Curriculum Vitae
Paul Macklin, Ph.D.

Center for Applied Molecular Medicine (CAMM)
Keck School of Medicine
University of Southern California (USC)
Los Angeles, CA USA

Mobile: (available upon request)
email: Paul.Macklin@usc.edu
www: http://MathCancer.org
Twitter: @MathCancer

EDUCATION:

1995–1999 **B.A. in Mathematics and German** (1999)
University of Nebraska, Lincoln (UNL)
Minors: Physics and Economics
Advisors: Profs. J. David Logan and Steven Cohn
Thesis topic: Simulation of contaminant transport in aquifers
highest distinction (summa cum laude), honors program

1999–2000 Graduate study in applied mathematics
University of Nebraska, Lincoln

2000–2003 **M.S. in Industrial and Applied Mathematics** (2003)
University of Minnesota, Twin Cities (UMN)
Advisor: Prof. John S. Lowengrub
Thesis topic: Nonlinear simulation of tumor growth and chemotherapy

2003–2007 **Ph.D. in Computational and Applied Mathematics** (2007)
University of California, Irvine (UCI)
Thesis topic: Ghost fluid/level set methods for computational oncology
Advisor: Prof. John S. Lowengrub
Kovalevsky Outstanding Ph.D. Thesis Award (departmental recognition)

POSTDOCTORAL AND TRAINING POSITIONS:

July 2007 **Postdoctoral student**
University of California, Irvine (UCI)
Mentor: Prof. John S. Lowengrub
Research: Coupling ghost fluid/level set models to discrete angiogenesis models

2007-2010 **Asst. Prof. of Health Informatics** (non-tenure track, training position)
School of Biomedical Informatics (SBMI, formerly School of Health Information Sciences)
University of Texas Health Science Center (UTHSC)
Mentor: Prof. Vittorio Cristini
Research: Calibrating patient-tailored mathematical models to pathology data

POST-Ph.D. POSITIONS:

2011–present **Asst. Prof. of Research Medicine**, Center for Applied Molecular Medicine (CAMM), Keck School of Medicine, University of Southern California (USC), Los Angeles, CA USA

2010–2011 **Lecturer**, Division of Mathematics, University of Dundee, Dundee, Scotland, UK

2007–2010 **Asst. Prof. of Health Informatics** (non-tenure track, training position under Vittorio Cristini), School of Biomedical Informatics (SBMI, formerly School of Health Information Sciences), University of Texas Health Science Center (UTHSC), Houston, TX USA

July 2007 **Postdoctoral Research Assistant** (with J.S. Lowengrub), Dept. of Mathematics, UCI

OTHER APPOINTMENTS and EXPERTISE:

2014–present **Founder and Co-Lead**, MultiCellDS Data Standardization Project (founded and led predecessor project MultiCellXML 2007–2014) **URL:** http://MultiCellDS.org

2013–present **Adjunct Member**, Biomedical Enginering, Viterbi School of Engineering, USC

2012–present **Associate Member**, Translational Oncology, USC Norris Comprehensive Cancer Center

2012–present **Co-Founder and Co-Director** (with Paul Newton), USC Consortium for Integrative Computational Oncology (CICO) (currently in hiatus)
URL: http://CICO.MathCancer.org

2012–2014 **Director of Education and Training Unit**, USC Physical Sciences in Oncology Center (USC PS-OC) **URL:** http://uscpsoc.org

JOURNAL PUBLICATIONS:

1. A. Ghaffarizadeh, S.H. Friedman and **P. Macklin**,*BioFVM: an efficient, parallelized diffusive transport solver for 3-D biological simulations*, Bioinformatics, 2016.
URL: http://dx.doi.org/10.1093/bioinformatics/btv730

2. S.M. Mumenthaler, G. D'Antonio, L. Prezioisi and **P. Macklin**, *The need for integrative computational oncology: An illustrated example through MMP-mediated tissue degradation*, Front. Oncol., 3:194, 2013. **URL:** http://dx.doi.org/10.3389/fonc.2013.00194

3. A. Hyun and **P. Macklin**, *Improved patient-specific calibration for agent-based cancer modeling*, J. Theor. Biol., 317:422-4, 2013. **URL:** http://dx.doi.org/10.1016/j.jtbi.2012.10.017

