# Oscar E. Fernandez

*Assistant Professor of Mathematics, Wellesley College*

*Dept. of Mathematics, Wellesley College*
*106 Central St., SCI 366, Wellesley, MA 02481*
*(781) 283-3164 · ofernand@wellesley.edu*
*Website: surroundedbymath.com*
*Research website: palmer.wellesley.edu/∼ofernand*

## Employment

2011–Present **Wellesley College**, *Wellesley, MA*.
Assistant Professor of Mathematics

2010–2011 **Institute for Mathematics and its Applications**, *Minneapolis, MA*.
Postdoctoral Fellow

2009–2010 **University of Michigan**, *Ann Arbor, MI*.
Michigan NSF AGEP Postdoctoral Fellow

## Education

2004–2009 **University of Michigan**, *Ann Arbor, MI*.
- Ph.D. in Applied and Interdisciplinary Mathematics
- Thesis title: *The Hamiltonization of Nonholonomic Systems and its Applications*
- Thesis Advisor: Anthony M. Bloch

2000–2004 **University of Chicago**, *Chicago, IL*.
B.S. in Applied Mathematics; B.A. in Physics

## Research Interests

Dynamics (especially geometric and nonholonomic mechanics), global analysis, integrability and quantization of constrained systems, mathematical physics, applied mathematics.

## Publications

### Refereed Research Articles

12. Fernandez, O.E. and Beltrán-Sánchez, H. The Entropy of the Life Table: A Reappraisal. *Theor. Pop. Biology*, 104 (2015), 26–45. [doi]
11. Balseiro, P. and Fernandez, O.E. Reduction of nonholonomic systems in two stages. *Nonlinearity*, 28(8) (2015), 2873–2912. [pdf] [doi]
10. Fernandez, O.E. Poincaré Transformations in Nonholonomic Mechanics. *Appl. Math. Lett.*, 43 (2015), 96–100. [pdf] [doi]

9. Fernandez, O.E., Bloch, A.M. and Zenkov, D.V. The Geometry and Integrability of the Suslov Problem. *J. Math. Phys.*, 55 (2014), 112704. [pdf] [doi]
8. Fernandez, O.E. Quantizing Conditionally Variational Nonholonomic Systems. *J. Phys. A: Math. Theor.*, 47(30) (2014), 305206. [pdf][doi]
7. Fernandez, O.E., Bloch, A.M. and Olver, P.J. Variational Integrators for Hamiltonizable Nonholonomic Systems. *J. Geometric Mechanics*, 4(2) (2012), 137–163. [pdf][doi]
6. Ohsawa, T., Fernandez, O.E., Bloch, A.M. and Zenkov, D.V. Nonholonomic Hamilton-Jacobi Theory via Chaplygin Hamiltonization. *J. Geometry and Physics*, 61(8) (2011), 1263–1291. [pdf][doi]
5. Fernandez, O.E. and Bloch, A.M. The Weitzenböck Connection and Time Reparameterization in Nonholonomic Mechanics. *J. Math. Physics*, 52 (2011), 012901. [pdf] [doi]
4. Fernandez, O.E., Mestdag, T. and Bloch, A.M. A Generalization of Chaplygin's Reducibility Theorem. *Reg. and Chaotic Dyn.*, 14(6) (2009), 635–655. [pdf][doi]
3. Bloch, A.M., Fernandez, O.E. and Mestdag, T. Hamiltonization of Nonholonomic Systems and the Inverse Problem of the Calculus of Variations. *Rep. Math. Phy.*, 63 (2009), 225–249. [pdf][doi]
2. Fernandez, O.E., Bloch, A.M. and Mestdag, T. The Pontryagin Maximum Principle applied to Nonholonomic Mechanics. *Proc., $IEEE$ $47^{th}$ Control Decision Conf.,* (2008), 4306–4311. [pdf][doi]
1. Fernandez, O.E. and Bloch, A.M. Equivalence of the Dynamics of Nonholonomic and Variational Nonholonomic Systems for certain Initial Data. *J. Phys. A: Math. Theor.*, 41(34) (2008) 344005. [pdf][doi]

### Non-Refereed Research Articles

1. Mestdag, T., Bloch, A.M. and Fernandez, O.E. Hamiltonization and Geometric Integration of Nonholonomic Systems. *Proc., 8th Nat. Congress on Theor. and Appl. Mechanics*, Brussels, Belgium (2009). [pdf]

### Submitted Research Articles

1. Fernandez, O.E. and Radhakrishnan, M. The Quantum Mechanics of Molecular Nanocars. *Submitted to Proc. Royal Society A*.

