

MONICA TORRES

EDUCATION

ITESM (*summa cum laude*), Queretaro, Mexico, Computer Engineering, BS, 1993.
Centro de Investigacion en Matematicas (CIMAT), Gto., Mexico, Mathematics, MS, 1997.
University of Texas at Austin, Austin, TX, Mathematics, Ph.D. (Advisor:Luis Caffarelli), 2002.

APPOINTMENTS

2011-present Associate Professor, Department of Mathematics, **Purdue University**.
2005-2011 Assistant Professor, Department of Mathematics, **Purdue University**.
2002-2005 Ralph Boas Assistant Professor, Dept. of Mathematics, **Northwestern University**.
2001-2002, Visiting Scholar, Dept. of Mathematics, **University of California at Berkeley**.
Jan 1994-Dec 1994 Software development for the ITESM, Queretaro, Mexico.

RESEARCH INTERESTS

- Geometric measure theory
- Partial differential equations
- Calculus of Variations
- Shape optimization
- Nonlinear hyperbolic conservation laws and shock waves
- Free boundary problems

RESEARCH AWARDS

1. NSF Grant DMS-0540869, Analysis, 6/10/05-05/31/09, \$43,200. PI: Monica Torres.
2. PRF Summer Faculty Award, 2008, \$8,000.
3. NSF Grant DMS-0901245, Analysis, 7/01/09-06/30/14, \$138,552. PI: Monica Torres.
4. PRF Travel Grant, Summer 2016, \$1,200.
5. NSF Grant DMS-1740950, 7/01/2017-7/01/2019, \$25,000. PI: Monica Torres. Co-PI: Keiko Kawamuro.
6. Simons Foundation, Award Number 524190, 9/01/2017-8/31/2022, \$42,000. PI: Monica Torres. Note: This grant will be active for two years since it can not coexist with a NSF grant.
7. NSF Grant DMS-1813695, Applied Analysis, 8/15/2018-8/15/2021, \$171,691. PI: Monica Torres.

OTHER AWARDS

- Olympiad of Mathematics, First National Place, 1988-1989.
- Excellence Undergraduate Fellowship, Instituto Tecnológico y de Estudios Superiores de Monterrey, ITESM, 1989-1993.
- CONACYT Doctoral Scholarship, Mexican Government, 1997-2000.

- Graduate Research Assistantship, University of Texas at Austin, 2001-2002.
- Distinguished Alumni of the Masters Program, Centro de Investigacion en Matematicas, CIMAT, 2003.

GRADUATE STUDENTS

1. Qinfeng Li.

Dissertation title: "Geometric Measure Theory and Shape Optimization".

He graduated in May 2018 and completed his PhD in 5 years. Qinfeng won a Purdue Research Foundation (PRF) fellowship for the academic year 2017-2018. He was offered a special postdoc at the Chinese Academy of Sciences, Beijing, which is highly competitive and with no teaching assignments. He accepted a postdoc at the University of Texas, San Antonio, starting in the Fall 2018.

2. Kathryn E. Yochman.

Dissertation title: "Analysis of the DPG method to solve Helmholtz equations with negative material parameters".

Katy successfully completed her oral exam on August 3, 2018.

Expected graduation date: May 2020.

3. Hanan Ussif Gadi.

Dissertation topic: "Traces of entropy solutions in L^p ".

Hanan successfully completed her oral examination on September 7, 2018. She is a 5th year student.

Expected graduation date: May 2020.

PUBLICATIONS

1. Li, Z., Lin, X., Torres, M. and Zhao, H., Generalized Snell's law for weighted minimal surfaces in heterogeneous media, *MAA, Methods and Applications of Analysis*, Vol. 10, No. 2, pp. 199-214, June 2003.
2. Torres, M., Plane-like minimal surfaces in periodic media with exclusions, *SIAM Journal on Mathematical Analysis*, Vol. 36, No. 2, pp. 523-551, August 2004.
3. Chopp, D., Torres, M. and Walsh, T., Level set methods to compute minimal surfaces in a medium with exclusions, *Interfaces and Free boundaries*, Vol. 7, No. 2, pp. 165-185, 2005.
4. Chen, G.-Q. and Torres, M., Divergence-measure fields, sets of finite perimeter and conservation laws, *Archive for Rational Mechanics and Analysis*, 175, No. 2, pp. 245-267, 2005.
5. Chen, G.-Q., Torres, M. and Ziemer, W., Measure-theoretic analysis and nonlinear conservation laws, *Pure and Applied Mathematics Quarterly*, Vol. 3, No. 3, pp. 841-879, 2007.
6. Torres, M. and Walsh, T., Finite element methods for non-linear acoustics in fluids, *Journal of Computational Acoustics*, Vol. 15, No. 3, pp. 353-375, 2007 (September issue).