4. A. D'Antonio, **P. Macklin**, and L. Preziosi, *An agent-based model for elasto-plastic mechanical interactions between cells, basement membrane and extracellular matrix*, Math. Biosci. Eng., 10(1):75-101, 2013. **URL:** http://dx.doi.org/10.3934/mbe.2013.10.75

5. **P. Macklin**, M.E. Edgerton, A.M. Thompson, and V. Cristini, *Patient-calibrated agent-based modelling of ductal carcinoma in situ (DCIS): From microscopic measurements to macroscopic predictions of clinical progression*, J. Theor. Biol., 301:122-40, 2012.
URL: http://dx.doi.org/10.1016/j.jtbi.2012.02.002

6. H. Hatzikirou, A. Chauviere, A.L. Bauer, A. Leier, M.T. Lewis, **P. Macklin**, T. Marquez-Lago, E. Bearer, and V. Cristini. *Integrative Physical Oncology*, WIREs Syst. Biol. Med., 4 (1): 1-14, 2012. **invited author: V. Cristini** **URL:** http://dx.doi.org/10.1002/wsbm.158

7. M.E. Edgerton, Y.-L. Chuang, **P. Macklin**, W. Yang, E.L. Bearer, and V. Cristini. *A novel, patient-specific mathematical pathology approach for assessment of surgical volume: Application to ductal carcinoma in situ of the breast*, Anal. Cell. Pathol., 34 (5): 247-63, 2011.
URL: http://dx.doi.org/10.3233/ACP-2011-0019

8. T.S. Deisboeck, Z. Wang, **P. Macklin**, and V. Cristini, *Multiscale Cancer Modeling*, Annu. Rev. Biomed. Eng., 13: 127-55, 2011. **invited author: T.S. Deisboeck**
URL: http://dx.doi.org/10.1146/ANNUREV-BIOENG-071910-124729

9. J.S. Lowengrub, H.B. Frieboes, F. Jin, Y.-L. Chuang, X. Li, **P. Macklin**, S.M. Wise, and V. Cristini, *Nonlinear modeling of cancer: bridging the gap between cells and tumors*, Nonlinearity, 23 (1): R1-91, 2010. **invited author: J.S. Lowengrub**
URL: http://dx.doi.org/10.1088/0951-7715/23/1/R01

10. **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): 765-98, 2009. **URL:** http://dx.doi.org/10.1007/s00285-008-0216-9

11. **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): 266-99, 2008.
URL: http://dx.doi.org/10.1007/s10915-008-9190-z

12. 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): S59-70, 2007.
URL: http://dx.doi.org/10.1016/j.neuroimage.2007.03.008

13. **P. Macklin** and J.S. Lowengrub, *Nonlinear simulation of the effect of microenvironment on tumor growth*, J. Theor. Biol., 245 (4): 677-704, 2007.**URL:** http://dx.doi.org/10.1016/j.jtbi.2006.12.004

14. **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): 392-401, 2006.
URL: http://dx.doi.org/10.1016/j.jcp.2005.11.016

15. **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): 191-220, 2005.
URL: http://dx.doi.org/10.1016/j.jcp.2004.08.010

JOURNAL PUBLICATIONS in REVIEW:

1. P. Newton, J. West, Z. Hassnain and **P. Macklin**, *An evolutionary model of tumor cell kinetics and the emergence of molecular heterogeneity driving Gompertzian growth*, SIAM Review (2015, in review) **URL:** http://arxiv.org/abs/1512.04590

PUBLISHED ABSTRACTS:

1. J. Benson and **P. Macklin**, *Cell-based modeling of mechanical and chemical stress in tissues during cryoprotocols*, Cryobiology 71(1): 176, Abstract 43, 2015.
URL: http://dx.doi.org/10.1016/j.cryobiol.2015.05.049

2. 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*, Proc. Am. Assoc. Cancer Res. (AACR), Abstract 2444, 2009.
URL: http://cancerres.aacrjournals.org/content/69/9_Supplement/2444.abstract

3. M.E. Edgerton, Y.-L. Chuang, **P.T. Macklin**, J. Kim, G. Tomaiuolo, A.D. Broom, S. Sanga, and V. Cristini, *Simulations of growth of DCIS parameterized from IHC*, Modern. Pathol. 22:26A-77A, Abstract 157, 2009.
URL: http://www.nature.com/modpathol/journal/v22/n1s/pdf/modpathol2008210a.pdf

