Mirela Domijan

Contact

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Employment Details:

2016- **Lecturer in Applied Mathematics**
University of Liverpool, Department of Mathematical Sciences

2013-16 **Research Associate**
University of Cambridge, The Sainsbury Laboratory (SLCU)

- *Area of research*: "Analysis of the single cell dynamics of the *A. Thaliana* plant circadian clock in a multicellular context"
  Advisor: Dr. James C.W. Locke; *Funding:* BBSRC
- developing and applying quantitative methods to study the plant circadian clock at the single cell level for the first time; performing statistical data analysis and developing stochastic models based on the single cell data
- established an ongoing collaboration with Dr. Philip Wigge's group (at SLCU) to study plant temperature sensing in plants and this has resulted in a publication in Science and Current Biology
- *Further role:* College Research Assistant at Wolfson College (2014-16)

2008-13 **Research Associate (2008-2009) and Fellow (2009-2013)**
University of Warwick, Warwick Systems Biology Centre (WSBC)

- *Area of research*: "Mathematical modelling and analysis of regulatory and signalling networks"
  Advisor: Prof. David A. Rand; *Funding:* ROBuST project (BBSRC and EPSRC) and EU BioSim Network of Excellence
- developed novel mathematical methodologies to guide building of mathematical models based on experimental data (published in J. Roy. Soc. Interface and Royal Society's Interface Focus)
- designed the first mathematical model of the temperature-sensitive plant circadian clock (published in Mol. Sys. Biol.)
- worked in a collaborative project with experimental teams at Edinburgh, Liverpool and Exeter Universities studying the role of the temperature and light effects on the plant circadian clock; contributed to the direction of multiple experiments with the Liverpool and Edinburgh teams
- established a collaboration with Prof. Elisabeth Pécou (then at the University of Nice- Sophia Antipolis) working on graph topologies of specific chemical reaction networks
- designed two Masters mini-projects proposals, attracted students to the projects and supervised students on these projects; initiated a collaboration with Dr. Isabelle Carré (at the Warwick School of Life Sciences) for one of the projects

Education:

2005-08 **PhD in Mathematics**
University of Warwick, Warwick Mathematics Institute (WMI)

- *Thesis title:* "Mathematical aspects of chemical reaction networks"
  Advisor: Prof. Sebastian van Strien
- awarded the prestigious Commonwealth Scholarship by the Commonwealth Scholarship Commission in the UK to fund studies
- developed mathematical approaches for the analysis of models of chemical reaction networks drawing on theory from algebraic geometry, bifurcation theory and graph theory

2004-05 **MPhil in Mathematics**

University of Waikato, NZ.

- *Thesis title:* "Dynamic probing of mechanisms underlying calcium oscillations"
  Advisors: Dr. Rua Murray and Prof. James Sneyd (University of Auckland)
- awarded the University of Waikato Masters Scholarship to fund studies

2000–03 **BSc(Hons)** *First Class* and **BA**
University of Waikato, NZ.

- *Major:* Mathematics, *Minor:* German
- School of Computing and Mathematical Sciences Honours Award, University of Waikato, 2003
- *Emmy Noether Prize* in Mathematics for the best first year female student, 2000
- Second-year Prize for Excellence in French, Department of European and Hispanic Studies, 2000

Publications

[1] N. Vimont, R. Beauvieux, A. Schwarzenberg, **M. Domijan**, S. Cortijo, P.A. Wigge, E. Dirlewanger, B. Wenden, (2018) Hormonal balance finely tunes dormancy status in sweet cherry flower buds *BiorXiv*, DOI: 10.1101/423871

[2] A. Hajdu, O. Dobos, **M. Domijan**, B. Blint, I. Nagy, F. Nagy, L. Kozma-Bognar, (2018) ELONGATED HYPOCOTYL 5 mediates blue light signaling to the *Arabidopsis* circadian clock, *The Plant Journal*.