### Research Articles in Preparation

1. Fernandez, O.E. Quantizing a Two-Wheeled Car with Off-Centered Center of Mass.

### Books

1. Fernandez, O.E. *Everyday Calculus: Discovering the Hidden Math All Around You*. Princeton, NJ: Princeton University Press (April 2014). Translations have been published in Japanese, Korean, and Portuguese.
2. Fernandez, O.E. *The Calculus of Happiness: How a Mathematical Approach to Life Adds Up to Health, Wealth, and Love*. Princeton, NJ: Princeton University Press (April 2017). Translations to be published in: Korean.

### Book Chapters

1. Fernandez, O.E. How Constructivism Can Boost Women and Minorities' Success in STEM Fields. In D. Kritt (Eds.), *Constructivism in an Age of Accountability*. Forthcoming, Fall 2017.
2. Fernandez, O.E. Help Save the Planet: Take the $\frac{1}{2}$ $CO_2$e Challenge! In B. Kateman (Eds.), *The Reducetarian Solution: How the Surprisingly Simple Act of Cutting 10% of Meat from Your Diet Can Transform Your Health and The Planet*. Harmondsworth, UK: Penguin Books (April 2017).

### Other Writing

I blog regularly about math in the news on The Huffington Post (here is the link to my author page), and on my site, surroundedbymath.com. I have also written blog posts for Princeton University Press, and the AMS Teaching and Learning Blog.

## Grants, Fellowships, and Honors

2015 *Wellesley Emerging Scholars Initiative* named a "Bright Spot in Hispanic Education" by the White House Initiative for Educational Excellence for Hispanics

2013–2015 *Wellesley Emerging Scholars Initiative*, MAA-Tensor Foundation Strengthening Underrepresented Minority Mathematics Achievement Grant

2014 *Career Enhancement Fellowship for Junior Faculty*, Woodrow Wilson National Foundation

2014 *Everyday Calculus* selected as one of American Association for the Advancement of Science's Books for General Audiences and Young Adults 2014

2012 *Mathematics in Context*, Three Colleges Presidential Innovation Fund Grant

2012 Wellesley College Brachman-Hoffman Small Grant

2011 *Applicable Mathematics Across the Three College Consortium*, Three Colleges Presidential Innovation Fund Grant

2011 *A Research-Based Hybrid IBL Approach to Calculus I*, Academy of Inquiry-Based Learning Small Grant

2009 Michigan NSF AGEP Postdoctoral Fellowship

2002–2009 Mellon Mays Undergraduate Fellowship

## Invited Research Talks

Jun. 2015 "The Poincaré–Hopf Theorem in Nonholonomic Mechanics," *ICERM Workshop on Integrability in Mechanics*, Providence, RI

May 2015 "The Poincaré–Hopf Theorem in Nonholonomic Mechanics," *SIAM Conference on Applications of Dynamical Systems*, Snowbird, UT

Aug. 2014 "The Quantum Mechanics of Nanocars," *Alán Aspuru-Guzik chemistry group, Harvard University*, Cambridge, MA

Jun. 2014 "The Quantum Mechanics of Nanocars," *Woodrow Wilson Foundation Career Enhancement Retreat*, Atlanta, GA

Aug. 2013 "A New Approach to the Integrability of the Suslov Problem," *AMMCS 2013 Conference*, Waterloo, Canada

May 2013 "A New Approach to the Integrability of the Suslov Problem," *SIAM Conference on Applications of Dynamical Systems*, Snowbird, UT