4. M.D. Edgerton, Y. Chuang, **P.T. Macklin**, S. Sanga, J. Kim, G. Tamaiuolo, W. Yang, A. Broom, K. Do, and V.Cristini, *Using mathematical models to understand the time dependence of the growth of ductal carcinoma in situ*, Cancer Res. 69(2 Suppl.), Abstract 1165, 2009.
URL: http://cancerres.aacrjournals.org/content/69/2_Supplement/1165

BOOK CHAPTERS:

1. J. Poleszczuk, **P. Macklin**, and H. Enderling. "Agent-based modeling of cancer stem cell driven solid tumor growth." In: K. Turksen (editor), *Stem Cell Dynamics and Heterogeneity: Methods and Protocols*, Springer, 2016. (in press) **invited author: H. Enderling**
URL: http://dx.doi.org/10.1101/035162

2. **P. Macklin**, S. Mumenthaler, and J.S. Lowengrub, "Modeling the impact of multiscale necrotic and calcified tissue biomechanics on cancer: application to ductal carcinoma in situ (DCIS)." In A. Gefen (editor), *Multiscale Computer Modeling in Biomechanics and Biomedical Engineering*, Springer, chap. 13, pp. 349–80, Berlin, Germany, 2013. ISBN: 9783642364815.
invited author: P. Macklin **URL:** http://dx.doi.org/10.1007/8415_2012_150

3. **P. Macklin** and M.E. Edgerton, "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, chap. 10, pp. 206–234, Cambridge, United Kingdom, 2010. ISBN: 978-0-521-88442-6. **invited author: P. Macklin**
URL: http://dx.doi.org/10.1017/CBO9780511781452.011

4. **P. Macklin** and M.E. Edgerton, "Discrete cell modeling." In V. Cristini and J.S. Lowengrub, *Multiscale Modeling of Cancer: An Integrated Experimental and Mathematical Modeling Approach*, Cambridge University Press, chap. 6, pp. 88–122, Cambridge, United Kingdom, 2010. ISBN: 978-0-521-88442-6. **invited author: P. Macklin**
URL: http://dx.doi.org/10.1017/CBO9780511781452.007

5. **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, chap. 2, pp. 8-23, Cambridge, United Kingdom, 2010. ISBN: 978-0-521-88442-6.
invited author: P. Macklin **URL:** http://dx.doi.org/10.1017/CBO9780511781452.003

6. **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: Issues and Applications in Oncology*, chap. 4, pp. 77-112. Springer, New York, NY, 2009. ISBN: 978-1-4419-0810-0. **invited author: P. Macklin**
URL: http://dx.doi.org/10.1007/978-1-4419-0811-7_4

7. 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*, chap. 6, pp. 113-82. Birkhäuser, Boston, 2008. ISBN 978-0-8176-4712-4. **invited author: V. Cristini**
URL: http://dx.doi.org/10.1007/978-0-8176-4713-1_6

OTHER PUBLICATIONS:

1. S.H. Friedman, A. Ghaffarizadeh, and **P. Macklin**, "Simulating multi-substrate diffusive transport in 3-D tissues with BioFVM." In: *NCI Handbook of Mathematical Methods in Cancer*, 2015. DOI: 10.1101/035709. **URL:** http://dx.doi.org/10.1101/035709

2. E.F. Juarez Rosales, A. Ghaffarizadeh, S.H. Friedman, E. Jonckheere and **P. Macklin**, "Estimating cell cycle model parameters using systems identification." In: *NCI Handbook of Mathematical Methods in Cancer*, 2015. DOI: 10.1101/035766. **URL:** http://biorxiv.org/content/early/2015/12/31/035766

3. A. Ghaffarizadeh, S.H. Friedman and **P. Macklin**, "Agent-based simulation of large tumors in 3-D microenvironments." In: *NCI Handbook of Mathematical Methods in Cancer*, 2015. DOI: 10.1101/035733. **URL:** http://dx.doi.org/10.1101/035733

DISSERTATION AND THESES:

1. 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).
Download: http://www.MathCancer.org/publications/Macklin_PhD_Dissertation_2007.pdf

2. P. Macklin, *Nonlinear Simulation of Tumor Growth and Chemotherapy*, M.S. Thesis, University of Minnesota School of Mathematics (2003).
Download: http://www.MathCancer.org/publications/Macklin_MS_Thesis_2003.pdf

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

INVITED AND CONTRIBUTED TALKS:

2015 (7 total)

2015 "Connecting Experiments, Data Standards, and 3-D Simulations for Multicellular Systems Biology." Department of Biomathematics *Research Frontiers in Biomathematics* seminar series. University of California-Los Angeles (UCLA). Los Angeles, CA USA. Nov. 19, 2015.

