# Johnny Guzmán

Associate Professor
Division of Applied Mathematics
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## Employment

*Brown University, Division of Applied Mathematics*
2013- Associate Professor
2008-2013 Assistant Professor

*University of Minnesota, School of Mathematics*
2005-2008 NSF Postdoctoral Fellow (advisor: Bernardo Cockburn)

## Education

*Cornell University*
2005 Ph.D. Applied Mathematics (advisor: Lars Wahlbin)

*California State University-Long Beach (CSULB)*
1999 B.S. Mathematics (primary mentors: Robert Mena and Kent Merryfield)

*Cerritos Community College*
1995-1997 Completed General Education courses

## Journal Articles

*Appeared/ In Press*

1. J. Guzmán, *Quadrature and Schatz's pointwise estimates in finite element methods,* BIT 45 (2005), 695-707.
2. J. Guzmán, *Local analysis of discontinuous Galerkin methods applied to singularly*

*perturbed problems*, J. Numer. Math. 14 (2006), 41-56.
3. J. Guzmán, *Pointwise estimates for discontinuous Galerkin methods with lifting operators for elliptic problems*, Math. Comp. 75 (2006), 1067-1085.
4. J. Guzmán, *Local and pointwise error estimates of the local discontinuous Galerkin method for Stokes Problem*, Math. Comp. 77 (2008), 1293-1322.
5. B. Cockburn, B. Dong and J. Guzmán, *Optimal convergence of the original discontinuous Galerkin method for the transport-reaction equation on special meshes*, SIAM J. Numer. Anal. 46 (2008), 1250-1265.
6. B. Cockburn and J. Guzmán, *Error estimates for the Runge-Kutta discontinuous Galerkin method for the transport equation with discontinuous initial data*, SIAM J. Numer. Anal. 46 (2008), 1364-1398.
7. B. Cockburn, B. Dong and J. Guzmán, *A superconvergent LDG-hybridizable Galerkin method for secondorder elliptic problems*, Math. Comp. 77 (2008), 1887-1916.
8. B. Cockburn, J. Guzmán and H. Wang, *Superconvergent discontinuous Galerkin methods for second-order elliptic problems*, Math. Comp., 78 (2009), 1-24.
9. E. Burman, J. Guzmán and D. Leykekhman, *Weighted error estimates of the continuous interior penalty method for singularly perturbed problems*, IMA J. Numer. Anal., 29 (2009), 284-314.
10. J. Guzmán, and B. Riviere, *Suboptimal convergence of nonsymmetric discontinuous Galerkin method for odd polynomial approximations*, J. Sci. Comp., 40 (2009), 273-280.
11. J. Guzmán, D. Leykekhman, J. Rossmann and A. Schatz, *Hölder estimates for Greens functions on convex polyhedral domains and their applications to finite element methods*, Numer. Math., 112 (2009), 221-243.
12. B. Cockburn, B. Dong and J. Guzmán, *A hybridizable and superconvergent discontinuous Galerkin method for biharmonic problems*, J. Sci. Comput., 40 (2009), 141-187.
13. B. Cockburn, J. Guzmán, C.-S. Soon and H. Stolarski, *Analysis of the embedded discontinuous Galerkin method for second-order elliptic problems*, SIAM J. Num. Anal., 47 (2009), no. 4, 2686-2707.
14. B. Cockburn, B. Dong, J. Guzmán, M. Restelli and R. Sacco, *A hybridizable discontinuous Galerkin method for steady state convection-diffusion-reaction problems*, SIAM J. Sci. Comp., 31 (2009), no. 5, 3827-3846.
15. B. Cockburn, J. Gopalakrishnan and J. Guzmán, *A new elasticity element made for enforcing weak stress symmetry*, Math. Comp., 79 (2010), 1331-1349.
16. B. Cockburn, B. Dong, J. Guzmán and J. Qian, *Optimal convergence of the original DG method in special meshes for variable velocity*, Siam J. Num. Anal., 48 (2010), no. 1, 133-146.
17. J. Guzmán, *A unified analysis of several mixed methods for elasticity with weak symmetry*, J. Sci. Comp., 44 (2010), 156-169.
18. A. Demlow, J. Guzmán, and A.H. Schatz, *Local energy estimates for the finite element method on sharply varying grids*, Math. Comp. 80 (2011), 1-9.
19. W. Wang, J. Guzmán and C.-W. Shu, *The multiscale discontinuous Galerkin method for solving a class of second-order elliptic problems with rough coefficients*, Int. J. Numer. Anal. Model, 8(2011), no. 1, 28-47.
20. J. Gopalakrishnan and J. Guzmán, *A second elasticity element using the matrix bubble*, IMA J. Numer. Anal, to appear.