7. Nguyen, P.C. and Torres, M., Characterizations of the existence and removable singularities of divergence-measure vector fields, **Indiana University Mathematics Journal**, Vol. 57, No. 4, pp. 1573-1598, 2008.
8. Chen, G.Q., Torres, M. and Ziemer, W., Gauss-Green Theorem for weakly differentiable vector fields, sets of finite perimeter, and balance laws, **Communications on Pure and Applied Math.**, Vol. 62, No. 2, pp. 242-304, 2009.
9. Chen, M., Walsh, T. and Torres, M., Existence of traveling wave solutions of a highorder nonlinear acoustic wave equation, **Physics letters A**, Vol. 373, Issue 11, pp. 1037-1043, 2009.
10. Torres, M. and De Pauw, T., On the distributional divergence of vector fields vanishing at infinity, **Proceedings of the Royal Society of Edinburgh**, 141A, 65-76., 2011.
11. Chen G-Q. and Torres, M., On the structure of solutions of nonlinear hyperbolic systems of conservation laws, **Communications on Pure and Applied Analysis**, Volume 10, Number 4, 1011-1036, 2011.
12. The integral of the normal and fluxes over sets of finite perimeter, with Ido Bright, **Interfaces and Free Boundaries**, 17, 245-259, 2015.
13. Characterizations of signed measures in the dual of BV and related isometric isomorphisms, with Phuc Nguyen, **Anna. Sc. Norm. Super. Pisa Cl. Sci. (5)**, Vol. XVII, issue 1, 385-417, 2017.
14. Modern Real Analysis, 2nd Edition, with William Ziemer, **Graduate Texts in Mathematics Series, Springer**, Volume 278, 382 pp., 2017.
15. One-sided approximation of sets of finite perimeter, with Giovanni Comi, **Rend. Lincei Mat. Appl.**, 28, no. 1, 181-190, 2017.
16. On the dual of BV, **Contemporary Mathematics**, Volume 709, 115-129, June 2018.
17. Occupational measures and averaged shape optimization, with Ido Bright and Qinfeng Li, published online in **ESAIM: Control, Optimization and Calculus of Variations**, Volume 24, Number 3, 1141-1165, 2018.
18. Morrey spaces and Generalized Cheeger sets, with Qinfeng Li, published online in **Advances in Calculus of Variations**, <https://doi.org/10.1515/acv-2016-0050> (forthcoming volume and issue), published online on June, 2017.
19. Regularity of interfaces for a Pucci type like segregation problem, with Luis Caffarelli, Stefania Patrizi and Veronica Quitalo, 40 pp., **submitted to Annales de l'Institut Henri Poincare / Analyse non lineaire**, 2018.
20. Cauchy fluxes and Gauss-Green formulas for divergence-measure fields over general open sets, with Gui-Qiang Chen and Giovanni Comi, 60 pp., **Submitted to Archive for Rational Mechanics and Analysis**, 2018.

21. Traces and extensions of bounded divergence-measure fields on rough open sets, with Gui-Qiang Chen and Qinfeng Li, 30 pp., **Submitted to Indiana University Mathematics Journal**, 2018.
22. Divergence-measure fields: Gauss-Green formulas and Normal Traces, with Gui-Qiang Chen, **preprint**.
23. Varifolds with prescribed first variation, with Salvatore Stuvard, **in preparation**.
24. Traces of unbounded entropy solutions of multidimensional scalar conservation laws, with Hanan Ussif Gadi, **in preparation**.

SPECIAL INVITATIONS

1. Academic visitor to the Oxford Centre for Nonlinear Partial Differential Equations in the Andrew Wiles Building, University of Oxford, for the period June 5-10, 2017. I gave two guest lectures on June 6 and 7, 2017:
 - Lecture 1: *Divergence-measure fields, the solvability of $\operatorname{div} \mathbf{F} = T$ and the dual of BV .*
 - Lecture 2: *Divergence-measure fields and nonlinear conservation laws.*
2. I gave a 10 hour mini-course on the topic:
 - Divergence Measure Fields, Conservation Laws, and Free Boundary Problems*
 - at the 14th International Conference on Free Boundary Problems: Theory and Applications held at Shanghai Jiao Tong University, China, July 2-15, 2017.
3. Guest at the Hausdorff Center for Mathematics, University of Bonn, August 2018.

