Blake H. Barker – Curriculum Vitae

CONTACT INFORMATION

Department of Mathematics
Brigham Young University
275 TMCB Brigham Young University
Provo, UT 84602

Tel: (801) 422-7936
E-mail: blake@math.byu.edu
Webpage: `https://math.byu.edu/~blake/`

RESEARCH INTERESTS

Stability of traveling waves in conservation laws, reaction diffusion equations, and other evolution systems, rigorous numerical verification, tipping points, wildfire, and applied math.

APPOINTMENTS

Brigham Young University
Associate Professor, Sept 2022 - Present
Assistant Professor, Aug 2016-2022

Brown University
Postdoctoral Fellow (NSF Postdoctoral Fellow in Mathematics), Sept 2014-July 2016, June 2017/2018
Mentor: Björn Sandstede

EDUCATION

Indiana University
Ph.D., Mathematics, July 2014
Dissertation Adviser: Kevin Zumbrun
Dissertation Title: "Numerical proof of stability of roll waves in the small-amplitude limit for inclined thin film flow"

Brigham Young University
M.S., Mathematics, May 2009
Thesis Adviser: Jeffrey Humpherys
Thesis Title: "Evans Function Computation"

Brigham Young University
B.S., Mathematics, Aug 2007

GRANTS, FELLOWSHIPS, AND AWARDS

- Department Distinguished Mentoring Award, 2020.
- Mentoring Environment Grant from the BYU College of Physical and Mathematical Sciences, 2017-2019.
- 2016 Richard C. DiPrima Prize
- National Science Foundation Postdoctoral Fellowship in Mathematics, 2014-2018, Award No. DMS-1400872.
- College of Arts and Sciences Dissertation Year Research Fellowship, 2013-2014.

PUBLICATIONS

1. B. Barker, J. C. Bronski, V. M. Hur, Z. Yang *Asymptotic stability of sharp fronts. I One bound state implies stability.* arXiv:2112.04700.

2. M. Allen, B. Barker, J. Gardner, M. Zhao, *Minimizers of a free boundary problem on three-dimensional cones.* Nonlinear Analysis, Vol 226, Jan 2023.

3. B. Barker, R. Manteiro, K. Zumbrun, *Transverse bifurcation of viscous slow MHD shocks.* Physica D: Nonlinear Phenomena, Vol 420, June 2021; see also arXiv:1901.09153v1.

4. B. Barker, J.D. Mireles James, J. Morgan, *Parameterization method for unstable manifolds of standing waves on the line*, SIAM Journal on Applied Dynamical Systems, 19(3), 1758-1797, 2020.

5. B. Barker, B. Melinand, K. Zumbrun, *Existence and stability of steady noncharacteristic solutions on a finite interval of full compressible Navier-Stokes equations.* arXiv:1911.06691v1.

6. B. Barker, J. Humpherys, J. Lytle, G. Lyng, *Evans function computation for the stability of travelling waves*, Phil. Trans. R. Soc. A 376: 20170184. http://dx.doi.org/10.1098/rsta.2017.0184

7. B. Barker, J. Humpherys, G. Lyng, K. Zumbrun, *Euler vs. Lagrange: The role of coordinates in practical Evans-function computations*, SIAM J. Appl. Dyn. Syst., 17(2), 1766-1785.

8. B. Barker, R. Nguyen, B. Sandstede, N. Ventura, C. Wahl, *Computing Evans functions numerically via boundary-value problems*, Physica D: Nonlinear Phenomena, Vol 367, 1 - 10, 2018. DOI: https://doi.org/10.1016/j.physd.2017.12.002.

9. B. Barker, J. Humpherys, G. Lyng, K. Zumbrun, *Balanced flux formulations for multidimensional Evans function computations for viscous shocks*, Quart. Appl. Math. October 25, 2017. DOI: https://doi.org/10.1090/qam/1492.

10. B. Barker, S. Jung, K. Zumbrun, *Turing patterns in parabolic systems of conservation laws and numerically observed stability of periodic waves,* Physica D: Nonlinear Phenomena, Vol 367, 11-18, 2018. DOI: https://doi.org/10.1016/j.physd.2017.12.003.