21. E.M. Behrens and J. Guzmán, *A mixed method for the biharmonic problem based on a system of first order equations*, SIAM J. Numer. Anal, 49 (2011), 789-817.
22. E.M. Behrens and J. Guzmán, *A new family of mixed methods for the Reissner-Mindlin plate model based on a system of first-order equations*, J. Sci. Comp., 49 (2011), 137-166.
23. J. Gopalakrishnan and J. Guzmán, *Symmetric non-conforming mixed finite elements for linear elasticity*, SIAM J. Numer. Anal., 49 (2011), 1504-1520.
24. J. Guzmán and D. Leykekhman, *Pointwise error estimates of finite element approximations to the Stokes problem on convex polyhedra*, Math. Comp., 81( 2012), 1879-1902.
25. J. Guzmán and M. Neilan, *A family of non-conforming elements for the Brinkman problem*, IMA J. Numer. Anal., IMA J. Numer. Anal, 32 ( 2012), no. 4, 1484-1508.
26. J. Guzmán, D. Leykekhman and M. Neilan, *A family of non-conforming elements and analysis of Nitsche's method for a singularly perturbed fourth-order problem*, Calcolo, 49 (2012), 95-125.
27. B. Cockburn, J. Guzmán and F.J. Sayas, *Coupling of RT and HDG with BEM, SIAM J. Numer. Anal.* 50 (2012), no. 5, 2778-2801.
28. J. Guzmán and M. Neilan, *Conforming and divergence free Stokes elements on general triangular meshes*, Math. Comp., 83 (2014) , no. 285, 15-36.
29. J. Guzmán, A. Salgado and F.-J. Sayas, *A note one the Ladyzenskaja-Babuska-Brezzi condition*, J. Sci. Comp., 56 (2013), 219-229.
30. J. Guzmán and M. Neilan, *Conforming and symmetric mixed finite elements for plane elasticity using rational bubbles*, Numer. Math., 126(2014), no. 1, 153-171.
31. S. Badia, R. Codina, T. Gudi and J. Guzmán, *Error Analysis of Discontinuous Galerkin Methods for Stokes Problem under Minimal Regularity*, IMA. J. Num. Anal., 34(2014), no.2, 800-819.
32. D. Arnold, R. Falk, J. Guzmán and G. Tsogtgerel, *On the consistency of the combinatorial codifferential*, Trans. Amer. Math. Soc. 366 (2014), no. 10, 5487-5502.
33. T. Gudi and J. Guzmán, *Convergence analysis of the lowest order weakly penalized adaptive discontinuous Galerkin methods*, *ESAIM Math. Model. Numer. Anal.* 48 (2014), no. 3, 753–764.
34. J. Guzmán and M. Neilan, *Conforming and divergence free Stokes elements in three dimensions*, *IMA J. Numer. Anal.* 34 (2014), no. 4, 1489–1508.
35. Y. Zhang, W. Wang, J. Guzman and C.-W. Shu, *Multi-scale discontinuous Galerkin method for solving elliptic problems with curvilinear unidirectional rough coefficients*, *J. Sci. Comput.* 61 (2014), no. 1, 42–60.
36. J. Guzman and C. Klivans, *Chip firing and energy minimization on M-matrices*, *J. Combin. Theory Ser. A* 132 (2015), 14–31.
37. J. Guzman and M. Sanchez-Uribe, *Max-norm Stability of low order Taylor-Hood elements in three dimensions*, *J. Sci. Comput.* 65 (2015), no. 2, 598–621.
38. J. Guzman, M. Sanchez-Uribe and M. Sarkis, *On the accuracy of finite element approximations to a class of interface problems*, Math. Comp. 85 (2016), no. 301, 2071–2098.
39. M. Ainsworth, J. Guzman and F.-J. Sayas, *Discrete extension operators for mixed methods on locally refined meshes*, Math. Comp., 85 (2016), no. 302, 2639–2650.
40. J. Guzman, M. Sanchez-Uribe and M. Sarkis, *Higher-order finite elements methods for*

