientific interests are focused on the engineering of plant morphogenesis, using microscopy, molecular genetic, computational and synthetic biology techniques (www.haseloff-lab.org). He and his group have developed new approaches to RNA engineering, quantitative imaging and gene expression in plants, and promote the potential of Synthetic Biology as a tool to engineer new feedstocks for sustainable use. He is a director of the OpenPlant Synthetic Biology Research Centre, a collaborative venture between the University of Cambridge and the John Innes Institute and Sainsbury Laboratory, Norwich (www.openplant.org).