2015 "Results and new directions for quantitative modeling in breast cancer." Breast Cancer Clinical Research Committee, USC Norris Comprehensive Cancer Center / Keck School of Medicine. Los Angeles, CA USA. Oct. 21, 2015.

2015 **Plenary talk:** "Barriers to advancement: Defining the challenges." Investigative Workshop: Many-cell System Modeling. National Institute for Mathematical and Biological Synthesis (NIMBioS), University of Tennessee. Knoxville, TN USA. July 8, 2015. **YouTube:** click here

2015 "Parallelized 3-D simulations of tumor-stroma interactions for the desktop." Annual Meeting for the Society of Mathematical Biology (SMB), Mini-symposium D3: Modeling Cell-Stroma Interactions in Health, Disease and Treatment, Atlanta, GA USA. June 30, 2015.

2015 "Integrating high-throughput data, digital cell lines, and compatible multicellular simulation and analysis software to model cancer." Annual Meeting for the Society of Mathematical Biology (SMB), Mini-symposium B2: Key Challenges for Open and Reproducible Computational Biology, Atlanta, GA USA. June 30, 2015.

2015 **Plenary talk:** "New open source tools for simulating large 3-D multicellular systems on the desktop." Emphasis Workshop: Stem Cells, Development and Cancer. Mathematical Biosciences Institute (MBI), University of Ohio. Columbus, OH USA. Apr. 14, 2015.

2015 "Scalable 3-D Agent-Based Simulations of Cells and Tissues in Biology and Cancer", Institute of Scientific Computing Research seminar, Lawrence Livermore National Lab, Lawrence, CA USA. Feb. 13, 2015.

2014 (7 total)

2014 **Plenary talk:** "Digital cell lines and MultiCellDS: Standardizing cell phenotype data for data-driven cancer simulations." COMBINE (Computational Modeling in Biology Network) 2014 Symposium, University of Southern California. Los Angeles, CA USA. Aug. 18, 2014.

2014 "Simulating 3-D systems of 500k cells with an agent model and digital cell lines", Department of Biostatistics seminar, University of Southern California, Los Angeles, CA USA. June 19, 2014.

2014 "Advances in parallelized 3-D agent-based cancer modeling and digital cell lines", Wolfson Centre for Mathematical Biology, University of Oxford, May 13, 2014.

2014 **Plenary talk:** "Calibrating breast cancer simulations with patient pathology: Progress and future steps." Sixth IMPAKT Breast Cancer Conference, European Society for Medical Oncology (EMSO). Brussels, Belgium. May 9, 2014.

2014 "3-D agent-based cancer modeling and digital cell lines", Dept. of Mathematics (Lowengrub Research Group), University of California at Irvine. Mar. 21, 2014.

2014 "Thoughts and Progress on Sharing Models and Data, and Other Topics", (Swanson Research Group), Northwestern University, Chicago, IL USA. Feb. 17, 2014.

2014 "Integrating next-generation computational models of cancer progression and outcome." 2014 Annual Meeting of the American Asssociation for the Advancement of Science (AAAS), Session 7093: Unlocking the Power of Big Data by Integrating Physical, Engineering, and Life Sciences (organized by the National Cancer Institute). Chicago, IL. Feb. 16, 2014.

2013 (5 total)

2013 "Progress towards user-friendly, 3-D multiscale agent-based simulators for larger (500k+ cells) cancer systems: application to *in situ* growth and tumor-stroma interactions." Annual Meeting for the Society of Mathematical Biology (SMB), Mini-symposium 11: Agent-based simulations in oncology: applications to therapeutics. Tempe, AZ. June 12, 2013.

