

Leonard A. Harris

Department of Cancer Biology
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EDUCATION

Ph.D. Chemical Engineering, *February 2010*

Cornell University, Ithaca, NY

“Multiscale Simulation of Reaction Dynamics in Chemical, Biological, and Materials Systems”

Paulette Clancy, Advisor

B.S. Chemical Engineering, *December 1998*

University of Colorado, Boulder, CO

AWARDS

National Library of Medicine Biomedical Informatics Postdoctoral Fellowship: 2015

Semiconductor Research Corporation Graduate Fellowship: 2001–2007

Edna O. and William C. Hoey Prize, *Outstanding performance in PhD research*, Cornell University, 2005

Lawrence Livermore Computational Chemistry and Materials Science Summer Institute: 2001

Post Fellowship, Cornell University: 2000–2001

Golden Key National Honor Society

Omega Chi Epsilon - Chemical Engineering Honor Society

Colorado Venture Centers Summer 1998 Scientific Internship

Newmont Gold Company Academic Scholarship: 1994–1998

COMPUTER SKILLS

Fortran, C/C++, Java, Perl, Python.

Git, SVN, Eclipse, Linux, Matlab, LaTeX.

RESEARCH EXPERIENCE

Vanderbilt University School of Medicine, Dept. of Cancer Biology (Nashville, TN)

Research Fellow, 2014–2015; Research Fellow Trainee, 2015–*present* (Carlos F. Lopez & Vito Quaranta, Advisors)

Modeling of cell population dynamics to interpret experimental time-lapse imaging data of cancer cell populations treated with targeted drugs. Current projects include studying the dynamics of mutant-EGFR non-small cell lung cancer cell lines in response to the tyrosine-kinase inhibitor erlotinib and BRAF-mutated melanoma cell lines in response to the small-molecule inhibitor vemurafenib. Also one of the primary developers of PySB, a Python-based modeling and simulation platform. Current work focuses both on implementing and interfacing with computational tools for facilitating model analysis. Examples include a variance-based sensitivity analysis toolkit, a GPU-based ordinary differential equation solver (cupSODA), a non-spatial stochastic simulation suite (StochKit), and spatial deterministic (FiPy) and stochastic (PyURDME) solvers.

University of Pittsburgh School of Medicine, Dept. of Computational and Systems Biology (Pittsburgh, PA)

Postdoctoral Associate, 2008–2012; Visiting Research Associate, 2013 (James R. Faeder, Advisor)

One of the primary developers of the BioNetGen modeling and simulation software package. Developed and implemented a variety of multiscale and accelerated-stochastic simulation approaches for rule-based models of biochemical systems with combinatorial complexity. Methods include a Runge-Kutta extension of

the partitioned-leaping algorithm (a tau-leaping derivative), an exact hybrid particle/population simulation approach, and a modular/multiscale/multi-algorithmic simulation environment for handling systems with extreme timescale disparities. Also oversaw the continued development of the RuleBender graphical user interface for BioNetGen and contributed to the SBML Level 3 Multistate and Multicomponent Species (“multi”) package specification. Additional work focused on translating Boolean logical models into chemical kinetic models encoded in the rule-based framework, an important step for generating predictive mechanistic models from experimental biochemical data.

Cornell University, School of Chemical and Biomolecular Engineering (Ithaca, NY)

Graduate Research Assistant, 2000–2001, 2003–2008 (Paulette Clancy, Advisor)

Computer simulation research using a variety of computational methods, including *ab initio*, semi-empirical and kinetic Monte Carlo. Topics of study included *ab initio* and semi-empirical molecular dynamics investigations of defect dynamics in Si, kMC studies of defect clustering in Si, and kMC investigations of droplet coalescence in clouds. Dissertation work focused on the development of a novel multiscale simulation approach for accelerating stochastic simulations of chemical reaction networks. Applications included models of calcium oscillations, circadian rhythms, synthetic gene regulatory networks, NF- κ B–I κ B signaling, and bacterial chemotaxis.

Lawrence Livermore National Laboratory (Livermore, CA)

Computational Chemistry and Materials Science Summer Institute, Summer 2001;

Graduate Student Researcher (*Computational Systems Biology*), 2002, Summer 2003

(Andrew A. Quong, Advisor)

Density functional investigations of water adsorption on the (110) surface of rutile TiO₂ and preliminary work on multiscale simulation methods for studying stochasticity in chemical reaction networks.

