10.IX.24

Professor Mark AJ Chaplain

PRESENT POSITION:
Gregory Chair of Applied Mathematics, University of St Andrews, 1st May 2105 –

HIGHER EDUCATION:
1982-1986, BSc (Honours) 1st Class, Applied Mathematics, University of Dundee
1987-1990, PhD Applied Mathematics, University of Dundee

PREVIOUS POSTS:
School of Mathematical Sciences, University of Bath, 1990–1996
Department of Mathematics, University of Dundee, 1996–2105
(Senior Lecturer, 1996–1998; Reader, 1998–2000; Personal Chair in Mathematical Biology, 2000–2013)
Ivory Chair of Applied Mathematics, University of Dundee, 1 February 2013 – 30 April 2015

RESEARCH INTERESTS:
Multiscale mathematical oncology.

RESEARCH SUMMARY:
To date 242 articles published in peer-reviewed scientific journals and contributed book chapters.

ORCID ID = 0000-0001-5727-2160 [https://orcid.org/0000-0001-5727-2160].

Selected publications:

Anderson, A.R.A., Chaplain, M.A.J. (1998) Continuous and discrete mathematical models of tumour-induced angiogenesis. *Bull. Math. Biol.* **60**, 857-899.
doi: 10.1006/bulm.1998.0042

Chaplain, M.A.J., Lolas, G. (2005) Mathematical modelling of cancer cell invasion of tissue: The role of the urokinase plasminogen activation system. *Math. Modell. Methods. Appl. Sci.* **15**, 1685-1734. https://doi.org/10.1142/S0218202505000947

McDougall, S., Anderson, A.R.A., Chaplain, M.A.J. (2006) Mathematical modelling of dynamic adaptive tumour-induced angiogenesis: Clinical implications and therapeutic targeting strategies. *J. Theor. Biol.* **241**, 564-589. https://doi.org/10.1016/j.jtbi.2005.12.022

Gerisch, A., Chaplain, M.A.J. (2008) Mathematical modelling of cancer cell invasion of tissue: Local and non-local models and the effect of adhesion. *J. Theor. Biol.* **250**, 684-704.
https://doi.org/10.1016/j.jtbi.2007.10.026

Ramis Conde, I., Drasdo, D., Chaplain, M.A.J., Anderson, A.R.A. (2008) Modelling the influence of the E-Cadherin - β-Catenin pathway in cancer cell invasion and tissue architecture: A multi-scale approach. *Biophys. J.* **95**, 155-165.
https://doi.org/10.1529/biophysj.107.114678

Macklin, P., McDougall, S., Anderson, A.R.A., Chaplain, M.A.J., Cristini, V., Lowengrub, J. (2009) Multiscale modelling and nonlinear simulation of vascular tumour growth. *J. Math. Biol.* **58**, 765-798. doi: 10.1007/s00285-008-0216-9

Ramis-Conde, I., Chaplain, M.A.J., Anderson, A.R.A., Drasdo, D. (2009) Multi-scale modelling of cancer cell intravasation: the role of cadherins in metastasis. *Pays. Biol.* **6** (2009) 016008 (12pp). doi: 10.1088/1478-3975/6/1/016008

Andasari, V., Gerisch, A., Lolas, G., South, A.P., Chaplain, M.A.J. (2011) Mathematical modeling of cancer cell invasion of tissue: biological insight from mathematical analysis and computational simulation. *J. Math. Biol.* **63**, 141-171. doi: 10.1007/s00285-010-0369-1

Schlüter, D.K., Ramis-Conde, I., Chaplain, M.A.J. (2012) Computational modeling of single cell migration: The leading role of extracellular matrix fibers. *Biophys. J.* **103**, 1141-1151. doi: 10.1016/j.bpj.2012.07.048