[3] P. D. Gould *, **M. Domijan***, M. Greenwood*, J.W.C. Locke and A.W.J. Hall, (2018) Circadian clock at the single cell level, *eLife*;7:e31700, DOI: 10.7554/eLife.31700

[4] J. Jung*, **M. Domijan*** et al. (2016) Phytochromes act as thermosensors in the night, *Science*.

- Altmetrics score: 222
- Reviewed by 15 news outlets

[5] **M. Domijan**, P.E. Brown, B. V. Shulgin and D.A. Rand, (2016) PeTTSy: a computational tool for perturbation analysis of complex systems biology models, *BMC Bioinformatics*.

[6] **M. Domijan** and D.A. Rand, (2015) Using constraints and their value for the optimisation of large ODE systems, *J.R. Soc. Interface.*

[7] M.S. Box, B.E. Huang, **M. Domijan** *et al.*, (2015) 'ELF3 controls thermoresponsive growth in Arabidopsis', *Current Biology*.

- Reviewed on 'Weeding the Gems", the GARNet blog:
  `http://blog.garnetcommunity.org.uk/page/2/`

[8] P. D. Gould*, N. Ugarte*, **M. Domijan*** *et al.*, (2013) Network balance via CRY signalling controls the Arabidopsis circadian clock over ambient temperatures, *Mol.Syst.Biol.* **9**(650): 177-186.

- F1000Prime recommended

[9] **M. Domijan**§ and E. Pécou, (2012) Interaction graph structure of mass-action reaction networks, *J. Math. Biol.*, **65**(2): 375–402.

[10] **M. Domijan** and D. A. Rand, (2011) Analysing the effects of light and temperature on circadian clocks, *Interface Focus* **1**(1): 177-186.

[11] M. Kirkilionis, **M. Domijan**, M. Eigel, E. George, M. Li and L. Sbano, (2009) A definition of cellular interface problems, LNCS **5391**, Springer.

[12] **M. Domijan**§ and M. Kirkilionis, (2009) Bistability and oscillations in chemical reaction networks, *J. Math. Biol.*, **59**(4): 467–501.

[13] **M. Domijan** and M. Kirkilionis, (2008) Graph theory and qualitative analysis of reaction networks, *Networks and Heterogeneous Media* **3**(2): 295–322.

[14] **M. Domijan**, R. Murray and J. Sneyd, (2006) Dynamical probing of the mechanisms underlying calcium oscillations. *Journal of Nonlinear Science* **16**(5): 483-506.

[15] **M. Domijan**, Bistability in chemical reaction networks, (2006) *2nd UniNet Workshop: Data, Networks and Dynamics*, Heidelberg. ISBN 3-8325-1308-6.

* denotes joint first author, § denotes corresponding author

Software:

M. Domijan, P.E. Brown, B. V. Shulgin and D.A. Rand, PeTTSy: a computational tool for perturbation analysis of complex systems biology models:
`http://www2.warwick.ac.uk/fac/sci/systemsbiology/research/software/`

This is a MATLAB-based software for sensitivity analysis of ODE mathematical models of regulatory and signalling systems. I have been involved in a considerable extension of the software suite, also adding in new functions based on the methodology that I have been developing in my first postdoctoral position.

Books:

[B1] C.R. Webb and **M. Domijan**, Introduction to MATLAB® for Natural Sciences, Springer, ongoing

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Collaborations

2013- **Dr. Philip Wigge** (The Sainsbury Laboratory, University of Cambridge)
- ongoing collaboration to study the thermoresponsiveness of the *Arabidopsis* plant
- ongoing collaboration to study the phytochrome behaviour in Brachypodium
- co-authored two publications

2009- **Prof. Anthony Hall** (University of Liverpool)
- ongoing collaboration as a Research Associate/Fellow as member of the ROBuST project (while at Warwick) and the current BBSRC project (at Cambridge)
- studying the dynamics of *Arabidopsis* plant circadian clock at population and single cell levels
- co-authored publication