Eltron Research Inc. (Boulder, CO)

Laboratory Technician, 1999

Experimental investigation of H₂S extraction from natural gas and conversion to elemental sulfur using novel ceramic membranes.

Univera Pharmaceuticals Inc. (Broomfield, CO)

Laboratory Intern, Summer 1998

Process development research for skin bleaching compound UP504. Work involved optimization of the chemical reaction producing UP504 as well as processes for isolating the compound from the reaction mixture. (Sponsored by Colorado Venture Centers)

Newmont Technical Services (Englewood, CO)

Laboratory Intern, Summer 1997

General laboratory work.

Resource Development Inc. (Wheatridge, CO)

Laboratory Intern, Summer 1996

General laboratory work.

TEACHING EXPERIENCE

Tutorials

- *Cell Dynamics and Models*, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, **March 2015**:
 - “Rule-Based Modeling with BioNetGen and RuleBender” (*joint with Prof. James Faeder, Jose Juan Tapia, and John Sekar*).
 - “Kinetic Modeling of Complex Systems in Systems Biology using PySB” (*joint with James Pino*).
- *The Eighth q-bio Summer School*, Albuquerque, NM, “Mechanistic Modeling of Complex Systems in Systems Biology,” **August 2014**.

- *Computational Cell Biology Summer School*, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, “Introduction to systems biology and rule-based modeling,” **August 2012 & 2013**.

Guest Lecturer

- BMIF 310: *Foundations of Bioinformatics*, C.F. Lopez (Ins.), Vanderbilt University, **Fall 2015**.
- CCANB347: *Cancer Systems Biology*, Course Director: Prof. Lourdes Estrada, Vanderbilt University, **Spring 2015**.
 - “Heterogeneity: Stochasticity in Biology” (*joint with Prof. Darren Tyson*).
 - “Mechanistic Modeling of Signaling Networks.”
- BMIF 310: *Foundations of Bioinformatics*, D.L. Tabb and C.F. Lopez (Ins.), Vanderbilt University, **Fall 2014**.
- PITT MSCMP 3780: *A Systems Approach to Inflammation*, Y. Vodovotz and G. Clermont (Ins.), University of Pittsburgh, **Fall 2013**.
- Drug Discovery, Systems and Computational Biology (DiSCoBio) University of Pittsburgh Cancer Institute Summer Academy: *Introduction to Systems Biology*, **Summer 2013**.
- Computational and Systems Biology/Biomedical Informatics (CoSBBI) Summer Academy: *Introduction to Systems Biology (joint with N. Miskov-Zivanov)*, **Summer 2012**.
- Training and Experimentation in Computational Biology (TECBio) REU @ Pitt: *Cellular/Systems Modeling and Dynamics (joint with N. Miskov-Zivanov)*, **Summers 2011–2013**.
- CMU 02-730 & PITT CMPBIO/MSCBIO 2040: *Cell and Systems Modeling*, J.R. Faeder and C.J. Langmead (Ins.), Joint CMU-Pitt Ph.D. Program in Computational Biology, **Springs 2010, 2012**.
- CMU 18-669: *Computing and Biology*, N. Miskov-Zivanov (Ins.), Carnegie Mellon University, **Fall 2010, Spring 2012**.
- CMU 15-872A: *Formal Methods in Systems Biology*, J.R. Faeder and C.J. Langmead (Ins.), Joint CMU-Pitt Ph.D. Program in Computational Biology, **Spring 2008**.
- CHEME 713: *Chemical Kinetics and Dynamics*, F.A. Escobedo (Ins.), Cornell University, **Spring 2003**.

Teacher’s Assistant

- CHEME 713: *Chemical Kinetics and Dynamics*, F.A. Escobedo (Ins.), Cornell University, **Spring 2003**.
 CHEME 313: *Chemical Engineering Thermodynamics*, F.A. Escobedo (Ins.), Cornell University, **Fall 2001**.
 CHEME 332: *Analysis of Separation Processes*, P. Clancy (Ins.), Cornell University, **Spring 2000**.
 CHEN 3210: *Chemical Engineering Principles 2*, R.D. Noble (Ins.), University of Colorado, **Fall 1998**.

Graduate student mentor to four undergraduate students at Cornell University from 2000–2008.

Postdoctoral mentor:

University of Pittsburgh (2010–2013): Mentored three summer REU students, one foreign visiting undergraduate student, and two Pitt undergraduate researchers.

