Curriculum Vitae
Paul Macklin

Department of Mathematics
University of Dundee
Dundee DD1 4HN
Scotland, UK

Phone: +44 (0)1382 384488
Mobile: (available upon request)
email: macklin@maths.dundee.ac.uk
www: http://www.maths.dundee.ac.uk/macklin

EDUCATION:

Sept. 2003 to June 2007 — **Ph.D. in Computational and Applied Mathematics**
University of California, Irvine
Thesis Topic: Ghost fluid / level set methods and their application to computational oncology
Advisor: Professor John Lowengrub
Kovalevsky Outstanding Ph.D. Thesis Award

June 2000 to Sept. 2003 — **M.S. in Industrial and Applied Mathematics**
University of Minnesota, Twin Cities
Thesis Topic: Nonlinear simulation of tumour growth and chemotherapy
Advisor: Professor John Lowengrub

June 1999 to May 2000 — Graduate study in applied mathematics
University of Nebraska, Lincoln

Aug. 1995 to May 1999 — **B.A. in Mathematics and German**
University of Nebraska, Lincoln
Minors: Physics and Economics
Thesis Topic: Finite difference methods for contaminant transport in aquifers
Advisors: Professor J. David Logan
Professor Steven Cohn
highest distinction (summa cum laude), honours program

RECENT EXPERIENCE:

Feb. 2010 to present — Lecturer
Department of Mathematics
University of Dundee, Scotland

Aug. 2007 to Feb. 2010 — Assistant Professor of Health Informatics
School of Health Information Sciences
University of Texas Health Science Center, Houston

July 2007 — Postdoctoral Research Assistant
Department of Mathematics
University of California, Irvine

Sept. 2003 to June 2007 — Graduate Teaching Assistant and Research Fellow
Department of Mathematics
University of California, Irvine

June 2000 to Sept. 2003 — NSF Graduate Research Fellow, Research and Teaching Assistant
Department of Mathematics
University of Minnesota, Twin Cities

June 2000 to Sept. 2001	Intern, fiber optics research group 3M, Saint Paul, MN
July 1999 to May 2000	NSF Graduate Research Fellow, Teaching Assistant Department of Mathematics and Statistics University of Nebraska, Lincoln
July 1998 to May 1999	Undergraduate Teaching Assistant Department of Mathematics and Statistics University of Nebraska, Lincoln

RESEARCH INTERESTS:

continuum, cellular automata, agent-based, and hybrid modelling of tumour growth ⋆ healthy and pathological tissue modelling ⋆ tissue engineering ⋆ integrative biomathematical modelling ⋆ patient-specific constraint and calibration of mathematical models ⋆ mathemtical modelling of immunohistochemistry and other histological stains ⋆ development of open standards for XML-based data and model exchange ⋆ agent-based and stochastic models of chemotherapy ⋆ scientific visualisation ⋆ mathematical biology ⋆ tumour-microenvironment interaction ⋆ multicomponent fluid flows ⋆ nonlinear simulation of free boundary problems ⋆ high performance computing

GRANTS:

2008 Co-I (100% salary) for *"Virtual Cancer:" Reducing cancer recurrence and progression. New paradigms in cancer diagnostics and treatment through computational modeling of biological systems.* (PI Vittorio Cristini) Cullen Trust for Health Care. 1 Aug. 2008–28 Feb. 2010 ($1.5 million)

2009 Co-I (10% salary) for *Multi-Scale Complex Systems Transdisciplinary Analysis Of Response To Therapy* (PI W. Daniel Hillis) NIH:NCI. 28 Sep. 2009–28 Feb. 2010 (center total: $3,112,763 UT: $683,768)

2009 Co-I (30% salary) for *Center for Transport Oncophysics* (PI Mauro Ferrari) NIH:NCI. 28 Sep. 2009–28 Feb. 2010 (center total: $2,394,313 UT: $553,740)

2009 Co-I (17% salary) for *Center for Systematic Modeling of Cancer Development* (PI Stephen T.C. Wong) NIH:NCI. 1 May 2010–28 Feb. 2010 (center total: $2,296,450 UT: $553,740)

JOURNAL PUBLICATIONS:

1. P. Macklin and J.S. Lowengrub, *Evolving interfaces via gradients of geometry-dependent interior Poisson problems: application to tumor growth*, J. Comput. Phys., 203 (1) (2005), pp. 191-220. DOI: 10.1016/j.jcp.2004.08.010

