

DR MARK FLEGG PHD

Phone: +61 (0)428 699 956 ◊ Email: mark.flegg@monash.edu ◊ Web: markflegg.com.au

EDUCATION

Doctor of Philosophy

January 2006 – January 2010

Queensland University of Technology

School of Physical and Chemical Sciences

Thesis: *Theoretical investigation of mechanisms of formulation and interaction of nanoparticles.*

Overall GPA: 7.0/7.0

B. App. Sc. (Honours)

January 2005 – November 2005

Queensland University of Technology

School of Mathematical Sciences

Thesis: *Modeling of electromagnetic modes in dielectric resonators and the application of these modes to mobile phone transmit filters.*

Overall GPA: 6.375/7.0

B. App. Sc. (Dean's Scholars Accelerated Honours Program)

January 2003 – June 2005

Queensland University of Technology

Entry requirements: Overall Position 1 or equivalent top 1% high school graduates and successful interview

Major in Physics

Minor in Mathematics

Overall GPA: 6.8/7.0 (with distinction)

EMPLOYMENT

Monash University

Feb 2014 - Present

Lecturer of Applied Mathematics

Melbourne, Australia

Lecturer and researcher, School of Mathematical Sciences.

University of Oxford

May 2010 - Dec 2013

Postdoctoral Research Assistant

Oxford, UK

Project: Stochastic reaction-diffusion processes in biology.

Queensland University of Technology

April 2009 - April 2010

Postdoctoral Research Fellow

Brisbane, Australia

Project: Investigating the role of bone marrow composition in osteoporosis, bone metastasis of breast and prostate cancer, and computational modelling of ultrasound for bone imaging applications.

TEACHING EXPERIENCE

Lecturer

Monash

ENG2005 Advanced Engineering Mathematics (Computational Mathematics, ~900 students) (2017)

MTH3310 Applied mathematical modelling (Continuum modelling, ~70 students) (2017)

MTH2032 Differential equations with modelling (Partial differential equations, ~300 students) (2015, 2016, 2017)

M43031 Mathematics in Biology and Medicine (Honours mathematical biology) (2015, 2016)

ENG2091 Advanced Engineering Mathematics A (PDEs and vector calculus, ~500 students) (2014)

QUT

PCB107 Physics and Quantitative Techniques (first year wave physics)	(2008)
MAB111 Mathematical Sciences 1a (first year mathematics)	(2008)
PCB669 Astrophysics II (honours astrophysics and cosmology)	(2009)

Teaching classes

Monash

MTH2032 - Differential equations with modelling (differential equations)	(2015, 2016)
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Oxford

B5a Techniques of applied mathematics	(2010-11)
B5b Applied partial differential equations	(2010-11)
B8a Mathematical biology and ecology	(2012-13)

QUT

MAB131, MAB132, MAB182, MAB311, MAB134, MAB180, MAB413, MAB312 (Mathematics; engineering mathematics, linear algebra, calculus and DEs).	(2004-2010)
PCB150, PCB107, PCB362 (Physics; optics, acoustics, mechanics, electronics and radiation physics).	(2006-2010)

Administration

Monash

Course coordination (multiple units) - assessment, subject content and structure.	(2014-2017)
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QUT

QUT Physics Bridging Course unit administrator - payroll, bookkeeping and management.	(2006-2009)
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Short Courses

Oxford

LMS/EPSRC Short Instructional Course: Stochastic Modelling in Biological Systems, Oxford.	(2012)
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STUDENT SUPERVISION

PhD

Mohammad Hossain - To commence in 2018 (principal supervision)

James Cavallo - Commenced February 2016 (principal supervision)

Honours and Masters

Jake Antmann - Honours dissertation: "A Mathematical Model of Kidney Branching Morphogenesis", 2016 (co-supervised with Dr. J.A. Flegg)

Dominic Maderazo - Honours dissertation: "Mathematical Modelling of T Cell-Dendritic Cell Interactions", 2015 (co-supervised with Dr. J.A. Flegg)

Chin Pang Ho - MSc dissertation: "Multiscale reaction-diffusion simulations in biology", 2012 (co-supervised with Dr. Erban)

Doctoral training

Robert Ross - DTC project: "Spatio-temporal modelling of the Min system in E.coli", 2013 (co-supervised with Dr. Erban and Dr. Robinson)

Marcin Paczkowski - DTC project: "Stochastic modelling of intracellular calcium dynamics", 2013 (co-supervised with Dr. Erban and Dr. Robinson)

Andreas Harris - DTC project: "Multiscale modelling of actin dynamics in filopodia", 2013 (co-supervised with Dr. Flegg and Dr. Robinson)

Undergraduate summer projects under scholarship

Marcus Pensa - AMSI summer project 2016-17

Kevin Duxbury - AMSI summer project 2015-16.