McDougall, S.R., Watson, M.G., Devlin, A.H., Mitchell, C.A., Chaplain, M.A.J. (2012) A hybrid discrete-continuum mathematical model of pattern prediction in the developing retinal vasculature. *Bull. Math. Biol.* **74**, 2272-2314. doi: 10.1007/s11538-012-9754-9

Sturrock, M., Hellander, A., Matzavinos, A., Chaplain, M.A.J. (2013) Spatial stochastic modelling of the Hes1 gene regulatory network: intrinsic noise can explain heterogeneity in embryonic stem cell differentiation. *J. R. Soc. Interface* **10**, 20120988.
https://doi.org/10.1098/rsif.2012.0988

Powathil, G.G., Adamson, D.J.A., Chaplain, M.A.J. (2013) Towards predicting the response of a solid tumour to chemotherapy and radiotherapy treatments: Clinical insights from a computational model. *PLoS Comput. Biol.* **9(7)**, e1003120.
doi: 10.1371/journal.pcbi.1003120

Domschke, P., Trucu, D., Gerisch, A., Chaplain, M.A.J. (2014) Mathematical modelling of cancer invasion: Implications of cell adhesion variability for tumour infiltrative growth patterns. *J. Theor. Biol.* **361**, 41-60. doi: 10.1016/j.jtbi.2014.07.010

Schlüter, D.K., Ramis-Conde, I., Chaplain, M.A.J. (2015) Multi-scale modelling of the dynamics of cell colonies: insights into cell adhesion forces and cancer invasion from in silico simulations. *J. R. Soc. Interface* **12**, 20141080. https://doi.org/10.1098/rsif.2014.1080

Chaplain, M.A.J., Ptashnyk, M., Sturrock, M. (2015) Hopf Bifurcation in a Gene Regulatory Network Model: Molecular Movement Causes Oscillations. *Math. Mod. Meth. Appl. Sci.* **25**, 1179-1215. https://doi.org/10.1142/S021820251550030X

Szymańska, Z., Cytowski, M., Mitchell, E., Macnamara, C.K., Chaplain, M.A.J. (2018) Computational modelling of cancer development and growth: Modelling at multiple scales and multiscale modelling. *Bull. Math. Biol.* **80**, 1366-1403. doi: 10.1007/s11538-017-0292-3

Franssen, L., Lorenzi, T., Burgess, A.E.F., Chaplain, M.A.J. (2019) A mathematical framework

for modelling the metastatic spread of cancer. *Bull. Math. Biol.* **81**, 1965-2010. 10.1007/s11538-019-00597-x

Hamis, S., Yates, J., Chaplain, M.A.J., Powathil, G. (2021) Targeting cellular DNA damage responses in cancer: An in vitro-calibrated agent-based model simulating monolayer and spheroid treatment responses to ATR-inhibiting drugs. *Bull. Math. Biol.* **83**:103 https://doi.org/10.1007/s11538-021-00935-y

Franssen, L., Sfakianakis, N., Chaplain, M.A.J. (2021) A novel 3D atomistic-continuum cancer invasion model: in silico simulations of an in vitro organotypic invasion assay. *J. Theor. Biol.* **522**: 110677
https://doi.org/10.1016/j.jtbi.2021.110677

Szymańska, Z., Lachowicz, M., Sfakianakis, N., Chaplain, M.A.J. (2024) Mathematical modelling of cancer invasion: Phenotypic transitioning provides insight into multifocal foci formation. *J. Comput. Sci.* **75**: 102175. https://doi.org/10.1016/j.jocs.2023.102175

Katsaounis, D., Harbour, N., Williams, T., Chaplain, M.A.J., Sfakianakis, N. (2024) A genuinely hybrid, multiscale 3D cancer invasion and metastasis modelling framework. *Bull. Math. Biol.* **86**: 64 https://doi.org/10.1007/s11538-024-01286-0

Full details available at my personal website:

https://www.st-andrews.ac.uk/mathematics-statistics/people/majc/

RESEARCH SUPERVISION:

Successful supervision of 31 PhD students and 19 post-doctoral research assistants.