2013 "Patient-calibrated 3-D simulations of ductal carcinoma in situ (DCIS) with comedonecrosis and calcification." Annual Meeting for the Society of Mathematical Biology (SMB), Mini-symposium 26: Patient-Specific Modeling of Cancer. Tempe, AZ. June 12, 2013.

2013 **Plenary talk:** "From multiscale data integration to predictions of emergent phenomena: the prognosis for patient-calibrated computational oncology." Mathways into Cancer II international workshop. Carmona, Spain. May 30, 2013.

2013 **Plenary talk:** "Exploring possibilities for next-generation computational cancer models that work together (a conversation starter)." Fourth Annual National Cancer Institute Physical Sciences-Oncology Center (NCI PS-OCs) Network Investigators' Meeting, Phoenix, AZ. Apr. 19, 2013.

2013 "From integration of multiscale data to emergent phenomena: the prognosis for patient-calibrated computational oncology." Department of Mathematics, Duke University, Durham, NC USA. Mar. 22, 2013.

2012 (7 total)

2012 "Progress, challenges, and opportunities in 3-D patient-calibrated computational modeling of cancer." Department of Aerospace and Mechanical Engineering seminar, University of Southern California, Los Angeles, CA USA. Nov. 28, 2012.

2012 "The emerging role of patient-calibrated computational modeling in cancer research: Progress, challenges, and opportunities", Department of Biomedical Engineering seminar, University of Southern California, Los Angeles, CA USA. Oct. 15, 2012.

2012 "Impact of improved intracellular fluid and calcification dynamics on patient-calibrated simulation of DCIS and comedonecrosis", Society for Industrial and Applied Mathematics (SIAM) Conference on the Life Sciences 2012, Mini-symposium 18: Mathematical Methods in Oncology: from Prognostic Screening to Therapeutic Treatment - Part I of II, San Diego, CA USA. Aug. 8, 2012.

2012 "Integration of pathology, radiology, and in vitro data in patient-calibrated cancer simulations: Recent advances and future outlook for ductal carcinoma in situ (DCIS)", Annual Meeting for the Society of Mathematical Biology (SMB), Mini-symposium 12: Bridging mathematical models and experiments, Knoxville, TN USA. Jul. 25, 2012.

2012 "(Agent-based) models to integrate and simulate complex cancer data: A conversation starter", Joint ASU/USC Meeting on Complex Adaptive Systems (CAS): Leveraging Advances in the CAS Sciences to Understand and Control Complex Diseases such as Cancer, Arizona State University (ASU) Complex Adaptive Systems Initiative (CASI) and University of Southern California Physical Sciences-Oncology Center (USC-PSOC), Scottsdale, Arizona

2012 "The emerging role of patient-calibrated computational modeling in cancer research: A case study in ductal carcinoma in situ (DCIS)", University of Southern California Physical Sciences-Oncology Center (USC-PSOC) Seminar Series, University of Southern California, Los Angeles

2012 "Patient-calibrated simulation of ductal carcinoma in situ (DCIS): a small step from the blackboard towards the bedside", Center for Applied Mathematical Sciences, University of Southern California, Los Angeles

2011 (10 total)

2011 "Patient-calibrated simulation of ductal carcinoma in situ (DCIS)", Aerospace and Mechanical Engineering (Newton Research Group), University of Southern California, Los Angeles

2011 "Patient-calibrated simulation of ductal carcinoma in situ (DCIS): a small step from the blackboard towards the bedside", Applied and Computational Mathematics Seminar, University of California, Irvine

2011 "Blackboard to Bedside in DCIS: Advancing mathematical models towards patient-tailored clinical application; a physics-based approach to generating new biological and clinical hypotheses", University of Southern California Physical Sciences-Oncology Center (USC-PSOC) Short Course on Multidisciplinary Cancer Modeling, Los Angeles

2011 "Patient-calibrated agent-based cancer modeling: emergent properties, clinical significance, and open problems", Computer Science Dept. (TEAMCORE / Tambe Research Group), University of Southern California, Los Angeles

2011 *"An illustration of patient-specific cancer modeling: from microscopic data to macroscopic, quantitative predictions"*, 8th European Conference on Mathematical and Theoretical Biology / Annual Meeting of the Society for Mathematical Biology (ECMTB/SMB), Mini-symposium 9: Multiscale modeling of biological systems: From Physical Tools to Applications in Tumor Growth Modeling–I, Kraków, Poland.