*elliptic problems with interfaces*, M2AN, 50 (2016), no. 5, 1561–1583.

41. J. Guzman, F. A. Sequeira, and C.-W. Shu, *H(div) conforming and DG methods for incompressible Euler's equations*, IMA J. Numer. Anal. (2016).
42. J. Guzman, M. Sanchez-Uribe and M. Sarkis, *A Finite Element Method for High-Contrast Interface Problems with Error Estimates Independent of Contrast*, submitted.
43. J. Guzman and C. Klivans, *Chip-firing on general invertible matrices*, SIAM J. Discrete Math. 30 (2016), no. 2, 1115–1127.
44. J. Guzman and M. Olshanskii, *Inf-sup stability of geometrically unfitted Stokes finite elements*, submitted.

**Selected Presentations**

- Blackwell-Tapia Conference, U. Tennessee, Oct. 2016
- Scientific computing seminar, Institut de Mathematiques de Bordeaux, Sept. 2016
- Computational and Applied Mathematics Seminar, U. Tennessee. Mar. 2016
- Scientific computing seminar, U. Houston, Mar. 2016
- Applied Mathematics Colloquium, NJIT, Jan. 2016
- SACNAS national conference, D.C., October 2015
- Three mini-symposium talks at ICIAM, Beijing, July 2015
- Advanced Numerical Methods in the Mathematical Sciences, Texas A & M, May 2015
- Numerical Methods for Partial Differential Equations, MIT, April 2015.
- Numerical Analysis Seminar, Universidad Nacional de Colombia- Bogota, Nov. 2014
- Structure Preserving Discretizations, IMA, Oct. 2014
- Durham LMS-EPSRC Symposium, Durham England, July 2014
- Robust Discretization and Fast Solvers for Computable Multi-Physics Models, ICERM, May 2014
- Numerical Analysis Seminar, U. Pittsburgh, March. 2014
- Numerical Analysis Seminar, IISC, Bangalore, May 2013.
- Numerical analysis seminar, U. Maryland, Nov. 2012
- Mini-symposium talk, WCCM, Sao Paulo, July 2012
- Seminar, CIMNE, UPC, Barcelona, June 2012
- Numerical analysis seminar, U. Pittsburgh, Mar. 2012
- Numerical analysis seminar, Courant Institute, NYU, Nov. 2011
- Finite Element Circus, U. Connecticut, Oct. 2011
- Two mini-symposium talks at ICIAM, Vancouver, July 2011
- Numerical Methods for Incompressible Fluid Flow Workshop, UBC, Vancouver, July 2011

