

Bruno Giuseppe Poggi Cevallos

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Ph.D Institution: University of Minnesota, Minneapolis, MN Fall 2015 - Ongoing

Ph.D studies: Doctorate in Mathematics

Ph.D Advisor: Svitlana Mayboroda

Master's Institution: Florida Institute of Technology, Melbourne, Fl.

Master's studies: Master of Science in Applied Mathematics

Master's Advisor: Ugur Abdulla

Graduate GPA: 4.0/4.0

Undergraduate Institution: Florida Institute of Technology, Melbourne, Fl.

Undergraduate Majors: Bachelor of Science in Aerospace Engineering &
Bachelor of Science in Mathematical Sciences

Undergraduate GPA: 4.0/4.0

Research Interests

My main areas of interest are Partial Differential Equations, Harmonic Analysis, and Geometric Measure Theory. My current research projects include:

- *Exponential Decay of the Fundamental Solution for the generalized Schrodinger Operator*, in collaboration with Svitlana Mayboroda.

- *Application of the Theory of Layer Potentials to the generalized Schrodinger Operator in the half-plane*, in collaboration with Simon Bortz, Steven Hoffman, Jose Luis Luna Garcia, and Svitlana Mayboroda.
- *Harmonic measure for sets with higher co-dimensional boundaries*.
- *Optimal Control of the Inverse Multiphase Stefan Problem on finitely many dimensions*, in collaboration with Ugur Abdulla.

I was funded through a research assistantship on Summer 2017 under the supervision of Svitlana Mayboroda, to advance work on a few of the above research projects. A paper resulting from this work has been submitted to the arXiv, and is undergoing the review process for publication.

I was one of seven concurrent program associates to the Harmonic Analysis program at the Mathematical Sciences Research Institute from January 17 to May 26 in 2017, funded through a research assistantship under the supervision of Svitlana Mayboroda.

I completed my Master's Thesis on July 2015, titled "On the Inverse Multiphase Stefan Problem". A paper with the main results of the thesis has been submitted to the arXiv, and is undergoing the review process for publication.

Abstract of the Master's Thesis:

We consider inverse multiphase Stefan problem, where information on the heat flux on the fixed boundary is missing and must be found along with the temperature and free boundaries. Optimal control framework is pursued, where boundary heat flux is the control, and optimality criteria consists of the minimization of the L_2 -norm declination of the trace of the solution to the Stefan problem from the temperature measurement on the fixed boundary. State vector solves multiphase Stefan problem in a weak formulation, which is equivalent to Neumann problem for the quasilinear parabolic PDE with discontinuous coefficient. Full discretization through finite differences is implemented and discrete optimal control problem is introduced. We prove well-posedness in Sobolev spaces framework and convergence of discrete optimal control problems to the original problem both with respect to cost functional and control. Along the way the convergence of the method of finite differences for the weak solution of the multiphase Stefan problem is proved. The

proof is based on the proof of uniform L_{∞} bound, and $W_2^{1,1}$ -energy estimate for the discrete multiphase Stefan problem.

I was a graduate mentor at the Florida Institute of Technology Department of Mathematical Sciences Research Experience for Undergraduates (FIT REU) in Partial Differential Equations and Dynamical Systems during Summer 2014 and Summer 2015. I was a graduate mentor for the Optimal Control and Inverse Problems for PDEs group.

On the year prior to the REU, I was working on an undergraduate research project on the Optimal Control for Inverse Stefan Problems method with Ugur Abdulla from Florida Institute of Technology.

During academic years 2012-2013 and 2013-2014, I was involved in a team project working on the design and development of an ornithopter.

Papers

- *Optimal control of the multiphase Stefan problem*, with U. Abdulla. arXiv:1508.00290, accepted for publication in Applied Mathematics & Optimization.
- *Exponential decay estimates for fundamental solutions of Schrodinger-type operators*, with S. Mayboroda. ArXiv: 1801.05499, submitted for publication.
- *Optimal control of the multidimensional multiphase Stefan problem*, with U. Abdulla. In preparation for submission.