2. P. Macklin and J.S. Lowengrub, *An improved geometry-aware curvature discretization for level set methods: application to tumor growth*, J. Comput. Phys., 215 (2) (2006), pp. 392-401. DOI: 10.1016/j.jcp.2005.11.016

3. P. Macklin and J.S. Lowengrub, *Nonlinear simulation of the effect of microenvironment on tumor growth*, J. Theor. Biol., 245 (4) (2007), pp. 677-704. DOI: 10.1016/j.jtbi.2006.12.004

4. H.B. Frieboes, J.S. Lowengrub, S. Wise, X. Zheng, P. Macklin, E.L. Bearer, and V. Cristini, *Computer Simulation of Glioma Growth and Morphology*, NeuroImage, 37 (S1), (2007), pp. S59-S70. DOI: 10.1016/j.neuroimage.2007.03.008

5. P. Macklin and J.S. Lowengrub, *A New Ghost Cell/Level Set Method for Moving Boundary Problems: Application to Tumor Growth*, J. Sci. Comput., 35 (2-3), (2008), pp. 266-99. DOI: 10.1007/s10915-008-9190-z

6. P. Macklin, S. McDougall, A.R.A. Anderson, M.A.J. Chaplain, V. Cristini, and J.S. Lowengrub, *Multiscale modelling and nonlinear simulation of vascular tumour growth*, J. Math. Biol., 58 (4-5), (2009), pp. 765-98. DOI: 10.1007/s00285-008-0216-9

7. J.S. Lowengrub, H.B. Frieboes, F. Jin, Y.-L. Chuang, X. Li, P. Macklin, S. Wise, and V. Cristini, *Nonlinear modeling of cancer: bridging the gap between cells and tumors*, Nonlinearity, 23 (1), (2010), pp. R1-R91. DOI: 10.1088/0951-7715/23/1/R01. **invited author: J.S. Lowengrub**

BOOKS AND BOOK CHAPTERS:

1. V. Cristini, H.B. Frieboes, X. Li, J.S. Lowengrub, P. Macklin, S. Sanga, S.M. Wise, and X. Zheng, "Nonlinear modeling and simulation of tumor growth." In N. Bellomo, M.A.J. Chaplain, and E. de Angelis (editors) *Selected topics in cancer modeling: Genesis, evolution, immune competition, and therapy. Modelling and Simulation in Science, Engineering, and Technology*, chapter 6, pp. 113-82. Birkhäuser, Boston, 2008. ISBN 978-0-8176-4712-4. **invited author: V. Cristini**

2. P. Macklin, J. Kim, G. Tomaiuolo, M.E. Edgerton, and V. Cristini, "Agent-Based Modeling of Ductal Carcinoma in Situ: Application to Patient-Specific Breast Cancer Modeling." In T. Pham (editor) *Computational Biology: Application to Patient-Specific Breast Cancer Modeling*, chapter 4, pp. 77-112. Springer, New York, NY, 2009. ISBN: 978-1-4419-0810-0. **invited author: P. Macklin**

3. P. Macklin, "Biological background" In V. Cristini and J.S. Lowengrub, *Multiscale Modeling of Cancer: An Integrated Experimental and Mathematical Modeling Approach*, Cambridge University Press, chapter 2, pp. 8-23, Cambridge, United Kingdom, 2010. ISBN: 978-0-521-88442-6. **invited author: P. Macklin**

4. P. Macklin, M.E. Edgerton, J.S. Lowengrub, and V. Cristini, "Discrete cell modeling." In V. Cristini and J.S. Lowengrub, *Multiscale Modeling of Cancer: An Integrated Experimental and Mathematical Modeling Approach*, Cambridge University Press, chapter 6, pp. 88–122, Cambridge, United Kingdom, 2010. ISBN: 978-0-521-88442-6. **invited author: P. Macklin**

5. P. Macklin, M.E. Edgerton, and V. Cristini, "Agent-based cell modeling: application to breast cancer." In V. Cristini and J.S. Lowengrub, *Multiscale Modeling of Cancer: An Integrated Experimental and Mathematical Modeling Approach*, Cambridge University Press, chapter 10, pp. 206–234, Cambridge, United Kingdom, 2010. ISBN: 978-0-521-88442-6. **invited author: P. Macklin**

PEER-REVIEWED ABSTRACTS AND OTHER PUBLICATIONS:

1. M.E. Edgerton, Y.-L. Chuang, P. Macklin, S. Sanga, J. Kim, G. Tomaiuolo, W. Yang, A.D. Broom, K.-.A. Do, and V. Cristini, *Using Mathematical Models to Understand the Time Dependence of the Growth of Ductal Carcinoma In Situ*, Canc. Res. 69 (Suppl. 2): Abstract 1165 (2009).