- Analysis and PDE Seminar, U. Delaware, March 2011.
- Mini-symposium presentation, SIAM annual meeting, Pittsburgh, July 2010
- Plenary talk, SIDIM, Univeristy of Puerto Rico-Mayagüez, Feb. 2009
- Mathematics Colloquium, WPI, Worcester, MA, Nov. 2009
- Applied Math Seminar, IMPA, Rio de Janeiro, Brazil, April 2009
- Three talks at MAFELAP, Brunel U., United Kingdom, June 2009
- Finite Element Circus, U. Delaware, DE, May 2009
- Applied Math Seminar, Michigan State U., East Lansing, MI, Mar. 2009
- Finite Element Circus, RPI, Troy, NY, Oct. 2008
- Computational and Applied Mathematics Seminar, UCI, Irvine, CA, April 2008
- Special Colloquium, Brown U., Providence, RI. Jan. 2008
- Special Colloquium, LSU, Baton Rouge, LA, Jan. 2008
- Numerical Analysis Seminar, Texas A&M, College Station, TX, Dec. 2007
- Special Colloquium, University of Illinois-Chicago, Chicago, IL, Dec. 2007
- BIRS meeting on DG methods, Banff, Alberta Canada, Nov. 2007
- Special Numerical Analysis/PDE seminar, U. of Kentucky, Lexington, KY, Sep. 2007
- Finite Element Circus, University of Maryland , College Park, MD, April 2007
- Computational and Applied Math Colloquium, Rice U., Houston, TX, April 2007
- Finite Element Circus, Penn State U., State College, PA, Nov. 2006
- DG mini-symposium, 7th World congress on computational mechanics, Los Angeles, CA, July 2007
- DG mini-symposium, AMS annual conference, Atlanta, GA, Jan. 2005
- Workshop on Numerical Approximations to PDE, Concepcion, Chile, Jan. 2004

Workshops or conferences attended (no talk given)

- Theory and Applications of discontinuous Galerkin methods, Oberwolfach, Feb. 2012
- Blackwell-Tapia conference, 2012.
- Mathematical Analysis of Turbulence, IPAM, Sep. 2014.
- SACNAS National Conferences, 2013, 2016.
- CAARMS, 2015.

**Grants**

*Completed Grants*

- NSF, Division of Mathematical Sciences, Postdoctoral Research Fellowship, 2005-2008, PI, $108,000
- NSF, Division of Mathematical Sciences (SCREMS), # 0922803, 2009-2011, CO-PI, $86,420
- CBMS/NSF (grant to organize workshop in June 2012), # DMS-1138011, 2012, PI, $43,648

- NSF, Division of Mathematical Sciences, # 0914596, 2009-2012, PI, $189,826

- NSA, REU Grant, # 003967, Summer 2014, PI, $61,706

- ARO, Conference Grant, GR5212022, Dec. 2016, PI, $14,950
- ONR, Conference Grant, GR5250018, Dec. 2016, PI, $18,389
- AFOSR, Conference Grant, GR5210010, Dec. 2016, PI, $ 23,201

*Current Grants*

- NSF, Division of Mathematical Sciences, Title: *Topics in the analysis of finite elements*, #1318108, 2013-2016, PI, $210,000
- Brazil Collaboration Grant (Internal), Co-PI, $19,576.
- NSF, Division of Mathematical Sciences, *Title: Topics in Finite Element Analysis*, 2016-2019

*Grants that were not funded*

- NSF, RTG: Advanced Numerical Modeling: Analysis and Design, PI, $2,671,188. Submitted in 2016.

**Service**

*University Service*

- Member of 2008 search committee for Prager Assistant Professor
- Applied mathematics library representative for 2009
- Mentor for Brown University's African, Latino, Asian and Native American (ALANA) mentoring program, 2008-2009 and 2009-2010
- Served on several Ph.d. thesis committees
- Given several prelim exams
- Concentration advisor, 2011-2013
- First Year Advisor, 2011-2016
- Graduate Selection Committee member 2013-
- IMSD expansion team 2016-

*Professional Service*

- Associate Editor: Journal of Numerical Mathematics and Journal of Scientific Computing
- Referee work: Mathematics of Computation, SIAM Journal on Numerical Analysis (SINUM), Numerische Mathematik, Journal of Scientific Computing, Computer Methods in Applied Mechanics and Engineering, M2AN, Science in China: Series A-Mathematics, Journal of Computational Physics, Journal of Computational and Applied Mathematics, ZAMM, SISC