CONTRIBUTIONS TO EDUCATION

I teach two graduate analysis classes with the material from my book with W. Ziemer, *Modern Real Analysis*, published in the Springer Graduate Texts in Mathematics Series. The book consists of 11 chapters that provide the students with a strong knowledge of the Lebesgue theory of integration and other topics such as functional analysis, Riesz representation theorems, distributions and Sobolev spaces, thus preparing the student for research in some field of analysis, such as PDE and Calculus of Variations. Indeed, the last chapter presents the Laplace's equation including the regularity of weak solutions. I teach one semester (MA544) on the Lebesgue theory of integration, with chapters 4-7, to first year graduate students. The presentation has a flavor of geometric measure theory since it introduces the Hausdorff measures in chapter 4; at the same time that the Lebesgue measure and the Lebesgue-Stieltjes measure are also introduced. I teach a second semester (MA545) with the remaining chapters 8-11. The theory of Sobolev spaces can be easily introduced after the chapters on functional analysis and distributions, providing a smooth transition to the study of the Laplace's equation and regularity of weak solutions. The content of chapters 1-3 coincide mostly with the topics covered in MA504, the bridge class to MA544 and MA545.

ORGANIZATION OF CONFERENCES

- Organized session at SIAM meeting, Boston, MA, July 2006.

- Co-organizer of the Midwest PDE Conference with Daniel Phillips and Patricia Bauman, November 2009.
- Co-organizer of 72nd Midwest PDE Seminar, November 2013, Purdue University.
- **Main organizer of the Midwest Women in Mathematics Symposium (WIMS) held at Purdue University on April 7, 2018.** This conference featured two plenary talks given by two distinguished full professors and 15 invited lectures comprised mainly of junior faculty including postdocs, assistant professors and associated professors. The conference spanned the areas of pure and applied analysis, including numerical analysis, as well as geometry and topology. About 90 participants attended the conference. It included round table discussions to address important topics such as how to achieve balance between family and careers, 2-body problems and how to succeed in graduate school and job search. In this direction, since the organizer has an interest in education about careers in mathematics outside academia, a female researcher from Sandia National Laboratories gave a talk about opportunities for women with a Ph.D. in mathematics to make a career in a National Laboratory.
- In order to continue with the mission of the WIMS conference, which includes the support of young mathematicians through networking and mentoring, we will organize a mini-workshop at Purdue in the Spring 2019. We will have 5 participants from outside Purdue to present their work. We will also have local participants to give talks. The workshop will include an informal session where students and postdocs can ask questions about future careers. The organizers will work very hard to choose speakers from underrepresented minorities, both male and female. For this reason, the organizers will also search for participants outside the Midwest. However, the mini-workshop will follow the same spirit as the Midwest Women in Mathematics Symposium which means they will create an environment where students and postdocs are free to express their concerns and questions.

INVITED RESEARCH LECTURES

1. Sharp constants for Nash inequality, Analysis Seminar, University of Texas at Austin, December 1998.
2. Harnack inequality, PDE Seminar, University of Texas at Austin, December 1999.
3. Plane-like minimal surfaces in periodic media with exclusions, Texas PDE Conference, Houston, April 2001.
4. Plane-like minimal surfaces in periodic media with exclusions, Conference on Calculus of Variations, Toronto, Canada, August 2001.
5. Plane-like minimal surfaces in periodic media with exclusions, PDE Seminar, University of California at Berkeley, November 2001.
6. Divergence-measure fields and conservation laws, International Conference on Nonlinear Evolution Equations and Applications, Northwestern University, June 2003.
7. Divergence-measure fields and nonlinear conservation laws, First Chicago Area PDE workshop, October 2003.