2009-13 **Prof. Andrew Millar** and **Dr. Karen Halliday** (University of Edinburgh) and **Dr. Steve Penfield** (then at the University of York, now at the John Innes Centre, Norwich)
- collaboration as a Research Associate/Fellow as member of the ROBuST project (while at Warwick)
- studying the effects of light and temperature cues on the *Arabidopsis* plant circadian clock.
- co-authored publication

2012 **Dr. Isabelle Carré** (University of Warwick)
- collaboration on setting up two Masters mini-projects where in the first one (designed by me and co-supervised by Prof. Rand) the student would investigate using mathematical modelling the effects of light on the circadian clock of the *O. Tauri* alga and then in Dr. Carré mini-project go on to test out the model predictions in her lab
- successfully attracted and supervised a Masters student on the first mini-project

2009 **Prof. Elisabeth Pécou** (then at Université de Nice Sophia Antipolis, now at Dassault Systèmes)
- collaboration studying the graph structure of specific chemical reaction networks
- co-authored publication

Selected Distinctions, Awards and Funding

Mathematics:
- Pump Priming Award for collaboration with Prof. Francesco Falciani (IIB), 2017, 5000GBP.
- UK Multiscale Biology Network Award for collaboration on "Investigating the role of oscillator architecture and inter-cell coupling on the spatiotemporal dynamics of circadian clocks" with Dr. Ozgür Akman (Exeter), 2017, 1000GBP.

- BBSRC Travel Award to attend SEB2015.
- Funding covering travel costs by the Multiscale Biology Network to attend their springboard meeting in Nottingham, 2015
- London Mathematical Society Travel Grant to attend ECM2012
- European Congress in Mathematics Women in Mathematics Award to attend ECM2012
- SIAM Student Travel Award, SMB Landahl travel grant and ESMTB travel grant, 2008
- Commonwealth Scholarship for PhD studies in the UK, 2005-2008
- University of Waikato Masters Scholarship (to fund M.Phil studies), 2004
- Link Foundation Chevening Scholarship to fund Certificate of Advanced Study in Mathematics at Cambridge University (unable to take up), 2004
- Funding from NZIMA to attend three workshops/conferences (listed below) and sponsoring two week-long visits to the University of Auckland, 2004-2005
- School of Computing and Mathematical Sciences Honours Award, University of Waikato, 2003
- *Emmy Noether Prize* in Mathematics for the best first year female student, University of Waikato, 2000
- *Earlier:* Top 100 Certificate from Eton Press Senior Mathematics Competition, 1999 Certificate of Distinction from Invitational Mathematics Challenge organised by the University of Waterloo, 1998

Languages:
- Second-year Prize for Excellence in French, Department of European and Hispanic Studies, University of Waikato, 2000
- Certificate of Excellence from the New Zealand Association of Language Teachers, 1999
- First place in Alliance Française Concours Oral in Waikato Region, 1998-1999 and in 1998 I was awarded a two-week trip to visit Alliance Française in Nouméa, New Caledonia
- First place in Waikato Goethe Society Examination in German, 1997-1998

Other: First place in Year 13-Dux (Valedictorian) of Hillcrest High School, Hamilton, NZ, 1999. University Entrance Bursary Scholarships in: Math with Calculus, Math with Statistics, French and Economics, 1999. Special Prize in Economics, Hillcrest High School, 1999.

Graduate and Undergraduate Teaching Experience

Research supervisions:

2017- 18 **Supervisor** for Masters mini-project and dissertation for Fawaz Aseeri (2017 intake) and Jacob Barrett-Newton (2018 intake)

2011-13 **Graduate mentor** for a Warwick Systems Biology PhD student
- provided support and mentoring for the student's PhD
- offered advice and suggested ideas on mathematical modelling meiosis (cell-division) in yeast.
- proof-read mathematical sections of the thesis drafts

2010-11 **Supervisor** for Masters projects for Warwick Systems Biology graduate students (3 students)
- co-supervised Masters mini-projects (with Prof. David Rand)
- designed two of the project proposals and attracted students to these; for one of the projects initiated a collaborative two-part project with Dr. Isabelle Carré at the School of Life Sciences, University of Warwick.
- provided constructive feedback on the project report drafts and examined them