2011 *"Mechanistic cell-scale modelling of ductal carcinoma in situ (DCIS): impact of cell biomechanics"*, 8th European Conference on Mathematical and Theoretical Biology / Annual Meeting of the Society for Mathematical Biology (ECMTB/SMB), Mini-symposium 74: Mechanical Models of Movement and Growth of Cells and Tissues–I, Kraków, Poland.

2011 **Plenary talk:** "Patient-calibrated modeling of ductal carcinoma in situ (DCIS): From microscopic measurements to macroscopic predictions of clinical progression." Second Annual National Cancer Institute Physical Sciences-Oncology Center (NCI PS-OCs) Network Investigators' Meeting, La Jolla, CA. Apr. 11, 2011.

2011 *"Patient-Calibrated Cancer Modeling: Current progress, and next steps to model-augmented clinical planning"*, Center for Applied Molecular Medicine, University of Southern California

2011 *"Agent-based modelling of ductal carcinoma in situ (DCIS): patient-calibrated simulation results"*, College of Life Sciences (Nathke Research Group), University of Dundee, UK. Feb. 10, 2011.

2011 *"Agent-Based Modelling of Ductal Carcinoma in Situ (DCIS)"*, Cell Behavior Ontology Workshop IV, Biocomplexity Institute, Indiana University, Bloomington, IN. Feb. 8, 2011.

2010 (6 total)

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

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 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: 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 *"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 *"Cancer biology for modellers"*, Mathematical Modelling of Cancer Growth and Treatment Summer School and Workshop, University of Dundee, United Kingdom (invited lecturer)

2009 (1 total)

2009 *"Towards patient-tailored, predictive cancer modeling: Discrete and continuum multiscale modeling and early results"*, Division of Mathematics, Dundee University

2008 (2 total)

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

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

2007 (3 total)

2007 *"An (*incomplete*) progression of mathematical cancer biology: From early continuum modeling to integrative modeling"*, Mathematics Department Colloquium, University of Nebraska, Lincoln

2007 *"Nonlinear simulation of centimeter-scale tumor growth into complex tissues"*, Mathematical Biology Seminar, University of Nebraska, Lincoln

2007 Mathematical Modelling and Analysis of Cancer Invasion of Tissues Workshop, Dundee, United Kingdom (contributed talk)

1999–2006 (4 total)

2006 *"Computational oncology: an introduction to cancer, with simulations and cool results"*, Mathematics Graduate Student Colloquium, University of California, Irvine

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

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

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

SELECTED HONORS:

2013 Work featured on front cover of *Notices of the American Mathematical Society* (March 2013 issue)
2009 UTHSC John P. McGovern Award for Outstanding Teaching
2007 UCI Department of Mathematics Kovalevsky Outstanding Ph.D. Thesis Award
2007 UCI School of Physical Sciences "Outstanding Contributions to the Dept. 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 Graduate Assistance in Areas of National Need (GAANN) 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

SELECTED SERVICE AND OPEN SOURCE WORK:

1. Developed PhysiCell: a physics-based, 3-D agent-based cell simulator, parallelized with OpenMP. Design goals include simulation of 10^6 or more cells on desktop computers and single supercomputer nodes. Recent testing exceeds the design goal with over 5×10^6 cells simulated on desktop workstations. Method paper and open source release in preparation for early 2016 submission.
   http://PhysiCell.MathCancer.org (2015–present)

2. Developed BioFVM: a 3-D diffusive transport solver for biological problems, parallelized with OpenMP. Design goals include simulation of 5-10 diffusing substrates in at least 1 million voxels on desktop computers and single supercomputer nodes. Recent testing exceeds the design goal with up to 128 diffusive substrates on 10 million or more voxels simulated feasibly on desktop workstations. Recently published in *Bioinformatics* and released in December 2015.
   http://BioFVM.MathCancer.org (2015–present)

3. Founded and led MultiCellDS project, a multidisciplinary effort to develop: a standard for multicellular simulation, experimental, and clinical data; a repository of *digital cell lines* and *digital tissues*; and open source tools for standardized data. Release planned in 2016.
   http://MultiCellDS.org (2014–present)

4. Developed and maintained the MultiCellXML project, an open XML-based data format for multicell agent-based simulations, with open source code samples. Project succeeded by MultiCellDS.
   http://multicellxml.sourceforge.net (2007–2014)