11. B. Barker, M. A. Johnson, P. Noble, L. M. Rodriques, K. Zumbrun, *Stability of Viscous St. Venant Roll Waves: From Onset to Infinite Froude Number Limit.* Journal of Nonlinear Science, 1-58, 2016. DOI: 10.1007/s00332-016-9333-6.

12. B. Barker, M. A. Johnson, P. Noble, L. M. Rodriques, K. Zumbrun, *Note on the stability of viscous roll-waves*, Comptes rendus Mecanique, Dec 2016, DOI:10.1016/j.crme.2016.11.001.

13. B. Barker and K. Zumbrun, *Numerical proof of stability of isentropic Navier-Stokes shocks.* Mathematical Models and Methods in Applied Sciences, Vol 26, No. 13. 2451-2469, 2016.

14. B. Barker, J. Humpherys, G. Lyng, and K. Zumbrun, *Viscous hyperstabilization of detonation waves in one space dimension,* SIAM Journal on Applied Mathematics, 2015, 75(3): 885-906.

15. B. Barker, H. Freistühler, K. Zumbrun, *Convex entropy, Hopf bifurcation, and viscous and inviscid shock stability*, Arch. Rational Mech. Anal., 2015 (DOI) 10.1007/s00205-014-0838-6.

16. B. Barker, *Numerical proof of stability of roll waves in the small-amplitude limit for inclined thin film flow*, Journal of Differential Equations, 257: 2950-2983, 2014.

17. B. Barker, M. Johnson, P. Noble, M. Rodrigues, and K. Zumbrun, *Nonlinear Modulational Stability of Periodic Traveling-Wave Solutions of the Generalized Kuramoto- Sivashinsky Equation*, Physica D: Nonlinear Phenomena, 258 no. 1: 11-46, 2013.

18. B. Barker, M. Johnson, P. Noble, M. Rodrigues, and K. Zumbrun, *Stability of periodic Kuramoto-Sivashinsky waves*, Applied Mathematics Letters, 25 no. 5: 824-829, 2012.

19. B. Barker, M. Lewicka, and K. Zumbrun, *Existence and stability of viscoelastic shock profiles,* Arch. Ration. Mech. Anal., Volume 200, Number 2, (2011) 491-532.

20. B. Barker, M. Johnson, M. Rodrigues, and K. Zumbrun, *Metastability of solitary roll wave solutions of the St. Venant equations with viscosity*, Physica D: Nonlinear Phenomena, 240 (2011) no. 16: 1289-1310.

21. S. Yarahmadian, B. Barker, K. Zumbrun, S. Shaw, *Existence and stability of steady states of a reaction convection diffusion equation modeling microtubule formation*, J. Math. Biol., Volume 63, (2011) 459-492.

22. B. Barker, M. Johnson, P. Noble, M. Rodrigues, and K. Zumbrun, *Whitham averaged equations and modulational stability of periodic solutions of hyperbolic-parabolic balance laws*, Journes quations aux drives partielles (2010), Exp. No. 3.

23. B. Barker, O. Lafitte, and K. Zumbrun, *Existence and stability of viscous shock profiles for 2-D isentropic MHD with infinite electrical resistivity,* Acta Mathematica Scientia, Volume 30, Number 2 Series B, (2010) 447-498.

24. B. Barker, J. Humpherys, and K. Zumbrun, *One-dimensional stability of parallel shock layers in isentropic magnetohydrodynamics,* Journal of Differential Equations, 249(9):2175-2213, 2010.

25. B. Barker, J. Humpherys, K. Rudd, and K. Zumbrun, *Stability of viscous shocks in isentropic gas dynamics*, Comm. Math. Phys. 281 (2008), no. 1, 231-249.

26. B. Barker, J. Humpherys, O. Lafitte, K. Rudd, and K. Zumbrun, *Stability of isentropic Navier-Stokes shocks*, Appl. Math. Lett. 21 (2008), no. 7, 742-747.