8. Divergence-measure fields, sets of finite perimeter and conservation laws, Workshop on Multi-dimensional Euler Equations and Conservation Laws, University of Pittsburgh, November 2003.
9. Divergence-measure fields and conservation laws, International Symposium on Multidimensional Conservation Laws and Related Topics, Shanghai Jiao Tong University, China, December 2003.
10. Divergence-measure fields and conservation laws, Second Symposium on Analysis and PDEs, Purdue University, July 2004.
11. Invited lecture, PDE Seminar, Georgia Institute of Technology, February 21, 2006.
12. Invited speaker at the FRG Workshop on Multidimensional Hyperbolic Conservation Laws and Free Boundary Problems, Houston, TX, March 4, 2006.
13. Invited lecture, AMS conference, Miami, FL, April 1, 2006.
14. Invited lecture, AMS conference, University of Notre Dame, April 8, 2006.
15. Invited lecture, SIAM conference, University of Toledo, April 22, 2006.
16. Invited lecture, Kansas State University, May 2006.
17. Taught mini-course at Fudan University, Shanghai, China, June 6-20, 2006.
18. Organized session at SIAM meeting, Boston, MA, July 2006.
19. Invited lecture, PDE seminar, Northwestern University, October 5, 2006.
20. Invited lecture, Analysis seminar, IMAS, UNAM, Mexico, August 2006.
21. Invited lecture, Workshop on hyperbolic conservation laws and related equations, BANFF Center, Canada, October 2006.
22. Invited lecture, AMS Meeting, De Paul University, Chicago, IL, October 2007.
23. Invited lecture, Prairie Analysis Seminar, Kansas State University, Manhattan, KS, November 2007.
24. Invited lecture, Nonlinear Waves and Hyperbolic Equations, Centre for Advanced Study (CAS), Norwegian Academy of Science and Letters, Oslo, August 20, 2008.
25. Invited lecture, University of Akron, November 25, 2008.
26. Invited lecture, AMS meeting, Washington, DC, January 9, 2009.
27. Invited lecture, Analysis seminar, Louisiana State University, March 15, 2009.
28. Invited lecture, Analysis seminar, Kansas State University, October 2009.
29. Invited lecture, BANFF Center, Canada, October 2009.
30. Invited lecture, PDE Conference, Northwestern University, March 2010.
31. Invited lecture, PDE Seminar, University of Houston, April 2011.
32. Invited lecture, Analysis Conference, University of Kentucky, May 2011.
33. Invited lecture, AWM Anniversary Conference "40 Years and Counting: AWM's Celebration of Women in Mathematics" at Brown University, September 17-18, 2011.

34. Invited lecture, SIAM Conference, November 2011.
35. Invited talk, Colloquium at the IIMAS, UNAM, Mexico, March 13, 2013.
36. Invited talk, Workshop on conservation laws and related equations, BANFF, Canada, June 2, 2013.
37. Invited talk, Prairie Analysis Seminar, Kansas State University, September 27, 2013.
38. Invited talk, Conference on Nonlinear Evolutionary Partial Differential Equations: theories and applications, Shanghai Jiao Tong University, China, June 2014.
39. Invited talk, CIMAT, Mexico, December 2014.
40. Invited talk, Conference on PDE and Free Boundary Problems, University of Pittsburgh, March 2015.
41. Invited talk, Analysis Seminar, University of Maryland, April 30, 2015.
42. Invited lecture, Conference on Nonlinear Partial Differential Equations and Their Numerical Analysis, Hangzhou Normal University, Hangzhou, China, May 2015.
43. Invited talk, Analysis Seminar, University of Texas at Austin, Fall 2015.
44. Invited lecture, Chinese Academy of Sciences, Beijing, China, August 18, 2016.
45. Invited lecture, Special Session on Conservation Laws at the AMS Fall Central Sectional Meeting at the University of North Texas, Denton, **September 9-10, 2017**.
46. Invited Lecture, Analysis and PDE seminar, University of Pittsburgh, **October 2, 2017**.
47. Invited Lecture, Analysis and PDE seminar, Carnegie Mellon University, **October 5, 2017**.
48. Invited Lecture, 9th International Conference on Nonlinear Partial Differential Equations and their Numerical Analysis, Hunan Normal University, Changsha City, China, **September 10-12, 2018**.
49. Invited Lecture, 51 Congreso de la Sociedad Matematica Mexicana, Villahermosa, Tabasco, **October 21-26, 2018**.
50. Invited Lecture, Midwest PDE Conference, Indiana University, **March 30-31, 2019**.

SERVICE TO NSF AND OTHER ORGANIZATIONS

- Panel member for the National Science Foundation (Analysis), February 2011.
- Panel member for the National Science Foundation (Applied Analysis), March 2014.
- Panel member for the National Science Foundation, December 2014.
- Panel member for the Simons Foundation, April 2018.
- Panel member for the National Science Foundation, December 2018.