Assistant supervision and student visitors

Melanie Neeland - (PhD student - Supervisor Dr. Michael de Veer), 2014

Stefan Hellander - (PhD student - Supervisor Prof. Per Lötstedt), 2012

Likun Zheng - (PhD student - Supervisor Prof. Hans Othmer), 2011

Miles Rivlin - (Honours student - Supervisor Prof. Christian Langton), 2009

CONFERENCES, SEMINARS AND WORKSHOP PARTICIPATION

Conference/workshop organisation and administration

- MATRIX workshop, Spatio-temporal stochastic systems in biology (part of the Month of Mathematical Biology), Creswick, Victoria, Australia (July 2018).
- Banff International Research Station Workshop (workshop ID 14w5103), Particle-Based Stochastic Reaction-Diffusion Models in Biology, Canada (November 2014).
- Workshop on Stochastic Modelling of Reaction-Diffusion Processes in Biology, Oxford, United Kingdom (9-11 July 2012).

Invited talks

- AMSI Bioinfosummer 2017.
- Workshop on introducing group projects into undergraduate mathematics courses, University of Sydney (Sept 2017).
- Stochastic Dynamical Systems in Biology: Numerical Methods and Applications workshop, University of Cambridge, UK (March 2016).
- AustMS 2015, Adelaide, Australia (September 2015)
- SMB annual meeting 2014, Osaka, Japan (July 2014)
- Mathematical Modeling in Cell Biology conference, Lyon, France (March 2013).
- SIAM CSE - MS237 Intracellular Processes: Stochastic Modeling and Numerical Methods (February 2013).
- Workshop on Stochastic Modelling of Reaction-Diffusion Processes in Biology, Oxford, United Kingdom (July 2012).
- Mathematics Department seminar series, University of Minnesota (June 2011). Host: Prof. Hans Othmer.
- ACPSEM QLD Branch Symposium (August 2009).

PUBLICATIONS

The following papers have been published in, or accepted by, peer reviewed journals. Preprints available for papers marked with an asterisk at markflegg.com.au.

1. James Cavallo and **Mark Flegg**, “Generalized Reversible Smoluchowski Kinetics.”, *SIAM Journal on Applied Mathematics*, (submitted 2017).
2. Dominic Maderazo, Jennifer Flegg, Melanie Neeland, Michael de Veer and **Mark Flegg**, “Physiological factors leading to a successful vaccination: a computational approach”, *PLOS computational biology*, (submitted 2017).
3. **Mark Flegg**, “Smoluchowski reaction kinetics for reactions of any order”, *SIAM Journal on Applied Mathematics*, Volume 76, Number. 4, 1403-1432 (2016)
4. Brodie Lawson and **Mark Flegg**, “A mathematical model for the induction of the mammalian ureteric bud”, *Journal of Theoretical Biology*, Volume 294, 43-56 (2016)*
5. Christian Yates and **Mark Flegg**, “The pseudo-compartment method for coupling PDE and compartment-based models of diffusion”, *Journal of the Royal Society Interface*, Volume 12, Number 106, 20150141 (2015)*
6. **Mark Flegg**, Stefan Hellander and Radek Erban, “Convergence of methods for coupling of microscopic and mesoscopic reaction-diffusion simulations”, *Journal of Computational Physics*, Volume 289, 1-17 (2015)*
7. Martin Robinson, **Mark Flegg** and Radek Erban, “Adaptive two-regime method: application to front propagation”, *Journal of Chemical Physics*, Volume 140, 124109 (2014)*
8. Christian Langton, Marie-Luise Wille and **Mark Flegg**, “A deconvolution method for deriving the transit time spectrum for ultrasound propagation through cancellous bone replica models”, *Institution of Mechanical Engineers. Proceedings. Part H: Journal of Engineering in Medicine*, Volume 228, Number 4, 321-329 (2014)
9. **Mark Flegg**, Jonathan Chapman, Likun Zheng and Radek Erban, “Analysis of the two-regime method on square meshes”, *SIAM Journal of Scientific Computing*, Volume 36, Number 3, B561-B588 (2014)*
10. Radek Erban, **Mark Flegg** and Garegin Papoian, “Multiscale stochastic reaction-diffusion modelling: application to actin dynamics in filopodia”, *Bulletin of Mathematical Biology*, Volume 76, Number 4, 799-818 (2013)*
11. **Mark Flegg**, Sten Rüdiger and Radek Erban, “Diffusive spatio-temporal noise increases IP3R calcium channel puff frequency”, *Journal of Chemical Physics*, Volume 138, 154103 (2013)*
12. Benjamin Franz, **Mark Flegg**, Jonathan Chapman and Radek Erban, “Multiscale reaction-diffusion algorithms: PDE-assisted Brownian dynamics”, *SIAM Journal on Applied Mathematics*, Volume 73, Number 3, 1224-1247 (2013)*
13. **Mark Flegg**, Jonathan Chapman and Radek Erban, “Two Regime Method for optimizing stochastic reaction-diffusion simulations”, *Journal of the Royal Society Interface*, Volume 9, Number 70, pp. 859-868 (2012)*
14. Jennifer Flegg, Helen Byrne, **Mark Flegg** and Sean McElwain, “Wound healing angiogenesis: the clinical implications of a simple mathematical model”, *Journal of Theoretical Biology*, Volume 300, pp. 309316 (2012)*
15. Michael Burchill, Dmitri Gramotnev, Galina Gramotnev, Brian Davison and **Mark Flegg**, “Monitoring and analysis of combustion aerosol emissions from fast moving diesel trains”, *Science of the Total Environment*, Volume 409, Number 5, pp. 985-993 (2011).