2. M.E. Edgerton ME, Y.-L. Chuang, P. Macklin, J. Kim, G. Tomaiuolo, A.D. Broom, S. Sanga, and V. Cristini, *Simulation of growth of DCIS parameterized from IHC*, Modern Path. 22 (Suppl. 1): 37A - 38A (2009).

3. A. Kumar, Y.-L. Chuang, P. Macklin, S. Sanga, J. Kim, G. Tomaiuolo, V. Cristini, and M.E. Edgerton, *A model to predict the proliferation index of ductal carcinoma in situ*, AACR Meeting Abstracts Online 2009: Abstract 2444 (2009).

4. P. Macklin, M.E. Edgerton, J. Kim, G. Tomaiuolo, and V. Cristini, *Application of an Agent-Based Cell Model to Ductal Carcinoma in Situ, with Patient-Specific Calibration*, The 8th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Special Session 39: Mathematical Cancer Modelling (2010).

JOURNAL PUBLICATIONS IN REVIEW:

1. T.S. Deisboeck, Z. Wang, P. Macklin, and V. Cristini, *Multiscale Cancer Modeling*, Annu. Rev. Biomed. Eng., in review. **invited author: T.S. Deisboeck**

2. P. Macklin, M.E. Edgerton, A. Thompson, and V. Cristini, *Patient-calibrated agent-based modelling of ductal carcinoma in situ (DCIS) I: Model formulation and analysis*, J. Theor. Biol, in review

3. P. Macklin, M.E. Edgerton, A. Thompson, and V. Cristini, *Patient-calibrated agent-based modelling of ductal carcinoma in situ (DCIS) II: From microscopic measurements to macroscopic predictions of clinical progression*, J. Theor. Biol, in review

JOURNAL PUBLICATIONS IN PREPARATION:

1. M.E. Edgerton, P. Macklin, Y.-L. Chuang, G. Tomaiuolo, W. Yang, J. Kim, A.K.K.L. Kumar, S. Sanga, A.D.M. Broom, A. Segura, S. Kaliki, K.-A. Do, and V. Cristini, *An application of a multiscale mathematical modeling framework of ductal carcinoma in situ*, PLoS Med., in preparation.

2. S. Sanga, M.E. Edgerton, P. Macklin, and V. Cristini, *From receptor dynamics to directed cell motion: a predictive multiscale model of cell motility in complex microenvironments*, in preparation.

3. P. Macklin, H.B. Frieboes, and V. Cristini, *Stochastic and Agent-Based Modeling Rationale for Hill-type Pharmocodynamic Response*, in preparation.

DISSERTATION AND THESES:

1. P. Macklin, *Analysis of an Explicit Finite Difference Scheme for a Groundwater Flow Problem*, Undergraduate Honors Thesis, University of Nebraska-Lincoln Honors Program (1999).

2. P. Macklin, *Nonlinear Simulation of Tumor Growth and Chemotherapy*, M.S. Thesis, University of Minnesota School of Mathematics (2003).

3. P. Macklin, *Toward Computational Oncology: Nonlinear Simulation of Centimeter-Scale Tumor Growth in Complex, Heterogeneous Tissues*, Ph.D. Dissertation, University of California-Irvine Department of Mathematics (2007).

SELECTED HONOURS:

2009 UTHSC-H School of Health Information Sciences John P. McGovern Award for Outstanding Teaching
2009 Front Cover of Journal of Mathematical Biology
2007 UCI Department of Mathematics Kovalevsky Outstanding Ph.D. Thesis Award
2007 UCI School of Physical Sciences "Outstanding Contributions to the Department of Mathematics" Award
2007 UCI Department of Mathematics Connelly Award (for an excellent teaching and research record)
2007 UCI Mathematics Department Kovalevsky Outstanding Ph.D. Thesis Award
2007 GAANN (Graduate Assistance in Areas of National Need) Fellowship
2007 University of California, Irvine Department of Mathematics Dissertation Fellowship
2006 University of California, Irvine Department of Mathematics Fellowship