RESEARCH FUNDING:
Since 1993 awarded over £5.8M pounds of external research funding from a variety of sources: EPSRC, BBSRC, MRC, NERC, The Royal Society, The Leverhulme Trust, The Wellcome Trust, CRUK, European Union, European Research Council.

In June 1999 awarded a Strategic Research Development (SRD) Grant of £950,000 from the Scottish Higher Education Funding Council (SHEFC) to set up SIMBIOS, an inter-disciplinary research centre. He acted as Director of this centre for a period of 3 years.

In 2008, awarded a prestigious European Research Council Advanced Investigator (ERC AdG) award, "*M5CGS: From Mutations to Metastases: Multiscale Mathematical Modelling of Cancer Growth and Spread*". €1.68M, 5 year award, September 2009 - August 2014.

In 2015, co-Investigator for the *EPSRC Centre for Multiscale Soft Tissue Mechanics - with application to heart and cancer (EP/N014642/1)* (PI - Professor Ray Ogden, University of Glasgow). Total funding of £2M over 4 years, 2016-2020.

RESEARCH PRIZES:
Whitehead Prize, The London Mathematical Society, July 2000.

Elected a Fellow of The Royal Society of Edinburgh, March 2003.

Recipient of a Leverhulme Personal Research Fellowship, April 2007 - 2009.

Recipient of the Society for Mathematical Biology 2014 and 2023 Lee Segel Prize for the best paper appearing in the Bulletin of Mathematical Biology in the previous two years. The two prize winning papers were:

McDougall, S.R., Watson, M.G., Devlin, A.H., Mitchell, C.A., Chaplain, M.A.J. (2012) A hybrid discrete-continuum mathematical model of pattern prediction in the developing retinal vasculature. *Bull. Math. Biol.* **74**, 2272-2314.

[Official citation: *"This impressive paper develops and applies a hybrid discrete-continuum model for predicting the spatial patterns that characterise the developing retinal vasculature. It links together careful experimentation with detailed model development to understand the dynamics of retinal development. The result is a visually stunning simulation study with close ties to experimental data."*]

Hamis, S., Yates, J., Chaplain, M.A.J., Powathil, G. (2021) Targeting cellular DNA damage responses in cancer: An in vitro-calibrated agent-based model simulating monolayer and spheroid treatment responses to ATR-inhibiting drugs. *Bull. Math. Biol.* **83**:103 https://doi.org/10.1007/s11538-021-00935-y

Elected an inaugural Fellow of the Society for Mathematical Biology, July 2017.

CONFERENCE ORGANISATION:
Over the past 25 years, organiser of many international mathematical biology conferences, workshops and summer schools, e.g.

On Growth and Form: Spatio-temporal pattern formation in biology, celebrating the life and works of D'Arcy Thompson on the 50th Anniversary of his death. University of Dundee, September 20-24, 1998. Over 100 participants.

International Conference on Mathematical Biology, Annual Meeting of The Society for Mathematical Biology, University of Dundee, 6-9 August 2003. First time the annual meeting of the SMB had been held independently outside North America. 225 participants.

ECMTB08, Triennial Meeting of the European Society of Mathematical and Theoretical Biology, University of Edinburgh, 30th June – 4th July 2008. 550 participants.

BAMC 2018, British Applied Mathematics Colloquium, University of St Andrews, March 26 - March 29, 2018 (315 participants)

EDITORIAL DUTIES:

Co-Chief Editor of the Journal of Theoretical Biology, July 2017 –

Subject Editor, Mathematics, Royal Society Open Science (RSOS), March 2016 –

EXTERNAL PROFESSIONAL ACTIVITIES:

Secretary and Treasurer of the European Society for Mathematical and Theoretical Biology (ESMTB), January 1998 – September 2002.

President, The Society for Mathematical Biology (SMB), July 2005 – July 2007.

President, Edinburgh Mathematical Society (EMS), October 2011 – October 2013.