



Systems Biology
Doctoral Training Centre



SYSTEMS BIOLOGY/ DOCTORAL TRAINING CENTRE

First Year Project Proposal - 2010

Supervisor(s):

Project 1 (3rd May-16th July)

Dr Mark Fricker, Dr Vicente Grau and Dr Boguslaw Obara

Title of Project / Field of research:

BiImage Informatics for Microbial Biology

Investigating critical developmental transitions via imaging, image analysis and mathematical modelling

Description of project / Current research interests:

Fungi cause devastating plant and human diseases. Furthermore, their global social and economic impact is increasing as climate change alters plant host demographics, and as the population of immunocompromised human hosts expands. In all cases, successful infection requires accurate perception of the host surface to drive spore germination and early development. We need to develop automated image analysis routines to systematically survey developmental responses across a broad range of stimuli using multiplex arrays (the stimulome).

Non-pathogenic fungi are also critical in ecosystem biology as they are the only organisms capable of complete degradation of wood in temperate forests. These fungi form extensive interconnected mycelial networks that scavenge efficiently for scarce resources in a heterogeneous environment. The architecture of the network continuously adapts to local nutritional cues, damage or predation, through growth, branching, fusion or regression. Such biological networks, honed by evolution, may exemplify potential solutions to real-world compromises between cost, coverage, resilience and persistence. We need to be able to automatically analyse the dynamic network architecture to evaluate their performance efficiently

Automated image analysis has become a necessary tool in basic systems biology, particularly with the generalization of high-throughput experimental protocols. While there is a close relationship between sample preparation, image acquisition and image analysis, nowadays these are still generally addressed as independent tasks. Our goal is to develop comprehensive approaches encompassing all these aspects.

The general aim of these projects is to develop automatic image analysis methods to measure complex parameters from microbial images, and to use these parameters to quantitative study and modelling of dynamic behaviour of fungal cells. The projects include a combination of experimental work and image acquisition (Dr Fricker), and image analysis with Dr Obara and Dr Grau at the Oxford e-Research Centre, and can focus on different aspects of the experimental pipeline including:

- Defining experimental protocols to image fungal cells at a micro-scale using confocal microscopy and a macro-scale using scintillation imaging.
- Developing automated image analysis techniques to extract the cells and fungal networks from microscopy images and videos acquired using different techniques.
- Developing classification approaches to define developmental stages or extract network parameters.
- Validation of proposed approaches using captured images and videos.
- Application of developed image analysis techniques to full-scale experiments.

Location: Department of Plant Sciences and Oxford e-Research Centre

Any other specific points: Backgrounds: cell biology, imaging techniques, image analysis and processing. For more information, please visit: <http://www.oerc.ox.ac.uk/research/iapsb>