Vanderbilt University (2014–*present*): Mentored one summer REU student, one rotation student, and one foreign visiting graduate student.

PUBLICATIONS

L.A. Harris, J.S. Hogg, J.J. Tapia, J.A.P. Sekar, S. Gupta, I. Korsunsky, A. Arora, D. Barua, R.P. Sheehan and J.R. Faeder, “BioNetGen 2.2: Advances in Rule-Based Modeling,” *Bioinformatics* (*in revision*).

L.A. Harris*, J.C. Pino*, M.S. Nobile*, A.L.R. Lubbock, D. Besozzi, G. Mauri, P. Cazzaniga and C.L. Lopez, “GPU-powered model analysis with PySB/cupSODA,” (*in preparation*). (**equal authors*)

L.A. Harris*, P.L. Frick*, S.P. Garbett, K.N. Hardeman, B.B. Paudel, C.F. Lopez, V. Quaranta, and D. Tyson, “An unbiased metric of antiproliferative drug effect *in vitro*,” *Nat. Methods*, **13**, 497–500 (2016). (**equal authors*)

L.A. Chylek, **L.A. Harris**, J.R. Faeder and W.S. Hlavacek, "Modeling for (physical) biologists: an introduction to the rule-based approach," *Phys. Biol.*, **12**, 045007 (2015).

J.E. Wenskovitch Jr. **L.A. Harris**, J.J. Tapia, J.R. Faeder and G.E. Marai, "MOSBIE: a tool for comparison and analysis of rule-based biochemical models," *BMC Bioinformatics* **15**, 316 (2014).

J.S. Hogg*, **L.A. Harris***, L.J. Stover, N.S. Nair and J.R. Faeder, "Exact hybrid particle/population simulation of rule-based models of biochemical systems," *PLoS Comput. Biol.* **10**, e1003544 (2014). (**equal authors*)

L.A. Chylek, **L.A. Harris**, C.-S. Tung, J.R. Faeder, C.F. Lopez and W.S. Hlavacek, "Rule-based modeling: a computational approach for studying biomolecular site dynamics in cell signaling systems," *WIREs Syst. Biol. Med.* **6**, 13-36 (2014).

K.A. Iyengar, **L.A. Harris** and P. Clancy, "Accurate implementation of leaping in space: The spatial partitioned-leaping algorithm," *J. Chem. Phys.* **132**, 094101 (2010).

L.A. Harris*, J.S. Hogg* and J.R. Faeder, "Compartmental rule-based modeling of biochemical systems," *Proceedings of the 2009 Winter Simulation Conference*, M.D. Rossetti, R.R. Hill, B. Johansson, A. Dunkin, and R.G. Ingalls, eds., pp. 908-919 (2009). (**equal authors*)

L.A. Harris, A.M. Piccirilli, E.R. Majusiak and P. Clancy, "Quantifying stochastic effects in biochemical reaction networks using partitioned leaping," *Phys. Rev. E* **79**, 051906 (2009).

E.M. Clarke, J.R. Faeder, C.J. Langmead, **L.A. Harris**, S.K. Jha and A. Legay, "Statistical Model Checking in *BioLab*: Applications to the Automated Analysis of T-Cell Receptor Signaling Pathway," *Lect. Notes Comput. Sci.* **5307**, 231-250 (2008).

L.A. Harris and P. Clancy, "A 'partitioned leaping' approach for multiscale modeling of chemical reaction dynamics," *J. Chem. Phys.* **125**, 144107 (2006).

L.A. Harris and A.A. Quong, "Molecular Chemisorption as the Theoretically Preferred Pathway for Water Adsorption on Ideal Rutile TiO₂(110)," *Phys. Rev. Lett.* **93**, 086105 (2004); **95**, 029602 (2005) (reply).

PRESENTATIONS

"An unbiased metric of antiproliferative drug effect *in vitro*," [LA Harris](#), *Department of Biomedical Informatics Research Forum*, Vanderbilt University School of Medicine, Nashville, TN, May 17, 2016.

"An unbiased metric of antiproliferative drug effect *in vitro*," [LA Harris](#), *Advancing Personalized Medicine using Structural Biophysics and Protein Dynamics*, Meharry Medical College, Nashville, TN, April 29, 2016.