- Co-taught a three week course in the African Institute of Mathematics-Senegal, Jan. 2017.
- Co-organizer of the conference *Frontiers in Applied and Computational Mathematics,* Providence, Jan. 2017.
- Co-organized mini-symposium at WONAPDE, Concepcion, Chile, Jan. 2016.
- Co-organizer of CBMS workshop on Finite element exterior Calculus, ICERM, Providence, June 2012
- Local organizer for Finite Element Circus Conference in the Spring 2010, Brown University
- Guest organizer of Finite Element Circus Fall 2010, IMA.
- Co-organized the DG mini-symposium in the 2009 MAFELAP conference, Brunel U., UK
- NSF panel member 2009, 2013, 2014.
- Poster Judge at the 2006, 2007 and 2009 national conferences of the Society for the Advancement of Chicanos and Native-Americans in Science

**Awards and Honors**

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| 2013 | Comfort and Urry Family Fund Prize |
| 2005 | NSF Postdoctoral Fellowship |
| 1999 | Ford Foundation and Cornell-Sloan Fellowships |
| 1999 | CSULB's Outstanding Graduate in Mathematics |

Teaching

*Brown University*

- Fall 2008, APMA 34, Introduction of Differential Equations
- Spring 2009, Spring 2011, Spring 2017, APMA 118, Introduction to Numerical Solution to Differential Equations
- Fall 2009 and Fall 2011, Fall 2015, APMA 257, Numerical Solution to Partial Differential Equations III
- Spring 2010, Spring 2012, Spring 2014, Spring 2016, APMA 16, Introduction to Scientific Computing
- Fall 2016, APMA 255, Numerical Solutions to Partial Differential Equations I
- Fall 2012, APMA 117, Computational Linear Algebra
- Fall 2013, APMA 1930L, Fast methods in scientific computing
- Fall 2014, APMA 2580, Computational Fluid Dynamics

*University of Minnesota*

- Calculus
- Sequences, Series and Foundations

*Cornell University*

- Calculus
- Real Analysis (in the Summer Math Institute)

*African Institute of Mathematics-Sengal*

- Introduction to numerical methods for elliptic PDEs. This was a three week course were students learned basic finite difference and finite element methods. This took place Jan.2017 and was co-taught with Gerard Awanou.

## Visitors for one month (or more)

- Edwin M. Behrens, Catholic University of Concepcion-Chile, Fall 2009.
- Thirupathi Gudi, Indian Institute of Science, mid July- mid August of 2012.
- Alexandre Madureira, LNCC, Brazil, August 2015-July 2016.
- Marcus Sarkis, WPI, August 2015-July 2016.
- Douglas Arnold, UMN, Nov. 2016.

## Research Supervision

### Ph.D. Students

- Manuel Sanchez-Uribe, Graduated May 2016

  Thesis Title: Analysis and Development of Finite Element Methods for Interface Problems

  First position: Dunham Jackson Assistant Professor at University of Minnesota

- Filander Sequeira, Graduated Dec. 2015, Ph.D. granted by Universidad de Concepcion, Chile, co-advised with Gabriel Gatica

  Thesis Title: Metodos de Elementos Fnitos Mixtos y Afines para Problemas No-lineales y de Transmision en Mecanica de Medios Continuos.

  First Position: Assistant Professor, Universidad Nacional de Costa Rica

### Undergraduate Students

- Summer research experience 2013: Jean Guilluame, Anthony Pellegrino and Samy Wu. Jean was supported by the *Leadership Alliance*. Students studied immersed boundary methods using finite elements. The application was blood flow through aorta.
- Summer research experience 2014: Samantha Davies, Arman Green, Cassidy Krause, Gopal Yalla. Supported by NSA Grant, and part of Leadership Alliance. Samantha and Gopal studied the generalized Constantin-Majda-Lax equations both analytically and numerically. Armand and Cassidy studied the discrete maximum principal or lack thereof.