Invited Talks and Poster Presentations (reverse chronological order)

- Invited to give a talk at the AMS *Regularity of PDEs in Rough Domains* Special Session, occurring at the AMS Sectional Meeting in Northeastern University in April 21-22, 2018, Boston, Massachusetts.
- Poster presentation at the Recent Developments in Harmonic Analysis workshop at the MSRI in May 15-May 19, 2017, Berkeley, California.
- Gave a talk for the Harmonic Analysis Graduate Student Seminar at the MSRI Harmonic Analysis Spring 2017 program, Berkeley, California.

- Gave a talk at the 2015 SIAM Conference on Analysis of Partial Differential Equations in Scottsdale, Arizona.
- Gave a talk at the JMM conference in January 2015, San Antonio, Texas.
- Poster presentation at the Young Mathematicians' Conference at Ohio State University in August 2014, Columbus, Ohio.
- Gave a talk at the 2014 SIAM-SEAS Conference in March, 2014, Melbourne, Florida.
- Gave a talk at the Embry-Riddle Undergraduate Mathematics Conference in March, 2014, Daytona Beach, Florida.
- Poster presentation at the Florida Institute of Technology Student Showcase in April, 2014, Melbourne, Florida. Won 'Best of Student Showcase in the Mathematical Sciences' honor.
- Poster presentation at the Florida Undergraduate Research Conference at Florida International University in Miami, February, 2014.

Honors (reverse chronological order)

Selected as a nominee from the Department of Mathematics at the University of Minnesota for MSRI funding for the MSRI Harmonic Analysis Summer School in Summer 2018 (these nominations are fiercely competitive).

Selected to be a Program Associate at the MSRI Harmonic Analysis program in Spring 2017.

Faculty Honors Award at Florida Tech, May 3, 2014 (for graduating with 4.0).

Outstanding Senior of the Year 2013-2014 (Campus-wide honor to one senior).

Winner of the James G. Potter Award 2012 (for winning the Potter Physics Competition).

Best of Student Showcase 2014 in Mathematical Sciences (for best research project in Mathematical Sciences department).

Outstanding Junior in Aerospace Engineering 2012 and Outstanding Senior in Aerospace Engineering 2013.

Member of Phi Kappa Phi Honor Society.

Honorable Mention at the Asian-Pacific Math Olympiad, 2010.

Teaching and Work Experience

Teaching Assistant at University of Minnesota during academic year 2015-2016, Fall 2016, and academic year 2017-2018.

Courses taught at the University of Minnesota as a teaching assistant

- Calculus I
- Calculus II
- Multivariable Calculus
- Sequences, Series and Foundations: Writing Intensive (a basic Introduction to Proof and Analysis)

Teaching Assistant at the Florida Institute of Technology during academic year 2014-2015 and Summer 2015.

Courses taught at the Florida Institute of Technology as a teaching assistant

- Linear Algebra & Differential Equations (thrice)
- Undergraduate-level Partial Differential Equations (twice)

Graduate Mentor at the Florida Institute of Technology Department of Mathematical Sciences Research Experience for Undergraduates (FIT REU) in Partial Differential Equations and Dynamical Systems during Summer 2014 (and expect to work for it too Summer 2015)

Tutor at the Mathematics Advancement Center at Florida Institute of Technology, Spring 2014.

Tutor at the Academic Support Center at Florida Institute of Technology, in academic year 2012-2013.

Community Outreach and other relevant organizational experience

- Organized the (graduate) Student PDE Seminar in Fall 2016. Co-organized the Analysis & PDE Working Seminar in Fall 2017.
- Co-organizer for the University of Minnesota Math Club (a club geared towards undergraduate students) in Fall 2017.

Citizenship

Ecuadorian and Italian

Languages

First language is Spanish. Very fluent in English.

Classes Taken in Mathematics in Graduate Career

- Theory of Complex Variables
- Theory of Ordinary Differential Equations
- Non-linear Partial Differential Equations Special Topics
- Numerical Methods in Partial Differential Equations
- Mathematical Programming (a nonlinear optimization course)
- Year-long sequence in Algebra

- Year-long sequence in Real Analysis
- Year-long sequence in Mathematical Fluid Mechanics
- Harmonic Analysis
- Functional Analysis
- Theory of Partial Differential Equations
- Passed an exam for a year-long course in Complex Analysis