5. Developed and Maintained EasyBMP, an open source, cross-platform C++ bitmap (BMP) image library for industrial, educational, and academic use - 99,917 downloads since inception
   http://easybmp.sourceforge.net (2005–present)

6. Developed and Maintained Easy BMP to AVI Movie Creator, an open source, cross-platform tool for converting images to movies, primarily for scientific visualization - 32,212 downloads since inception
   http://easybmptoavi.sourceforge.net (2006–present)

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

RECENT TEACHING:

University of Southern California (2011–present)

Fall 2013 Organized and led the 2013 **Convergence of the Sciences in Biology and Medicine** short course for the USC Physical Sciences in Oncology Center, for a mixed audience of medical, biology, and engineering students and faculty. Gave demonstration on (1) multiscale computational modeling and (2) integration of computational modeling of high-content screening data. **URL:** http://uscpsoc.org/ShortCourse/

Fall 2011 Gave lectures on multiscale mathematical modeling in cancer for multidisciplinary audience at the USC PS-OC 2011 Short Course on physical sciences in cancer.

University of Dundee (2010–2011)

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

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 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

GRANTS:

2015 Co-PI (15% effort) for *Developing a quantitative pathologic image analysis platform to stratify breast cancer patients.* (PI David B. Agus) Breast Cancer Research Foundation. Oct. 2015–Oct. 2016 (total: $247,701)

2014 Co-PI (20% effort) for *Application of breast cancer data element standardization in predictive multiscale cancer models.* (PI David B. Agus) Breast Cancer Research Foundation. Oct. 2014–Oct. 2015 (total: $250,000)

2013 Co-PI (20% effort) for *A Multiscale Dynamical Computational Platform for Clinical Breast Cancer Predictions.* (PI David B. Agus) Breast Cancer Research Foundation. Oct. 2013–Oct. 2014 (total: $239,486)

2013 Co-I (15% effort) for *(PQB6)An Integrative Computational and Bioengineered Tissue Model of Metastasis.* (PI David B. Agus/Anthony Atala/Shay Soker) NIH:NCI. 1 Sep. 2013–31 Jul. 2017 (total: $2,302,955)

2013 PI (0% salary; support for 3 undergraduates) for *Developing user-friendly, modular multiscale cancer models.* USC Undergraduate Research Associates Program (URAP). July 2013-July 2014 ($6400)

2012 Co-PI (5% effort) for *Establishing The Center for Integrative Computational Oncology (CICO) at VSOE/KSOM.* (Co-PIs P. Macklin and P. Newton) USC James H. Zumberge Research And Innovation Fund, Multi-School Interdisciplinary Award. Sept. 2012–Sept. 2013 (total: $50,000)

2012 PI (0% salary; support for 2 undergraduates) for *Validating a patient-calibrated breast cancer simulator.* USC Undergraduate Research Associates Program (URAP). July 2012-July 2013 ($6600)

2008 Co-I (100% effort) 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 (total: $1.5 million)

2009 Co-I (10% effort in Y1; 15% effort in Y3-5) 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% effort) 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% effort) fo *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)

1999 PI/Fellow (stipend and educational costs) for *National Science Foundation Gradute Research Fellowship Program* (NSF GFRP), 1999-2000; 2001-2003. (total: $76,500)

TRAINEES: M.S. / MSc level and above:

Rishi Rawat — **M.D./Ph.D. student**, Keck School of Medicine, USC (in progress).
Research: Agent-based simulations of prostate and breast glands (10-week rotation)
Role: research mentor (2016–present).

Colleen Garvey — **Ph.D. student** in Biology, USC (in progress).
Research: High-content screening of lung cancer cells for use in computational modeling.
Role: Committee member (advisor: Shannon Mumenthaler) (2015–present).

William Matloff — **M.D./Ph.D. student**, Keck School of Medicine, USC (in progress).
Research: Agent-based simulations of angiogenesis and liver regeneration.
Role: research mentor (2015–present).

Ahmadreza Ghaffarizadeh — **Postdoctoral student**, Center for Applied Molecular Medicine, USC.
Research: agent-based models, image processing, and simulation of colon cancer metastases in bioengineered livers.
Role: Mentor (2014–present).