16. **Mark Flegg**, Daniel Mason, Dmitri Gramotnev and Galina Gramotnev, “A method for the analysis of thermal tweezers for manipulation and trapping of nanoparticles and adatoms on crystalline surfaces”, *Journal of Applied Physics*, Volume 107, Number 10, 104317 (2010)*
17. **Mark Flegg**, Christopher Poole, Andrew Whittaker, Imelda Keen and Christian Langton, “Rayleigh theory of ultrasound scattering applied to liquid-filled contrast nanoparticles”, *Physics in Medicine and Biology*, Volume 55, (2010)*
18. **Mark Flegg**, Philip Pollet and Dmitri Gramotnev, “Ehrenfest model for condensation and evaporation processes in degrading aggregates with multiple bonds”, *Physical Review E*, Volume 78, Number 1, 031117 (2008)*
19. **Mark Flegg** and Dmitri Gramotnev, “Exact solution for stochastic degradation and fragmentation processes in arbitrary chain and ring aggregates with multiple bonds”, *Physical Review E*, Volume 77, Number 1, 021105 (2008)*

The following papers are peer-reviewed conference publications:

1. **Mark Flegg**, Dmitri Gramotnev, David Katoshevski, Galina Gramotnev, Michael Burchill and Jennifer Thackham, “Ultrasound manipulation and trapping of airborne nano-particles”, *Proceedings of the Australian Institute of Physics congress, Adelaide, Australia* (2008).
2. Michael Burchill, **Mark Flegg**, Brian Davison, Galina Gramotnev and Dmitri Gramotnev, “Analysis of combustion aerosols from diesel trains”, *Proceedings of the Australian Institute of Physics congress, Adelaide, Australia* (2008).

The following are published technical reports:

1. Dmitri Gramotnev, Galina Gramotnev, Esa Jaatinen and **Mark Flegg**, “Vegetation and air quality in the urban environment: Literature review and directions for the future research”, *Technical Report for the Brisbane City Council* (2006).

MAJOR GRANTS

- ARC Discovery Early Career Researcher Award 2014 (DE140101268): “Stochastic mathematical modelling of the Wnt signalling pathway.” - \$385,000
- ARC Discovery Project 2016 (DP160104892): “Controlling cell polarity and asymmetric cell division in meiosis.” - \$330,000

SMALL GRANTS

- Monash Cross-Faculty Strategic Research Seed Funding \$23,093 (2016). “The origins of aneuploidy in cell division: a mathematical pilot study?”
- Monash Faculty of Science Cross-Campus Initiative Fund \$10,000 (2017).

PRIZES, AWARDS AND HONOURS

- Monash Faculty of Science Research Showcase Scheme \$5,000 (2016) “MAXIMA Symposium on Interdisciplinary Mathematical Applications”
- MATRIX Workshop Support (2018) - Funding to host an international workshop at MATRIX at Melbourne, Australia.
- Banff International Research Station Workshop Support (2014) - Funding to host an international workshop at the Banff International Research Station, Canada.
- QUT Faculty-Based Award (2006) - Research scholarship for PhD study.

- Co-operative Education for Enterprise Development (CEED) Award (2005) - Industry-based research scholarship for Honours projects.
- Dean's Scholars Accelerated Honours Program (2003) - A selective, accelerated undergraduate course designed for the top one percent of high school graduates (three year undergraduate course and one year honours course condensed into three years).
- Dean's Award for Excellence in Mathematics (2004) - For excellence in the mathematical sciences program at Queensland University of Technology.
- Queen's Badge (2004) - Presented on behalf of the Crown to young people with outstanding personal achievements and acts within their community.
- Robocup Junior Soccer World Champion (2002) - First in the international robotics competition, Robocup (Soccer Division).

RESEARCH INTERESTS

Applied mathematics
Multiscale modelling
Continuum modelling
Transport-limited processes
Stochastic modelling of physical processes
Diagnostic ultrasound modelling

REFEREES

Professor Radek Erban
Royal Society University Research Fellow and Fellow of Merton College,
Mathematical Institute, University of Oxford,
Email: erban@maths.ox.ac.uk

Professor Kevin Burrage
Professor of Computational Mathematics,
School of Mathematical Sciences, Queensland University of Technology,
Email: kevin.burrage@qut.edu.au

Professor Kate Smith-Miles
Professor of Applied Mathematics and Australian Laureate Fellow,
School of Mathematics and Statistics, University of Melbourne
Email: smith-miles@unimelb.edu.au