"An unbiased metric of antiproliferative drug effect *in vitro*," [LA Harris](#), *Cancer Biology Science Hour*, Vanderbilt University School of Medicine, Nashville, TN, September 30, 2015.

"Heterogeneity, stochasticity, and the drug-sensitive phenotype of oncogene-addicted cancer cells," [LA Harris](#), *Integrative Cancer Biology Program (ICBP) Principal Investigators Meeting*, National Institutes of Health, Bethesda, MD, May 6, 2015.

"Intrinsic Stochasticity and Heterogeneous Drug Response in Cancer Cell Populations," [LA Harris](#), *Vanderbilt-Ingram Cancer Center Signal Transduction Mini-Retreat*, Vanderbilt University School of Medicine, Nashville, TN, April 13, 2015.

"Intrinsic Stochasticity and Heterogeneous Drug Response in Cancer Cell Populations," [LA Harris](#), *Modeling Cancer: Integrating Scales, Disciplines and Programs* (ICBP/PSOC Annual Meeting), Tampa, FL, February 26-28, 2015 (**selected from poster abstracts*).

"Intrinsic Stochasticity and Heterogeneous Drug Response in Cancer Cell Populations," [LA Harris](#), DR Tyson, V Quaranta and CF Lopez, *Gordon Research Conference on Stochastic Physics in Biology*, Ventura, CA, January 11-16, 2015 (**selected from poster abstracts*).

“Intrinsic stochasticity and heterogeneous drug response in cancer cell populations,” [LA Harris](#), *Cancer Biology Science Hour*, Vanderbilt University School of Medicine, Nashville, TN, December 10, 2014.

“Clonal Heterogeneity vs. Stochastic Cell Fate Decisions in Cancer Response to Targeted Drugs,” [LA Harris](#), DR Tyson, V Quaranta, and CF Lopez, *Particle-Based Stochastic Reaction-Diffusion Models in Biology*, Banff, Alberta, Canada, November 9–14, 2014.

“Exact Hybrid Particle/Population Simulation of Rule-Based Models,” JS Hogg, [LA Harris](#), LJ Stover, NS Nair and JR Faeder, *American Institute of Chemical Engineers Annual Meeting*, Pittsburgh, PA, 2012.

“A Generalized Runge-Kutta Framework for Tau-Leaping,” [LA Harris](#) and JR Faeder, *American Institute of Chemical Engineers Annual Meeting*, Minneapolis, MN, 2011.

“Construction and Simulation of Modular, Multiscale, Multi-Algorithmic Dynamical Models,” [LA Harris](#) and JR Faeder, *American Institute of Chemical Engineers Annual Meeting*, Salt Lake City, UT, 2010.

“Probing the effects of stochasticity in biochemical reaction networks using multiscale simulation,” [LA Harris](#), AM Piccirilli, ER Majusiak and P Clancy, *American Institute of Chemical Engineers Annual Meeting*, Salt Lake City, UT, 2007.

“Multiscale simulation of chemical, biological and materials systems,” [LA Harris](#), *Edna O. and William C. Hooley Award Seminar*, School of Chemical and Biomolecular Engineering, Cornell University, Ithaca, NY, 2005.

“Multiscale Modeling of Self-Interstitial Clustering During Post-Implantation Annealing of Silicon,” [LA Harris](#) and P Clancy, *Semiconductor Research Corporation Graduate Fellowship Program Annual Conference*, San Francisco, CA, 2004.

“Multiscale Modeling of Nonequilibrium Population Dynamics: Seamlessly Integrating the Mesoscopic and Macroscopic Levels of Description,” [LA Harris](#) and P Clancy, *3rd International Conference COMPUTATIONAL MODELING AND SIMULATION OF MATERIALS*, Acireale (CT), Sicily, Italy, 2004.

“Multiscale Modeling of Chemical Reaction Dynamics: Seamlessly Integrating the Mesoscopic and Macroscopic Levels of Description,” [LA Harris](#) and P Clancy, *American Institute of Chemical Engineers Annual Meeting*, San Francisco, CA, 2003.

“Next-Generation Process Simulation: Integrating the Mesoscopic and Macroscopic Levels of Description,” [LA Harris](#) and P Clancy, *Semiconductor Research Corporation TECHCON '03*, Dallas, TX, 2003.

“Density Functional Investigation of H₂O Adsorption on the (110) Surface of Rutile TiO₂,” [LA Harris](#) and AA Quong, *Materials Research Society Fall Meeting*, Boston, MA, 2002.