Samuel Friedman — **Postdoctoral student**, Center for Applied Molecular Medicine, USC.
Research: agent-based models, MultiCellDS, digital cell lines, and related tools.
Role: Mentor (2013–present).

Edwin Juarez	**Ph.D. candidate** in Electrical Engineering, USC (in progress). **Research:** parameter identification and control theory in cancer. **Role:** Co-advisor (with Edmond Jonckheere) (2012–present).
Brian Hurt	**Ph.D. studies** in Aerospace and Mechanical Engineering, USC (left for private industry in 2013). **Research:** mathematical modeling of cancer. **Role:** Co-advisor (with Paul Newton).
Jeffrey West	**Ph.D.** in Aerospace and Mechanical Engineering, USC (in progress). **Research:** Markovian and related models of cancer initiation and dissemination. **Role:** Committee member (advisor: Paul Newton) (2013–present).
Angela Lee	**Ph.D.** in Aerospace and Mechanical Engineering, USC (2013). **Research:** Simulations of cancer cell deformation in flow. **Role:** Committee member (advisor: Paul Newton)
Jeremy Mason	**Ph.D.** in Aerospace and Mechanical Engineering, USC (2013). **Research:** Parameter identification for a Markov model of cancer metastatic dissemination. **Role:** committee member (advisor: Paul Newton)
Lydia Hill	**Ph.D.** in Mathematics, University of Dundee (2011). **Research:** Pharmacodynamics in cancer cells. **Role:** Internal examiner (advisor: Mark Chaplain)
Sandeep Sanga	**Ph.D.** in Biomedical Engineering, University of Texas at Austin (2009). **Research:** Multiscale modeling of cancer cell motility, and breast cancer dataset normalization. **Role:** committee member (advisor: Vittorio Cristini)
Jahun Kim	**Ph.D. studies**, University of Texas Health Science Center (discontinued studies). **Research:** Agent-based simulations of ductal carcinoma in situ. **Role:** committee member (advisor: Vittorio Cristini)
Giovanna Tomaiuolo	**Ph.D.** in Biomedical Engineering, University of Naples (2008). **Research:** Image processing-based feature extraction from breast cancer pathology data. **Role:** summer mentor

TRAINEES: Selected undergraduates:

Brian Shaw	**Undergraduate intern** (Viterbi School of Engineering, USC) cross-disciplinary development of user-friendly multiscale 3-D cancer simulators, Jul. 2013-present (funded by URAP) - supervisor/mentor
Demi Nguyen	**Undergraduate intern** (Dornsife College of Letters, Arts & Sciences, USC) cross-disciplinary development of user-friendly multiscale 3-D cancer simulators, Jul. 2013-May 2014 (funded by URAP) - supervisor/mentor

Kelsi Chesney	**Undergraduate intern** (Dornsife College of Letters, Arts & Sciences, USC) cross-disciplinary development of user-friendly multiscale 3-D cancer simulators, Jul. 2013-May 2014 (funded by URAP) - supervisor/mentor
Kellie Spector	**Undergraduate intern** (Dornsife College of Letters, Arts & Sciences, USC) for multidisciplinary modeling of lymphoma, Sep. 2012-May 2013 - supervisor/mentor
Margy Gunnar	**Undergraduate intern** (Dornsife College of Letters, Arts & Sciences, USC) for patient-calibrated DCIS project, University of Southern California, Sep. 2012-May 2013 (funded by URAP program) - supervisor/mentor
Alice Hyun	**Undergraduate intern** (Viterbi School of Engineerin, USC) for patient-calibrated DCIS project, University of Southern California, June 2012-May 2013 (funded by URAP program) - supervisor/mentor
Jasmine McAllister	**Undergraduate researcher** (Dornsife College of Letters, Arts & Sciences, USC) in breast cancer pathology modeling project, University of Southern California, May 2012-May 2014 - mentor
Gregor Omelasz	**BSc senior dissertation** in Mathematics (2011) - University of Dundee, Scotland - undergraduate dissertation supervisor
Lisa Mordente	**BSc senior dissertation** in Mathematics (2011) - University of Dundee, Scotland - undergraduate dissertation supervisor
Deepa Raghunathan	**Summer intern** - MD Anderson Cancer Center - 2008 - summer mentor *2008 STEP-UP Clinical and Research Internship Award for Research Excellence*