Nov. 2012 "Nonholonomic Systems: Dynamics and Simulations via Time Transformations," *Univ. Mass. Amherst Applied Math Seminar*, Amherst, MA

Sep. 2012 "An Improved Integrability Theorem for Hamiltonizable Nonholonomic Systems," *Third Iberoamerican Meeting On Geometry, Mechanics and Control*, Salemanca, Spain

Jul. 2012 "Variational Integrators for Hamiltonizable Nonholonomic Systems," *Ninth AIMS Conference*, Orlando, FL

Mar. 2012 "Variational Integrators for Hamiltonizable Nonholonomic Systems," *IMPA Seminar*, Rio de Janeiro, Brazil

Apr. 2011 "Variational Integrators for Hamiltonizable Nonholonomic Systems," *Mathematical Physics Seminar*, Univ. of Minnesota, Minneapolis, MN

Nov. 2010 "Applications of the Hamiltonization of Nonholonomic Systems," *Mathematical Physics Seminar*, Univ. of Minnesota, Minneapolis, MN

Sep. 2010 "Developing Variational Integrators for Hamiltonizable Nonholonomic Systems," *Modern Math Workshop*, Anaheim, CA

Feb. 2010 "The Hamiltonization of Nonholonomic Systems and its Applications," *Applied Math Seminar*, Univ. of Michigan, Ann Arbor, MI

Jan. 2010 "Dynamical Systems and Nonholonomic Mechanics," *Univ. of Ill. at Chicago*, Chicago, IL

Jan. 2010 "Nonholonomic Systems and their Hamiltonization," *Fourth Intl. Young Researchers Workshop on Geometry, Mechanics and Control,* Ghent, Belgium

Oct. 2009 "Explicitly Solvable Nonholonomic Systems," *AMS Sectional Meeting*, University Park, PA

## Contributed Research Talks and Posters

Oct. 2014 "Quantizing Nonholonomic Systems," *Annual Meeting of Mid-Atlantic APS*, University Park, PA

Aug. 2011 "Applications of the Hamiltonization of Nonholonomic Systems," Poster, *Appl. Dynamics and Geometric Mechanics Conf.*, Olberwolfach, Germany

Oct. 2010 "Simulating Nonholonomic Mechanics using Variational Integrators through Hamiltonization," *Postdoctoral Seminar*, Institute for Mathematics and its Applications, Minneapolis, MN

Mar. 2010 "Developing Geometric Integrators for Hamiltonizable Nonholonomic Systems," *Institute for Mathematics and its Applications*, Minneapolis, MN

Dec. 2008 "The Pontryagin Maximum Principle applied to Nonholonomic Mechanics," *IEEE* $47^{th}$ *Conference on Decision and Control*, Cancun, Mexico

## Non-Research Talks

Jun. 2016 "The Calculus of Music," *MIT MathROOTS Program*, MIT, Cambridge, MA

Jun. 2016 "Research-Based Strategies for Improving Women and Minority Students' STEM Experience." *2016 Massachusetts PKAL Regional Meeting: Best Practices in STEM Education*, Westfield State Univ., Westfield, MA

Jun. 2016 "A Few Easy Ways to Boost Student Success in Math," *Alumni Reunion 2016*, Wellesley College, Wellesley, MA

Oct. 2015 "Closing the Achievement Gap in STEM," *Wellesley College Science Center Faculty Seminar Series*, Wellesley College, Wellesley, MA

Jun. 2015 "A Short Introduction to the Hidden Math All Around You," *Alumni Reunion 2015*, Wellesley College, Wellesley, MA

Apr. 2015 "A Short Introduction to the Hidden Math All Around You," *Junior Open Campus event for students and parents*, Wellesley College, Wellesley, MA

Apr. 2013 "Visualizing Mathematics," *Junior Open Campus event for students and parents*, Wellesley College, Wellesley, MA

Nov. 2010 "Falling Cats, Spinning Disks and Snakeboarding: A Tour Through the Mathematics of Mechanics," *Undergraduate Math Club*, Univ. of Minnesota, Minneapolis, MN.

