Curriculum Vitae

Mariano Marcano

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Education

State University of New York, Stony Brook, Computational Applied Mathematics, Ph.D. 1998
University of Puerto Rico, Río Piedras, Applied Mathematics, M.Sc. 1990
University of Puerto Rico, Cayey, Mathematics, B.Sc. 1986

Academic Positions

Professor, Department of Computer Science, University of Puerto Rico at Río Piedras, 2012–present
Associate Professor, Department of Computer Science, University of Puerto Rico at Río Piedras, 2007–2011
Associate Professor, Department of Mathematics, University of Puerto Rico at Río Piedras, 2003–2007
Assistant Professor, Department of Mathematics and Computer Science, University of Puerto Rico at Río Piedras, 1998–2003
Visiting Assistant Professor, Department of Mathematics, Duke University, 2000–2001

Research Area

Mathematical and Computational Physiology

Research Description

Using physics and chemistry principles, I formulate equations for different processes in physiology. The processes involve transport of substances through different spaces, which are separated by membranes. The formulation yields systems of nonlinear differential equations, which solutions must be approximated by means of numerical methods. The problem structures and the chemical reactions represented in the model, introduce parameters which values are unknown or known with uncertainty. Then I develop optimization problems to study the variation of the model parameters with respect to the problem's expected performances. Resulting in differential equation constrained optimization problems.

Articles in Refereed Journals

1. Mariano Marcano, Amitabha Bose, and Paul Bayman. A one-dimensional map to study multi-seasonal coffee infestation by the coffee berry borer. *Mathematical Biosciences*, 333, March 2021. doi: 10.1016/j.mbs.2020.108530

2. Mónica Nadal-Quirós, Leon C. Moore, and Mariano Marcano. Parameter estimation for a mathematical model of a non-gastric $H^+(Na^+)/K^+(NH_4^+)$ ATPase. *Am. J. Physiol. Renal Physiol.*, 309: F434–F446, 2015. doi:10.1152/ajprenal.00539.2014

3. Claudia Patricia Ruiz-Diaz, Carlos Toledo-Hernández, Alberto M. Sabat, Mariano Marcano. Immune response to a pathogen in corals. *J. Theor. Biol.,* 332, 141–148, 2013. doi:10.1016/j.jtbi.2013.04.028

4. Aniel Nieves-González, Chris Clausen, Mariano Marcano, Anita T. Layton, Harold E. Layton, and Leon C. Moore. Fluid Dilution and Efficiency of Na^+ Transport in a Mathematical Model of a Thick Ascending Limb Cell. *Am. J. Physiol. Renal Physiol.*, 304:6, F634–F652, 2013. doi:10.1152/ajprenal.00100.2012

5. Miguel A. Acevedo, Mariano Marcano, Robert J. Fletcher, Jr. A diffusive logistic growth model to describe forest recovery. *Ecol. Model.*, 244:13–19, 2012. doi:10.1016/j.ecolmodel.2012.07.012

6. Mariano Marcano, Anita T. Layton, and Harold E. Layton. Maximum Urine Concentrating Capability in a Mathematical Model of the Inner Medulla of the Rat Kidney. *Bull. Math. Biol.* 72(2):314–339, 2010. doi:10.1007/s11538-009-9448-0

7. Mariano Marcano, Hun-Mo Yang, Aniel Nieves-González, Chris Clausen, and Leon C. Moore. Parameter Estimation for Mathematical Models of NKCC2 Cotransporter Isoforms. *Am. J. Physiol. Renal Physiol.*, 296: F369–F381, 2009. doi:10.1152/ajprenal.00096.2008

8. Mariano Marcano, Anita T. Layton, and Harold E. Layton. An Optimization Algorithm for a Distributed-Loop Model of an Avian Urine Concentrating Mechanism. *Bull. Math. Biol.* 68:1625–1660, 2006. doi:10.1007/s11538-006-9087-1

9. M. Marcano-Velázquez and Harold E. Layton. An Inverse Algorithm for a Mathematical Model of an Avian Urine Concentrating Mechanism. *Bull. Math. Biol.*, 65(4):665–691, 2003. doi:10.1016/S0092-8240(03)00029-6

10. Reginald P. Tewarson, William Toro, and Mariano Marcano. Preferential interaction and inverse problem algorithms in models of renal concentrating mechanism. *Appl. Math. Lett.*, 11(3):51–59, 1998. doi:10.1016/S0893-9659(98)00033-0

11. Reginald P. Tewarson and Mariano Marcano. Use of generalized inverse in a renal optimization problem. *Inverse Probl. Eng.*, 5:1–9, 1997. doi:10.1080/174159797088027649

Articles in Conference Proceedings

12. M. Marcano-Velázquez and P.V. Negrón-Marrero. The numerical solution of the von Kármán equations using multigrid methods. *Congr. Numer.*, 94:17–28, 1993.

