Timothy James Rudge

Personal Details

Date of Birth: 28th August 1977
Nationality: British
Email: tjr34@cam.ac.uk

Education and Training

Jan. 2010 - Mar. 2014	**PhD**: Synthetic Biology
	Dept. Plant Sciences, University of Cambridge, UK
	Design of synthetic self-organising multicellular systems: Engineering methods and tools for synthetic multicellular systems in plants and microbes. Theoretical analysis, modelling, practical construction and measurement of regulatory networks in *E. coli*. Modelling and measurement of cellular biophysics. Established and administered online registry of bacterial and plant DNA parts using JBEIR software. **Skills and techniques:** molecular and microbiology, cloning and DNA assembly, plate fluorometer assays, confocal and wide-field microscopy, custom imaging using Arduino/MicroManager, micro-fluidics, image analysis, mathematical biology, and advanced computational modelling.

Jul. 2006 - Jul. 2007	**Graduate Certificate in Business**: Applied Finance	5.5/7 GPA
Part Time	Queensland University of Technology, Brisbane, Australia	

Sep. 2001 - Sep. 2002	**Masters by Research**: Computer Vision, Image Processing, Graphics and Simulation	Distinction, 73% GPA
	University College London (Computer Science), London, UK	
	Thesis: Developed, implemented, and optimised a novel numerical algorithm for solution of the radiative transfer equation in 3D for application to diffuse optical tomography. Validated algorithm against Monte Carlo and radiosity-diffusion approach. Awarded *distinction*.	

Oct. 1995 - Jun. 1998	**BEng(Hons)**: Mechatronics	Class 2:1, 69% GPA
	Leeds University (Mechanical/Electrical Engineering), Leeds, UK	

Peer-reviewed Publications (*=first joint authors)

Rudge*, T., Federici*, F., Steiner*, P., Kan, A., Haseloff, J., **Cell shape-driven instability generates self-organised, fractal patterning of cell layers**, *ACS Synthetic Biology*, May 2013

Federici F., Rudge T., Pollak B., Haseloff J., Gutierrez R., **Synthetic Biology: opportunities for Chilean bioindustry and education**, *Biological Research*, 46:383-393, June 2013

Correia, T., Rudge, T., Koch, M., Ntziachristos, V., Arridge, S., **Wavelet-based data and solution compression for efficient image reconstruction in fluorescence diffuse optical tomography**, *J. Biomed. Optics*,18(8):86008, 2013

Correia, T., Rudge, T., Arridge, S., **Efficient image reconstruction in fluorescence diffuse optical tomography (fDOT) using data and solution compression**, *Proc. SPIE*, 8799, 2013

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Rudge*, T., Steiner*, P., Phillips, A., Haseloff, J., **Computational modeling of synthetic microbial biofilms**, *ACS Synthetic Biology*, 1(8):345-352, 2012

Ducros, N., D'andrea, C., Valentini, G., Rudge, T., Arridge, S., Bassi, A., **Full-wavelet approach for fluorescence diffuse optical tomography with structured illumination**, *Optics Letters*, 35(21):3676-3678, 2010

Rudge, T., Soloviev, V., Arridge, S., **Fast image reconstruction in fluoresence optical tomography using data compression**, *Optics Letters*, 35(5):763-765, 2010

Rudge, T. and Burrage, K., **Effects of Intrinsic and Extrinsic Noise Can Accelerate Juxtacrine Pattern Formation**, *Bulletin of Mathematical Biology*, 70(4):971-991, 2008

Dupuy, L., Mackenzie, J., Rudge, T., Haseloff, J., **A System for Modelling Cell-Cell Interactions during Plant Morphogenesis**, *Annals of Botany*, 101(8):1255-1265, 2008

Rudge, T. and Geard, N., **Evolving Gene Regulatory Networks for Cellular Morphogenesis**, *Advances in Natural Computation*, 3:239-252, 2005

Rudge, T. and Haseloff, J., **A Computational Model of Cellular Morphogenesis in Plants**, *Lecture Notes in Computer Science*, 3630:78-87, 2005

Research Employment

Jan. 2013 - April 2013 **Intern,** Microsoft Research Cambridge, Bio-computation Group

Development of computational and experimental methods for engineering transcription networks.

Jan. 2009 – January 2010 **Research Associate**, Centre for Medical Image Computing, Dept. of Computer Science, University College London

Development of linear reconstruction algorithms for fluorescence diffuse optical tomography (fDOT) using concurrent X-Ray CT data as structural prior, and application to experimental data. Implementation on large datasets using parallel architectures and high performance computing cluster. **Skills and techniques:** optics and transport theory, inverse problems, numerical optimisation, numerical methods for PDEs (finite elements, finite volumes), wavelets, image registration and processing.

Apr. 2004 – April 2006 **Research Officer**, University of Queensland, ARC Centre for Complex Systems / Advanced Computational Modelling Centre

Mathematical modelling and analysis of stochastic effects on juxtacrine pattern formation in chick embryos. Application of evolutionary algorithms and recurrent neural networks (machine learning) to genetic control of cellular development, using model of cellular morphogenesis developed in previous work. Analysis and modelling of a specific observed intracellular vesicle shape formation process. Modelling of plant morphogenetic responses to incident light. Independently proposed and planned research projects, administered project management and reporting. Initiated, organised and hosted half-day cross-disciplinary workshop on Complex Systems. **Skills and techniques:** stochastic calculus and differential equations, Monte Carlo simulation, evolutionary algorithms, neural networks, L-systems.