2003 University of California, Irvine Department of Mathematics Research Fellowship
1999 NSF Graduate Research Fellowship
1999 Inducted Phi Beta Kappa
1998 Barry M. Goldwater Scholarship

TRAINEES (Ph.D. level and above):

Sandeep Sanga	**Ph.D.** in Biomedical Engineering - University of Texas at Austin - 2009 - committee member
Jahun Kim	**Ph.D.** student - University of Texas Health Science Center - committee member
Giovanna Tomaiuolo	**Ph.D.** in Biomedical Engineering - University of Naples, Italy - 2008 - helped mentor summer student

RECENT TEACHING:

University of California-Irvine (2004–2007)

Fall 2004	Math 2B: Single Variable Calculus - Teaching Assistant
Winter 2005	Math 3D: Elementary Differential Equations - Teaching Assistant
Spring 2005	Math 3D: Elementary Differential Equations - Teaching Assistant
Spring 2005	Math 107: Numerical Differential Equations - Teaching Assistant
Fall 2005	Math 2E: Multivariable Calculus - Teaching Assistant
Winter 2006	Math 3D: Elementary Differential Equations - Teaching Assistant
Spring 2007	Math 130C: Probability and Stochastic Processes - Teaching Assistant

University of Texas Health Science Center (2007–2009)

Fall 2007	HI 5001: Mathematical Methods for Health Informatics - Assisting Instructor
Spring 2008	HI 5001: Numerical Methods for Health Information Sciences - Assisting Instructor **Note:** Co-developed new Octave-based numerics curriculum
Summer 2008	HI 5001: Mathematical Modeling of Biological Systems and Disease - Guest Lecturer
Spring 2009	HI 5311: Foundations of Health Information Sciences II (Mathematical Modeling in Biomedicine) - Co-Instructor **Note:** Co-developed new multidisciplinary team-based curriculum **Note:** Recognised for outstanding teaching for new curriculum

University of Dundee (2010–present)

Fall 2010	MA51002: Computational Modelling and Programming - Instructor **Note:** Developed new course including numerical simulation of random variables, stochastic processes, stochastic differential equations, ODEs, BVPs, PDEs, and image processing
Fall 2010	MA40001: PTS and Project Work - Co-Instructor **Note:** Course emphasises student presentation skills in mathematical biology
Spring 2011	MA22003: Statistics and Discrete Mathematics - Co-Instructor

SERVICE:

1. Developed and Maintained the MultiCellXML project, an open XML-based data format for multi cell agent-based simulations, with open source code samples - http://multicellxml.sourceforge.net (2011–present)

2. Reviewer for *Journal of Theoretical Biology*, *Biophysical Journal*, *Cell Proliferation*, *Biomechanics and Modeling in Mechanobiology*, and *Journal of Computational Physics*, *Journal of Biological Dynamics* (2007–present)

3. Developed and Maintained EasyBMP, an open source, cross-platform C++ bitmap (BMP) image library for industrial, educational, and academic use - http://easybmp.sourceforge.net (2005–present)

4. Developed and Maintained Easy BMP to AVI Movie Creator, an open source, cross-platform tool for converting images to movies, primarily for scientific visualization - http://easybmptoavi.sourceforge.net (2006–present)

5. Founded and Organized the UCI Mathematics Graduate Student Colloquium (MGSC) - http://math.uci.edu/∼mgsc/ (2006–2007)

INVITED TALKS:

1999 *"Finite differences and stability calculations in a filtration model"*, Workshop on Mathematical Methods in the Geosciences and Related Areas, University of Nebraska, Lincoln

2006 *"Computational Oncology: An Introduction to Cancer, with Simulations and Cool Results"*, Mathematics Graduate Student Colloquium, University of California, Irvine

2007 *"Nonlinear Simulation of Centimeter-Scale Tumor Growth into Complex Tissues"*, Mathematical Biology Seminar, University of Nebraska, Lincoln

2007 *"An (*Incomplete*) Progression of Mathematical Cancer Biology: From Early Continuum Modeling to Integrative Modeling"*, Mathematics Department Colloquium, University of Nebraska, Lincoln

2008 *"Multiscale modeling and simulation of nonlinear vascular tumor growth"*, "Spatial Dynamics of Growth and Signaling" Symposium at the Conference on Mathematical Systems Biology, University of California, Irvine