Selected Abstracts (5/19)

1. Mónica Nadal-Quirós, Leon C. Moore, and Mariano Marcano. A Simulated Cell Reprogramming from a Pharmacological Perspective. *FASEB J* April 2015 29:1029.1

2. Mónica Nadal-Quirós, Aniel Nieves-González, Leon C. Moore, and Mariano Marcano. Low basolateral Na+ pump activity in macula densa cells may be necessary to generate tubuloglomerular feedback responses. *FASEB J* April 2014 28:892.32

3. Mónica Nadal-Quirós, Aniel Nieves-González, Leon C. Moore, and Mariano Marcano. Sodium Transport in a Mathematical Model of a Macula Densa Cell. *FASEB J* April 2013 27:912.25

4. Mariano Marcano and Melvin Bonilla-Félix. A Mathematical Model for a Renal Medullary Tubule Structure of Neonatal Rats. *FASEB J* April 2012 26:1100.4

5. Mariano Marcano and Melvin Bonilla-Félix. Parameter Estimation for a Mathematical Model of the Urine Formation of Neonatal Rats. *FASEB J* April 2011 25:840.5

Technical Reports

- Mariano Marcano, Hun-Mo Yang, Aniel Nieves-González, Mónica Nadal-Quirós, Chris Clausen, and Leon C. Moore. Parameter Estimation for Models of NH_4^+ Transport by the Renal Na-K-2Cl and K-Cl Cotransporters. *Technical Report (Online)*. University of Puerto Rico, Río Piedras, 2011. `http://ccom.uprrp.edu/~mmarcano/manuscripts/NKCC2_KCC_NH4.pdf`

- Roberto Muñoz-Alicea, Pablo V. Negrón-Marrero, M. Marcano-Velázquez. A Mathematical Model for Macrophage, T-cell, and Mycobacterium Tuberculosis Interactions. *Technical Report*. Department of Mathematics, University of Puerto Rico, Humacao, 1999. `http://mate.uprh.edu/~pnegron/informes_tecnicos/tuberculosis/pr.pdf`

Invited Talks

- *Modeling Hormone Regulation of Renal Flows*. Mathematical Biology Seminar, New Jersey Institute of Technology, November 20, 2018.

- *Water and sodium regulation in a mathematical model of urine formation*. A Conference in Honor of Harold Layton's 60th Birthday, Duke University, Durham NC, February 18-19, 2017.

- *Two modes of urine formation in neonatal rat kidney by means of optimization problems*. Biomathematics/Computational Biology Colloquium, Courant Institute of Mathematical Sciences at New York University, December 16, 2014.

- *Mathematical modeling for physiology: A win-win situation*. Department of Physiology Seminar, Medical Sciences Campus, University of Puerto Rico, November 6, 2014.

- *Optimization Problems and Algorithms for Mathematical Models of Renal Systems.* Mathematical Biosciences Institute Workshop 5, The Kidney: Cellular, Tubular, and Vascular Physiology. Ohio State University, February 19-23, 2007.

- *A Mathematical Model of the Urine Concentrating Mechanism Process: Direct and Inverse Problems.* Department of Biology, University of Puerto Rico, Río Piedras, September 5, 2001.

- *Algorithms for the Inverse Problem of the Urine Concentrating Mechanism Models.* Center for Mathematics and Computation in the Life Sciences and Medicine, Duke University, Durham, North Carolina, July 27, 2000.

Talks in International Meetings

- *Parameter Computation for Urine Dilution and Concentration in a Mathematical Model of a Neonatal Kidney.* International Congress in Industrial and Applied Mathematics, Vancouver, BC, Canada, July 18–22, 2011.

- *Parameter Computation for a Mathematical Model of the Urine Concentrating Process of Neonatal Rats.* Society of Mathematical Biology 2010-BIOMAT 2010, Rio de Janeiro, Brazil, July 24–29, 2010.

- *Estimation of Parameters for Maximum Urine Concentrating Capability in a Mathematical Model of the Rat Inner Medulla.* Joint SMB-SIAM Conference on the Life Sciences, Annual Meeting of The Society of Mathematical Biology, North Carolina State University, Raleigh, North Carolina, July 31–August 4, 2006.

- *Reduced-gradient and Genetic Algorithms for an Inverse Problem of the Urine Concentrating Mechanism.* International Conference for Mathematics in Biology and Medicine, Annual Meeting for the Society for Mathematical Biology, Ann Arbor, Michigan, July 25–28, 2004.

- *A Least-Squares Technique to Compute the Parameters in the Urine Concentrating Mechanism.* 2000 SIAM Annual Meeting, Río Grande, Puerto Rico, July 10–14, 2000.