Teaching:

2016- **Course module leader for "MATH299: Mathematics for Engineering"**
Department of Mathematical Sciences, University of Liverpool

- leading a course for second-year Engineering undergraduates ($\sim$ 330 students) learning linear algebra and multivariable calculus

2014-16 **Lecturer for "Bioinformatics: Introduction to MATLAB for Biologists"**
University of Cambridge, School of Biological Sciences Bioinformatics Training Facility

- co-lecturing with Dr. Cerian Webb a two-day course (four times a year) covering basics of MATLAB programming with a focus on data analysis, statistics, and image processing functionalities

- involved in curriculum development and creation of the course material
- lectured to 20-40 attendees of various discipline backgrounds and educational levels (postgraduates and staff from various life-science faculties)
- in the latest feedback survey (May 2015), out of the 17 attendees that completed the survey, 40% rated the course as 'excellent', 46.67% rated it as 'good' and 86.67% stated that they would recommend the course

2015 **Supervisor for "Engineering Maths Part 1A"**
University of Cambridge, Emmanuel College

- taught and prepared supervision (tutorial) material to eight groups of first-year undergraduates (2-3 students per group)
- topics covered include: introduction to step and impulse functions and step and impulse response of linear systems represented by ODEs, convolution, Fourier series and introductory probability
- lead discussion and set essays
- marked essays and provided detailed and constructive feedback
- advised on exam technique

2012 **Lecturer for "MA256: Introduction to Systems Biology"**
University of Warwick, Warwick Mathematics Institute

- lectured a course for second-year Mathematics undergraduates (~ 50 students) introducing them to various mathematics research topics within the Systems Biology field
- topics covered include: introductory dynamical systems theory with the focus on theory of oscillators
- developed the course syllabus (six one-hour lectures)
- prepared lecture and exercise class material (the material and notes are still used in the current version of the course)
- contributed to the exam writing and marking
- managed a postgraduate teaching assistant taking the exercise classes

2011 **Course Module Leader for "CH924: Mathematical Models of Biological Systems"**
University of Warwick, MOAC doctoral training centre

- led a four-week Masters course compulsory for Systems Biology and MOAC (Molecular Organisation and Assembly of Cells) DTC students
- set course syllabus, prepared the lectures and exercise class material, set and marked essays
- wrote and marked the exams approved by an external examiner, and organised and ran oral examinations
- directed and managed two postdoctoral tutors and three postgraduate teaching assistants involved in the running of the lectures and exercise classes

2009 **Teaching Assistant**
University of Warwick, Systems Biology and MOAC DTCs

- tutored at a two-day pre-sessional mathematics course covering diverse topics in mathematical biology and introductory statistics to $\sim 20-25$ graduate students (with natural sciences, mathematics and computing backgrounds) entering the PhD program

2003-04 **French Teaching Assistant**
Collège Lou Vignaires, Avignon, France.

- language assistant for classes of students aged 13-19

2004-05 **Teaching Assistant in Mathematics**
2001-03 University of Waikato, NZ.

- teaching assistant for undergraduate courses in Algebra, Multivariable Calculus and Mathematics for Economics.
- examination invigilator and marker for undergraduate mathematics courses

Additional examinations:

2018 **University Examiner** (internal) for a UoL PhD candidate

2017 **University Examiner** (2nd marker): 2 MSc mini-projects and a dissertation at UoL.

2011 **University Examiner** (2nd marker) for Masters mini-project at WSBC

2010 **Internal (second) examiner** for Master in Maths (MMath) research project at WMI

Reviewing & Admin activities

- Member of the EPSRC Early Career Forum (ECF), Oct 2018–
- UoL reviewer for XJTLU Postgraduate Research Scholarship Application, Liverpool University, Oct 2018.
- Independent Maths Reviewer for Quest MRC SDF scheme, Liverpool University, July 2018.
- Referee for Frontiers in Plant Science, Journal of Mathematical Biology, BMC Systems Biology, Journal of Theoretical Biology, IEEE Control Systems Magazine, Sensors.
- Reviewer for a graduate textbook proposal for Cambridge University Press.