Nov. 2002 – Feb. 2004 **Research Associate**, Cambridge University, Plant Sciences

Design and implementation of a computational model of plant cellular morphogenesis. Development of an interactive software framework for computational modelling of multicellular systems (*CellModeller*), including cell mechanics, genetic control, and intercellular signalling. Design and implementation of 3D image processing and segmentation algorithms for confocal micrographs. Plant growth and confocal microscopy. Technical aspects of projects were self-directed and independently proposed and planned. Gained broad exposure to developmental and cellular biology and skills in computational biology. **Skills and techniques:** biophysical modelling, numerical methods (e.g. differential equations), image processing, confocal microscopy, plant culture.

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Other Employment

Oct. 2007 – Oct. 2008 **Quantitative Developer**, Endeavour Capital Management LLP, London

Risk analysis of interest rate and foreign exchange derivative portfolio and development of analytical software. Implementation of systematic trading software platform using statistical analysis and optimisation methods. Extensive use of very large databases, for historical data analysis, model fitting and validation. Gained valuable exposure to financial markets and their participants. **Skills and techniques:** business critical software development, mathematical finance, macro- and micro-economics, stochastic simulation, databases.

Oct. 2006 – Aug. 2007 **Risk Analyst**, InterGen (Australia), Brisbane

Risk analysis of portfolio of electricity derivatives and generation assets, including development of new risk management metrics. Proposed, planned and implemented automated pricing software framework, making significant efficiency gains. Critical analysis of Value At Risk (VaR) model in application to Power markets, including backtesting, and making recommendations to management. Exposure to broader energy markets, including regulatory and legislative context, retail and wholesale sectors. Participation in management meetings and contribution to business plans. **Skills and techniques:** stochastic models for energy prices (e.g. mean reverting jump diffusion), Excel/VBA, databases, forecasting, mathematical finance.

May 2006 – Oct. 2006 **Software Engineer (Contract)**, Leica Geosystems, Brisbane

Product development engineering of a mobile, small form factor GPS guidance system for agriculture. Real-time embedded *Linux* software development. Development of a vehicle simulation for off-line testing, and database system for field-trial data logging over mobile data network. Reverse engineering of nearest competitor system. Participation in field-trials on a working farm. Gained valuable exposure to product development cycle and agricultural technology market. **Skills and techniques:** embedded systems, GPS, databases, statistical analysis for product testing.

Mar. 1999 – Jan. 2001 **EFL Instructor**, Tokyo, Japan

Independently planned and taught lessons to a given syllabus for adult and child learners. Designed engaging learning activities for a broad range of students with varying skills and expectations. Set and marked exams to a given syllabus, maintained student records, and counselled students.

Invited Talks

Aug. 2013, Q-bio 7 Conference (pp. Jim Haseloff), St. John's college, Santa Fe

May 2013, MODEMIC Biofilm modelling workshop, École Normale Supérieure, Paris

Dec 2012, First Workshop on Synthetic Biology, Pontificia Universidad Católica de Santiago, Chile

June 2012, SynthSys Centre seminar series, Edinburgh University

Awards and Scholarships

Jan. 2010 - Jan. 2013, *Microsoft Research PhD Studentship*, Cambridge

Dec 2012, *Chile Projects* (Cambridge University Centre for Latin American Studies, and Antofagasta PLC) grant for participation in the *First Chilean Workshop on Synthetic Biology*, Pontificia Universidad Católica de Santiago, Chile.

June 2012, *Wellcome Image Award* (with Fernan Federici, PJ Steiner and Jim Haseloff)

July 2011, Prize for *Best first year PhD seminar*, Dept. Plant Sciences, University of Cambridge

Sept. 2001 - Sept. 2002, *EPSRC Studentship*, University College London

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July 1998, *Institution for Mechanical Engineers Best Student Prize* in Mechatronics, Leeds University

Teaching and Outreach Experience

Dec. 2012, *Computational modelling practical*, First Workshop on Synthetic Biology, Pontificia Universidad Católica de Santiago, Chile

Mar. 2011 - June 2011, Demonstrator, *Mathematical Biology*, University of Cambridge

Nov. 2010, Developed and presented interactive demo at EUSEA (European Union Science Events Association) 2WAYS Grand Final, Natural History Museum, Brussels

Sept. 2009, Organised *Fluorescence diffuse optical tomography reconstruction theory workshop*, UCL, London

Apr. 2005, Organised *Interdisciplinary workshop on Complex Systems*, University of Queensland, Australia

Publicity and Press

June 2013, Oscillator Blog, Scientific American, *Fractal Bacteria*, http://blogs.scientificamerican.com/oscillator/2013/06/09/fractal-bacteria/

June 2013, Lab Rat Blog, Scientific American, *The fractal patterns of bacterial colonies*, http://blogs.scientificamerican.com/lab-rat/2013/06/09/the-fractal-patterns-of-bacterial-colonies/

June 2013, ScienceDaily, *Fractal Patterns Spontaneously Emerge During Bacterial Cell Growth*, http://www.sciencedaily.com/releases/2013/06/130611084115.htm

Aug. 2012, Cell Picture Show, *Biofilms*, http://www.cell.com/cell_picture_show-biofilms

Positions of Responsibility

Nov. 2010 - Present, *Administrator* of PlantFab DNA registry database.

Sept. 2001 – Sept. 2002, *MRes CVIPGS Representative on Staff-Student Committee*, UCL, London