2008 Society of Mathematical Biology Annual Meeting, Montreal, Canada (invitation declined)

2008 *"Patient-Calibrated Multiscale Modeling of Ductal Carcinoma in Situ (DCIS)"*, Institute of Molecular Medicine (Ferarri Research Group), University of Texas Health Science Center, Houston

2009 State of the Art in Computational Modelling of Cancer Minisymposium, SIAM Conference on Computational Science and Engineering CSE09, Miami, FL (invitation declined)

2009 *"Clinical-Mathematical Collaboration on Patient-Specific Modeling of Breast Cancer"*, RTG Workshop, Department of Mathematics, University of Utah, Salt Lake City (invitation declined)

2009 *"Towards Patient-Tailored, Predictive Cancer Modeling: Discrete and Continuum Multiscale Modeling and Early Results"*, Division of Mathematics, Dundee University

2010 *"Application of an Agent-Based Cell Model to Ductal Carcinoma in Situ, with Patient-Specific Calibration"*, The 8th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Special Session 39: Mathematical Cancer Modelling, Dresden University of Technology, Germany (invitation declined)

2010 *"Cancer Biology for Modellers"*, Mathematical Modelling of Cancer Growth and Treatment Summer School and Workshop, University of Dundee, United Kingdom (invited lecturer)

2010 *"An agent-based cell model; application to DCIS"*, Mathematical Modelling of Cancer Growth and Treatment Summer School and Workshop, University of Dundee, United Kingdom (invited lecturer)

2010 *"Agent-Based Cancer Modelling: Parameter estimation and patient-specific calibration"*, Mathematical Modelling of Cancer Growth and Treatment Summer School and Workshop, University of Dundee, United Kingdom (invited lecturer)

2010 *"Agent-Based Cancer Modelling: Numerical Method and Simulation Results"*, Mathematical Modelling of Cancer Growth and Treatment Summer School and Workshop, University of Dundee, United Kingdom (invited lecturer)

2010 *"Agent-based cancer modelling: patient calibration and simulation results"*, Mathematics Seminar, Department of Computing Science and Mathematics, University of Stirling, United Kingdom

2010 *"Agent-based modelling of ductal carcinoma in situ (DCIS): patient-calibrated simulation results"*, Computational Mathematics and Mathematical Biology Seminar, Department of Mathematics, Heriot-Watt University, Edinburgh, United Kingdom

2011 *"Mechanistic cell-scale modelling of ductal carcinoma in situ (DCIS): impact of cell biomechanics"*, "Mechanical Models of Movement and Growth of Cells and Tissues" mini-symposium at the Annual Meeting of the Society for Mathematical Biology / 8th European Conference on Mathematical and Theoretical Biology (SMB/ECMTB), Kraków, Poland (mini-symposium under review)

2011 *"An illustration of patient-specific cancer modeling: from microscopic data to macroscopic, quantitative predictions"*, "Multiscale modeling of biological systems: from physical tools to applications in tumor growth modeling" mini-symposium at the Annual Meeting of the Society for Mathematical Biology / 8th European Conference on Mathematical and Theoretical Biology (SMB/ECMTB), Kraków, Poland (mini-symposium under review)

INVITED WORKING GROUPS AND STANDARDS COMMITTEES:

2011 Cell Behavior Ontology Workshop – for development of the Cell Biology Ontology (CBO) and the Cell Biology Modeling Specification Language (CBMSL) – Biocomplexity Institute, Indiana University, Bloomington, IN

CONTRIBUTED AND OTHER TALKS:

1999 Second Annual Regional Workshop in Mathematics and Statistics, University of Nebraska, Lincoln

2005 The Modeling of Cancer Progression and Immunotherapy Workshop, American Institute of Mathematics (AIM), Palo Alto, CA

2007 Mathematical Modelling and Analysis of Cancer Invasion of Tissues Workshop, Dundee, United Kingdom

TECHNICAL AND OTHER SKILLS:

Programming and Software skills:

- C++ and OpenGL/GLUT, with emphasis on scientific and high-performance computing
- Cross-platform/cross-architecture software development
- Open source/collaborative software development
- 2-D and 3-D scientific visualization
- MATLAB, Maple, Mathematica, COMSOL, and other mathematics software
- GIMP, Inkscape, and other open source graphic editing software
- W3C standards-compliant HTML and CSS web authoring
- PHP webpage authoring

Other skills:

- Building and maintaining computers
- Wired and wireless networking and security
- Fluent spoken and written German

- Public speaking skills

REFERENCES:

Available upon request