- *The Numerical Solution of the von Kármán Equations using Multigrid Methods.* Fifth Copper Mountain Conference on Multigrid Methods, University of Colorado at Denver, April 1991.

Grants

1. *Optimal Mathematical Models of Renal Transport Processes.* Principal Investigator (PI). National Institute of General Medical Sciences of the National Institutes of Health (NIH), Award number 1SC1GM084744, $596,000, August 1, 2008–July 31, 2013.

2. *Mathematical modeling and inverse problem for the urine concentrating mechanism.* PI. A pilot project in Support for Continuous Research Excellence (MBRS–SCoRE) program under the NIH Grant S06GM08102, $105,000, August 1, 2004–July 31, 2007.

3. *Mathematical models for the urine concentrating mechanism: Direct and inverse problems,* Puerto Rico Experimental Program to Stimulate Competitive Research (PR-EPSCoR) start-up funds under the National Science Foundation (NSF) Grant EPS-0223152, $107,594, January 1, 2004–July 31, 2005.

4. PI, *Mathematical modeling and inverse problem for the urine concentrating mechanism,* UPR Institutional Research Fund (FIPI), $21,200, July, 2003–June, 2005.

5. PI, *Mathematical Model and Numerical Solution for the Kidney Concentrating Mechanism,* FIPI, $7,700, 1999–2000 and $9,695, 2001–2002.

6. *Numerical Solution of Renal Transport Equations,* PI, Reginald P. Tewarson, Research Supplement for Under Represented Minorities for Mariano Marcano, National Institute of Diabetes and Digestive and Kidney Diseases of the NIH, Award number 3R01DK1759318S1, 1995–1997.

Short Academic Visits

- Courant Institute of Mathematical Sciences at New York University, June 2–August 9, 2014, December 11, 2014–January 19, 2015, May 27–August 8, 2015, and May 27–August 5, 2016.

- Center for Computational Science at Tulane and Xavier Universities, New Orleans, LA, June 2–14, 2003.

Affiliation with Other Departments or Institutions

- Faculty, graduate programs in the departments of Mathematics, Biology, and Environmental Sciences, University of Puerto Rico, Río Piedras.

- Research Associate, Center for Mathematics and Computation in the Life Sciences and Medicine, Department of Mathematics, Duke University, Durham, NC, August 2001–July 2002.

Advised Students

Ph.D. Dissertations

1. Mónica A. Nadal Quirós, *Sodium and Water Regulation in Renal Macula Densa Cells: A Computational Study*, Biology Department, 2016. Currently, Assistant Professor, Inter-American University of Puerto Rico.

2. Claudia P. Ruiz Diaz (co-advised with Alberto Sabat from Biology), *Understanding Coral Immune Response to Diseases: Experimental and Mathematical Modeling Approach*, Environmental Sciences Department, 2014. Currently, Research Scientist, University of Puerto Rico (UPR).

Master's Theses in Applied Mathematics

1. Teresa L. Pagán López, *A Mathematical Model of Ion and Water Transport in a Lacrimal Gland Cell*, 2020. Currently, Data Analyst at Banco Popular de Puerto Rico.

2. Christian J. Dennis Aponte, *Mathematical Models of Renal Cells with Cell Volume Regulatio*, 2018. Currently, Data Analyst at Banco Popular de Puerto Rico.

3. Mónica A. Nadal Quirós, *Parameter Estimation for Mathematical Models of Ion Transport in the Renal System*, 2010.

4. Lourdes Vázquez, *A Splitting Technique for the Advection-Diffusion Equation*, 2008. Currently, Instructor, Atlantic University College, Puerto Rico.

5. Néstor Mendoza, *Un Problema Inverso para un Modelo Simplificado para Simular el Mecanismo de Concentración de Orina*, 2007. Currently, Geometry & Inertial Data Analyst at Baker Hughes, Calgary, Canada.

6. Aniel Nieves, *An Optimization Algorithm for a Sodium-Potassium-Chloride Cotransporter Model*, 2006. Currently, Assistant Professor, UPR, Río Piedras.

7. Rubén León, *The Method of Regularized Stokeslets with Applications*, 2005.

8. Dannael Carrero, *A conservative numerical method for the solution of a renal model*, 2003. Currently, Instructor, UPR, Ponce.

Undergraduate Projects

1. Giovanni G. Colón Cabezudo, *Effect of Environmental Factors on Model Rates of the Coffee Berry Infestation by the Coffee Berry Borer in Puerto Rico.* Mathematics Department, 2020.

2. Andrés J. Rodríguez Aponte, *Numerical Methods for the Diffusion-Advection Equation: An Application on a Two-Dimensional Model of the Nephron.* Mathematics Department, 2017. Currently, MSc. student, Columbia University, NY.