ACTIVITIES TO BROADEN THE PARTICIPATION OF UNDERREPRESENTED GROUPS

- Member of the Department of Mathematics Alliance Mentoring Plan.
- Member of the Department of Mathematics Diversity Committee.
- Participated, together with the Latino Cultural Center, in the 10/23/12 workshop mentoring program at Jefferson High School.

- Participated, together with the Latino Cultural Center, in the October 2013 workshop mentoring program at Jefferson High School.
- Gave a *Graduate Student Recruitment* talk at the Facultad de Ciencias, UNAM, Mexico, March 14, 2013.

DEPARTMENTAL SERVICE

- Organized Student PDE seminar, Fall 2006.
- Member of the Department of Mathematics Calculus Committee.
- Member of the Department of Mathematics Diversity Committee.
- Prepared and graded the *Qualifying Analysis Exam*, August 2012.
- Prepared and graded the *Qualifying Analysis Exam*, January 2014.
- Invited faculty to the AWM Purdue Chapter Meeting, January 2013.
- Helped to organize the Graduate Recruitment Weekend, March 1-2, 2013.
- Member of the Graduate Committee, Fall 2013- Fall 2015.
- Member of the Mathematics Department Alliance GPG Mentoring Plan.

UNIVERSITY SERVICE

- Advisor of the Society of Hispanic Engineers (SHPE), Purdue Chapter, 2006-2010.
- Member of the College of Science Diversity Committee, 2012-2014. Worked on the project of increasing the number of undergraduate minorities at Purdue. Conducted interviews with minority students to understand the issues they face and performed workshop mentoring programs at Jefferson High School.
- Member of the College of Science Diversity Committee, 2018-2019.

Member of the Ph. D. Committee for:

- (1) Thitarie Rungratgasame, defended her thesis on July 18, 2012
- (2) Jose Lugo, defended his thesis on April 11, 2013
- (3) Wenhui Shi, defended her thesis on June 27, 2013
- (4) Mariana Vega, defended her thesis on February 17, 2014
- (5) Guanying Peng, defended his thesis on July 15, 2014
- (6) Thomas Backing, defended his thesis on April 11, 2016
- (7) Seongmin Jeon, oral exam taken in the Spring 2018.

Member of the committee for Master's Degree of:

Alexia Mintos, graduated in the Spring, 2010

OTHER PROFESSIONAL ACTIVITIES

- Attended workshop on mixed type PDE arising in mechanics and geometry, at the AIM (American Institute of Mathematics), Palo Alto, CA. March 16-March 22, 2008.

- Attended workshop on hyperbolic conservation laws and related equations, at the IMA (Institute for Mathematics and its Applications), Minneapolis, MN, July 12-26, 2009.
- Attended Conference in Geometric Measure Theory, University Paris-Diderot, Paris 7, September 2012.
- Attended Summer School at the Center for Nonlinear Analysis, Carnegie Mellon University, Pittsburgh, PA, May 2013.
- Visiting fellow in the program "Free Boundary Problems and Related Topics" at the Isaac Newton Institute for Mathematical Sciences, Summer 2014.
- Attended Conference on Calculus of Variations and Nonlinear Partial Differential Equations UT-Austin, May 17-May 31, 2015.
- Attended Conference on Calculus of Variations and Nonlinear Partial Differential Equations Columbia University, May 2016.
- Attended Conference on Partial Differential Equations (in honor of Irene Fonseca), University of Montreal, June 2016.
- Attended Conference on Partial Differential Equations (in honor of David Kinderlehrer), Carnegie Mellon University, July 2016.
- Attended the 2017 Shanks Workshop on Mathematical Aspects of Fluids Dynamics, April 8-9, 2017.

EDITORIAL WORK

Referee for the following journals:

Communications in Mathematical Physics
 Proceedings of Edinburgh Mathematical Society (PEMS)
 Annales de la Faculte de Sciences de Toulouse
 Annali della Scuola Normale Superiore di Pisa Archive for Rational Mechanics and Analysis
 Communications in Partial Differential Equations
 Communications on Pure and Applied Analysis
 Electronic Journal of Differential Equations
 Journal of Differential Equations
 Indiana University Mathematics Journal
 SIAM Journal of Mathematical Analysis
 Computer and Mathematics with Applications
 Springer Proceedings in Mathematics and Statistics
 Journal of the London Mathematical Society