Talks and Presentations

- I have given over 30 talks (over 20 of these by invitation) at national and international conferences and department seminars
- my talk at SBMC08 can be viewed at: `http://www.sbmc08.de/lifestreams.html`

Invited:

- (upcoming) **Some recent developments in modelling of circadian rhythms**, MIR@W day on "Nonlinear Systems Today", in honour of David Rand's 70th and Claude Baesen's 60th birthday celebrationa, University of Warwick, Dec 2018
- **Modelling Insulin effects on Cell Cycle and Bio Energetics**, 2nd Joint Liverpool-Glasgow Maths Healthcare Centre Meeting, Liverpool, Aug 2018
- **Modeling insights into the behaviour and function of the Arabidopsis circadian clock**, John Innes Centre, Norwich, UK, June 2018
- **Mathematics of Circadian Rhythms**, Allotey workshop: connecting with the AIMS network, University of Liverpool, UK, May 2018
- **Some insights into modelling the behaviour of the plant circadian clock**, University of Manchester, April 2018
- **Insights into the plant circadian clock at the single-cell level**, QMBE Seminar, University of Exeter, UK, Feb 2018
- **Insights into the *Arabidopsis* circadian clock at single cell level**, Nottingham University Department Seminar, UK, Dec 2017
- **Modeling insights into the behaviour and function of the *Arabidopsis* circadian clock**, Mathematics in Life Sciences (MiLS), Mathematical Modelling of Plant Biology meeting, UK, June 2017
- **Modeling insights into the behaviour and function of the *Arabidopsis* circadian clock**, Biomathematics Seminar, University of Sheffield, April 2017
- **Linking models to data: assessing the value of model constraints**, Non-likelihood Based Statistical Modelling, CRiSM (Centre for Research in Statistical Methodology), University of Warwick, Sept 2015
- **Mathematical modelling of the plant circadian clock**, ECMTB 2014 Minisymposium on Mathematical Modeling of Genetic and Biochemical Circuits, Gothenburg, Sweden, July 2014
- **Mathematical Modeling of the Plant Circadian Clock**, University of Portsmouth Maths Seminar, Dec 2013
- **Some observations on interaction graphs of mass-action reaction networks**, mini-symposium "Progress in chemical reaction network theory, 6th ECM, Krakow, July 2012
- **Light and temperature effects on the circadian clock**, NUI Maynooth, April 2012
- **Algebraic geometry and chemical reactions**, Queen Mary University of London, Feb 2012
- **Interaction graphs of mass-action chemical reaction networks**, Max Planck Institute in Magdeburg, Sept 2011
- **Temperature and light effects on circadian clocks**, Halliday and Millar Lab joint internal seminars, University of Edinburgh, Nov 2010
- **Interaction graphs of chemical reaction networks are rich in circuits**, Bristol University Maths Seminar, June 2010
- **Analyzing chemical reaction networks using stoichiometry information**, BioSim workshop, Venice, Italy, March 2009
- **Stoichiometric network analysis and graph theoretic methods for studying spatial models of chemical reaction networks**, SIAM Conference on the Life Sciences, Montreal,

Aug 2008

- **A study of chemical reaction networks: from stable steady-states to chaotic dynamics**, 4th UniNet Workshop: New directions in network modeling, University Rene Descartes, July 2008
- **What are...some graphs of chemical reaction networks?**, Zürich Graduate Colloquium (ETH Zürich and UZH), March 2008
- **Conditions for some common bifurcations in chemical reaction networks via SNA**, 3rd UniNet Workshop: Robustness of Network Models, University of Girona, May 2007
- **A closer look at chemical reaction networks: saddle-node and Hopf bifurcations**, Kompakt Seminar in Blackforest organized by Prof. W. Jäger, Uni. of Heidelberg, Aug 2006

Other Talks and Posters:

- **Exploring the circadian clock through experiments and modelling at the single cell and population level**, UK Clock Club, Manchester, July 2018
- **Modeling insights into the behaviour and function of the *Arabidopsis* circadian clock**, (poster), ICAR2016, South Korea, July 2016
- **Modeling insights into plant thermal responsiveness**, SEB 2015, Prague, June-July 2015
- **Linking models to data: assessing the value of model constraints**, SEB 2014, Manchester, June 2014
- **Light and temperature effects on the circadian clock**, ESMTB 2011, Krakow, June 2011
- **Novel Balance Equations for buffering the circadian clock**, (poster), Plant Systems Biology UK Workshop, Edinburgh, March 2011
- **Light and temperature effects in the Arabidopsis Thaliana circadian clock**, Plant Systems Biology UK Workshop, Edinburgh, March 2011
- **Novel Balance Equations for buffering the circadian clock**, (poster), BBSRC Grantholder workshop London, Jan 2011
- **The cryptochromes and phytochrome A regulate temperature compensation of the circadian clock?** (joint presentation with Dr. Julia Foreman, University of Edinburgh), Plant Systems Biology UK Workshop, Nottingham, June 2010
- **Some Bifurcation Conditions via Stoichiometric Network Analysis**, (poster), SIAM Conference on the Life Sciences, Montreal, Aug 2008
- **Stoichiometric network analysis and graph theoretic methods for studying spatial models of chemical reaction networks**, Annual Meeting of The Society of Mathematical Biology, Toronto, July-Aug 2008
- **The study of chemical reaction systems via stoichiometric network analysis**, The European Conference on Mathematical and Theoretical Biology 2008, Edinburgh, June-July 2008
- **New approaches to study dynamic behaviour of chemical reaction systems via stoichiometric network analysis**, SBMC08 Conference on Systems Biology of Mammalian Cells, Dresden, May 2008
- **Sufficient conditions for a simple Hopf bifurcation in chemical reaction networks**, British Applied Mathematics Colloquium, University of Bristol, April 2007
- **Conditions for oscillatory behaviour via stoichiometric network analysis**, (poster), Cellular Protein Translocation and Numerical Methods for Computation on Complex Domains, University of Warwick, Nov 2006
- **Dynamical probings of mechanisms underlying calcium oscillations**, NZIMA One-Day Workshop, University of Auckland, July 2005
- **Applications of fixed point theorems to ordinary differential equations**, University of Waikato Mathematics Seminars, Nov 2002

Other science communication activities:

- presentation at "Wolfson Research Event 2015", Wolfson College, Cambridge, May 2015
- presentation to Lord Sainsbury during his visit to SLCU, June 2015
- preparing and running a mathematical modelling workshop for Christ's and Sidney Sussex College group of students visiting SLCU, Aug 2015

Other Training/Workshops

- Biological Timing Study Group 2018, University of Manchester, June 2018
- MSBNet Multiscale Biology Study Group 2017, University of Birmingham, Dec 2017
- Invitation to participate at the 5th Computational Biology Workshop, The Sainsbury Laboratory University of Cambridge, Aug 2017
- An Introduction to Solving Biological Problems with Python, School of Biological Sciences Bioinformatics Training, June 2015
- SBSI Modeling and Analysis workshop with Systems Biology Software Infrastructure, CSBE informal forum, University of Edinburgh, Dec 2010
- Workshop 2: Circadian Clocks in Plants and Fungi, MBI, University of Ohio USA, Oct 2010
- Hands-on session in stochastic modelling, CSBE informal forum, U. of Edinburgh, July 2010
- EPSRC Symposium Workshop on Clocks, Switches and Signals (CSS), U. of Warwick, May 2010
- BioSim conference, Copenhagen, Aug 2009
- ANZIAM, Napier NZ, Jan-Feb 2005
- NZIMA Workshop on Dynamical Systems and Numerical Analysis, Leigh, NZ, Dec 2004
- NZIMA Workshop on Dynamical Systems and Numerical Analysis, Raglan, NZ, Aug-Sept 2004