3. Gabriela Bergollo, *Parameter Estimation for a Mathematical Model of an Electrogenic Cotransporter.* Biology Department, 2016. Currently, Ph.D. student, University of Washington, Seattle, WA.

4. Guillermo Fontánez, *Sensitivity Analysis for Mathematical Models of Na-K-Cl and K-Cl cotransporters.* Computer Science Department, 2011. Currently, Senior actuary, Latin American region, QBE Insurance, Buenos Aires, Argentina.

Courses Taught

- *Undergraduate*

  1. Numerical Analysis.
  2. Linear Algebra.
  3. Numerical Linear Algebra. Numerical methods with applications from linear algebra for computer science students.
  4. Introduction to Computational Cell Biology. Mathematical modeling of transport processes within the cell and model fitting techniques.
  5. Calculus I.
  6. Pre-calculus I and II.
  7. Fundamental Structures of Computer Science. Introduction to the various areas of computer science, skills related to problem solving, and general concepts of programming.
  8. Undergraduate Seminar in Mathematics. Introduction to undergraduate research.
  9. Appreciation of Mathematics. Introduction to modern mathematics topics for students of humanity and social sciences.

- *Graduate*

  10. Computational Analysis I and II. Graduate courses in numerical analysis.
  11. Nonlinear Optimization. Numerical methods for solving nonlinear optimization problems.
  12. Projects in Applied Mathematics. A project course for Master's students in applied mathematics.
  13. Computer Applications in Biology. Mathematical biology for graduate students in biology.
  14. Topics in Applied Mathematics. Elective courses offered under the same code and only require the approval of the graduate committee:
      (a) Numerical Methods for Partial Differential Equations.
      (b) Mathematical Fluid Mechanics.
      (c) Computational Cell Biology. Mathematical modeling of cell processes governed by partial differential equations.

Courses Created or Modified

- Course creation: Computational Analysis II, Numerical Linear Algebra and Introduction to Computational Cell Biology.

- Course adaptation to the blended modality (on-line and in classroom): Computational Analysis I and Nonlinear Optimization.

Services

- Member of the Department of Computer Science personnel committee, August 2018–present and 2007–2016 (Chair, July 2009– December 2014). Duties: search and recommendation for faculty hiring, faculty annual evaluations, faculty tenure and promotion evaluations and recommendations.
- Member of the Department of Mathematics graduate committee, August 2010–present and November 2005–July 2007. Duties: Student admissions and progress evaluations, graduate curriculum revision, program rules revision, and organize the preparation of qualifying exams.
- Mathematics Graduate Program academic advisor, March–December 2018.
- Member of the advisory committee on the administration of the online platform for distance learning in the UPR, Río Piedras, April–May 2016.
- Member of the College of Natural Sciences personnel committee, July 2009–December 2012 and August 2013–May 2014.
- Member of the committee for writing the graduate program proposal of the Department of Computer Science, August 2011–2014.
- Member of the evaluation committee for the Project Title V/PPOHA fellowship program, April 2011–May 2014.
- Member of the committee for the development of biomedical research in the UPR, Río Piedras, August–December 2007. Reported to the Chancellor on the state of the biomedical research in the UPR, Río Piedras.
- Member of the evaluation committee for the UPR AGEP (Alliance for Graduate Education and the Professoriate) and NASA fellowship programs, June 16, 2008.
- Member of the Department of Mathematics personnel committee, November 2004–July 2007.
- Wrote the Department of Mathematics Master's self-study for the Office of the Dean for Graduate Studies and Research, November 2004–April 2005. Assessment done every five years.

Graduate Qualifying Exams

Prepare and grade:

- Computational Analysis
- Optimization

Reviewer of Grant Proposals

- European Research Council (ERC).
- Program of Institutional Research Fund (FOPI), University of Puerto Rico at Humacao.

Reviewer of Journal Articles

- American Journal of Physiology, Renal Physiology.
- Bulletin of Mathematical Biology.

Professional Activities

International conferences

- Organizing committee member, *Workshop on Dynamics, Control and Numerics for Fractional PDE's*, San Juan, Puerto Rico, December 5–7, 2018.
- Organizing committee member, *INFORMS International (Institute for Operations Research and the Management Sciences)*, Río Grande, Puerto Rico, July 8–11, 2007.
- Organizing committee member, *Mathematical Models for Physiology*, minisymposium at 2000 SIAM (Society for Industrial and Applied Mathematics) Annual Meeting, Río Grande, Puerto Rico, July 10–14, 2000.

Local conferences

- Chair, organizing committee, SIDIM 2009 ("Seminario Interuniversitario de Investigación en Ciencias Matemáticas"), University of Puerto Rico, Río Piedras, March 6–7, 2009. Puerto Rico annual meeting in mathematical sciences.
- Member of SIDIM organizing committee, 2002–2010.