## Teaching

I teach my courses using a combination of interactive lectures and inquiry-based learning (IBL). I also regularly use technology—such as online Java applets and SMART boards—to help students interact with the math we're learning. **NOTE:** I did not teach during the 2014–2015 academic year due to being on sabbatical.

**Assistant Professor**, Wellesley College, Dept. of Mathematics

- Intro. to Fourier Analysis and PDEs — Spring (2016, 2014)
- Complex Analysis — Fall 2013
- Real Analysis — Fall 2015, Spring 2013
- Mathematical Methods for the Physical Sciences — Fall (2015, 2013, 2012)
- Ordinary Differential Equations — Spring (2014, 2013, 2012)
- Calculus II — Spring 2012
- Calculus I — Spring 2016, Fall 2011

**Graduate Student Instructor**, Univ. of Michigan, Dept. of Mathematics

- Topics in Elem. Math (IBL course, team taught) — Fall 2009
- Calculus II — Summer 2009
- Calculus III — Winter 2008
- Calculus I — Fall (2005, 2007), Winter 2006

## Student Research Supervised

**Project title:** *Global Pricing Models for Medical Devices*. Spring 2013

- Work done in collaboration with Boston Scientific. Students supervised: Ana Plascencia Casillas '14, Shuyu Gao '13, Karan Kanodia '13 (Babson College), Laura Liu '14, and Farheen Rahimtoola '13

**Project title:** *Assessing Risk in the Quality Control Process*. Spring 2013

- Work done in collaboration with Boston Scientific. Students supervised: Sookyo Jeong '14, Gerta Malaj '13, Sophie Sun '14, and Elsa Wong '15 (Babson College)

**Project title:** *The Quantum Mechanics of a Nanocar*. Summer 2012–Fall 2012

- Work done with Ana Plascencia Casillas '14

## Student-Oriented Outreach Activities

**Co-Director: Wellesley Emerging Scholars Initiative** Fall 2013–Present

- Created a learning community for students of color enrolled in calculus courses. We meet twice weekly for 2 hours total to work on challenging calculus problems in small groups. The program is funded by a MAA-Tensor SUMMA grant.

**Organizer: Applicable Mathematics Lecture Series** 2012–Present

- Lectures' location rotates between Babson, Olin, and Wellesley Colleges and focus on the real-world applications of mathematics. Recent lecturers were from: Mathworks Inc., Wolfram Inc., The Chubb Corporation, and Bank of America.

**Co-organizer: "Epic Pi Day 2015"** Spring 2015

- Set up pi-related activities and provided food for the over 130 science students and faculty that attended; event began at 9:26:53 a.m. on 3/14/15.

Mentor to Latina students in *Mezcla* Fall 2012–Present

Wellesley College *Math Games* judge Fall 2014

**Head Mathematics Coach** Fall 2006–Spring 2010

University of Michigan, Ross School of Business *Preparation Initiative*

- Trained incoming mathematics coaches (and served as one myself) to tutor, advise, and mentor students of color applying to the business B.A. program and enrolled in first-year calculus courses.

## College and Departmental Service

**College-wide:**

- Dean of students search committee Fall 2015–Present
- Agenda committee (sets agenda for academic council meetings) Fall 2015–Present
- Sherman Fairchild Foundation grant steering committee Spring 2015–Present
- Honor code council Fall 2012–Spring 2014

**Departmental:**

- Mathematics tenure-track hiring committee Fall 2015–Present
- Math dept. "virtual career panel" coordinator Fall 2015–Present
- One of three representatives at our "Meet the Departments" biannual events Fall 2012–Present
- Applied math curriculum committee Spring 2015–Present

## Professional Development Activities

- AACU Massachussetts PKAL Conference, Framingham State University, Framingham, MA Fall 2015
- Legacy of R.L. Moore Inquiry-Based Learning Conference, Austin, TX June 2010
- Society for the Advancement of Chicanos and Native Americans in the Sciences (SACNAS) Conference, Dallas, TX Fall 2009
- Referee: J. Mathematical Physics, J. Applied Mechanics, J. Geometric Mechanics, Physica D, SIGMA
- Book reviewer for Princeton University Press