POSTERS

“An unbiased metric of antiproliferative drug effect *in vitro*,” [LA Harris](#), PL Frick, SP Garbett, KN Harde- man, BB Paudel, V Quaranta, CF Lopez and DR Tyson, *Vanderbilt-Ingram Cancer Center Annual Scientific Retreat*, Vanderbilt University School of Medicine, Nashville, TN, May 6, 2016.

“Intrinsic Stochasticity and Heterogeneous Drug Response in Cancer Cell Populations,” [LA Harris](#), DR Tyson, V Quaranta and CF Lopez, *Vanderbilt-Ingram Cancer Center Annual Scientific Retreat*, Vanderbilt University School of Medicine, Nashville, TN, April 30, 2015.

“Intrinsic Stochasticity and Heterogeneous Drug Response in Cancer Cell Populations,” [LA Harris](#), DR Tyson, V Quaranta and CF Lopez, *2015 Postdoctoral Association and Shared Resources Symposium*, Vanderbilt University School of Medicine, Nashville, TN, April 28, 2015.

“Intrinsic Stochasticity and Heterogeneous Drug Response in Cancer Cell Populations,” [LA Harris](#), DR Tyson, V Quaranta and CF Lopez, *Cell Dynamics and Models*, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, March 3–6, 2015.

“Intrinsic Stochasticity and Heterogeneous Drug Response in Cancer Cell Populations,” [LA Harris](#), DR Tyson, V Quaranta and CF Lopez, *Modeling Cancer: Integrating Scales, Disciplines and Programs* (ICBP/PSOC Annual Meeting), Tampa, FL, February 26-28, 2015.

“Intrinsic Stochasticity and Heterogeneous Drug Response in Cancer Cell Populations,” [LA Harris](#), DR Tyson, V Quaranta and CF Lopez, *Gordon Research Conference on Stochastic Physics in Biology*, Ventura, CA, January 11–16, 2015.

“A Runge-Kutta Framework for Tau Leaping,” [LA Harris](#), LJ Stover, NS Nair and JR Faeder, *The Sixth q-bio Conference on Cellular Information Processing*, St. John’s College, Santa Fe, NM, 2012.

“Multiscale Simulation of Rule-Based Models,” [LA Harris](#) and JR Faeder, *The Second q-bio Conference on Cellular Information Processing*, St. John’s College, Santa Fe, NM, 2008.

“Quantifying Stochasticity in Oscillatory Biochemical Reaction Networks Using Multiscale Simulation,” [LA Harris](#), AM Piccirilli, ER Majusiak and P Clancy, *Computational Cell Biology*, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, 2007.

“Water Adsorption on TiO₂(110): The Importance of Coupling Modeling and Experimental Efforts and Computational Pitfalls That Can Confuse the Situation,” [LA Harris](#) and AA Quong, *3rd International Conference COMPUTATIONAL MODELING AND SIMULATION OF MATERIALS*, Acireale (CT), Sicily, Italy, 2004.

“Multiscale Modeling of Nonequilibrium Population Dynamics in Systems Containing Widely Disparate Characteristic Timescales,” [LA Harris](#) and P Clancy, *4th Annual Cornell Graduate Research Symposium*, Ithaca, NY, 2004.

“Density Functional Investigation of Water Adsorption on the Rutile TiO₂(110) Surface,” [LA Harris](#) and AA Quong, *Semiconductor Research Corporation Graduate Fellowship Program Annual Conference*, Dallas, TX, 2002.

REFERENCES

Prof. Carlos F. Lopez, Assistant Professor, Departments of Cancer Biology, Biomedical Informatics, and Biomedical Engineering, Vanderbilt University School of Medicine, Nashville, TN 37232. E-mail: c.lopez@vanderbilt.edu

Prof. Vito Quaranta, Professor, Department of Cancer Biology, Vanderbilt University School of Medicine, Nashville, TN 37232. E-mail: vito.quaranta@vanderbilt.edu

Prof. James R. Faeder, Associate Professor, Department of Computational and Systems Biology, University of Pittsburgh School of Medicine, Pittsburgh, PA 15260. E-mail: faeder@pitt.edu

Prof. Paulette Clancy, Samuel W. and M. Diane Bodman Professor in Chemical Engineering, School of Chemical and Biomolecular Engineering, Cornell University, Ithaca, NY 14853. E-mail: pqc1@cornell.edu