SCIENTIFIC SOFTWARE

- B. Barker, J. Humpherys, J. Lytle, and K. Zumbrun, *STABLAB: A MATLAB-based numerical library for Evans function computation*, Available at: https://github.com/nonlinear-waves/stablab.git.

- B. Barker, Jeffrey Humpherys, Joshua Lytle, Jalen Morgan, Taylor Paskett. *STABLAB-PYTHON: A Python-based numerical library for studying stability of traveling waves.* Available at https://github.com/nonlinear-waves/.

INVITED TALKS AND CONFERENCE PRESENTATIONS

1. Solving ODE eigenvalue problems with rigorous computation. M@th Hub workshop-seminar (online), Georgia Tech, December 2022.

2. Identification of tipping points due to bifurcation and noise. Applied Math Seminar at George Mason University, October 2022.

3. Stability of Sharp Fronts - Computer Assisted Methods of Proof. SIAM Conference on Nonlinear Waves and Coherent Structures, August 2022.

4. Stability of sharp fronts - computer assisted methods of proof. The Twelfth IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena: Computation and Theory, March 2022.

5. Verifying stability of traveling waves with rigorous computation. SIAM Dynamical Systems, May 2021.

6. "Rigorous numerical verification of wave stability." CRM CAMP In Nonlinear Analysis Seminar, November 2020.

7. "An open problem." BIRS Connections in Infinite Dimensional Dynamics Workshop, May 2020.

8. "Stability of viscous and inviscid MHD waves." Analysis of Fluids Seminar-Princeton University, April 2020.

9. "Rigorous verification of wave stability." EQUADIFF 2019, July 2019, Universiteit Leiden.

10. "Rigorous numerical verification of wave stability." Stability of Nonlinear Waves: Computation and Analysis, July 2019, Institut Henri Poincaré.

11. "Rigorous verification of wave stability." SIAM Dynamical Systems, May 2019.

12. "Rigorous verification of wave stability." IMACS Nonlinear Waves and Coherent Structures, April 2019, Georgia University.

13. "Rigorous numerical verification". Math Colloquium, College of Charleston, March 2019.

14. "Numerical stability analysis for thin film flow: toward rigorous verification." Utah State University, Math Seminar, 17 Jan 2019.

15. "Computation of the Evans Function in Large Systems". SIAM Annual Meeting, July 12, 2018.

16. "Rigorous numerical verification of properties of traveling waves". Université Paris 13, July 3, 2018.

17. "Rigorous numerical verification of properties of traveling waves". SIAM Nonlinear Waves, June 13, 2018.

18. "Numerical bifurcation study for viscous shock and detonation waves". BYU Physics Theory Seminar, 6 March 2018.

19. "Recent Advances in Rigorous Computation of the Evans Function." SIAM Conference on Applications of Dynamical Systems, May 2017.

20. "A Boundary Value Algorithm for Computing the Evans Function." SIAM Conference on Nonlinear Waves and Coherent Structures, Philadelphia, USA, August 2016.

21. "Recent Results Verifying Stability of Traveling Waves with Computer Assisted Proof." American Institute of Mathematical Sciences conference on Differential Equations, Dynamical Systems and Applications, Orlando, FL, 2 July 2016.

22. "Numerical proof of stability of viscous shock profiles." Kansas University, KS, 26 April 2016.

23. Poster: "Efficient and rigorous computation of the Evans function." KUMU Conference on PDE, Dynamical Systems, and Applications, April 23, 2016.

24. "Numerical stability analysis for 1D isentropic gas." SIAM Conference on Analysis of Partial Differential Equations, Scottsdale, AZ, 9 Dec 2015.

25. "Numerical bifurcation study for viscous shock and detonation waves." SIAM Conference on Analysis of Partial Differential Equations, Scottsdale, AZ, 7 Dec 2015.

26. "Numerical bifurcation study for viscous shock and detonation waves." Boston University and Brown University joint PDE seminar, 17 Nov 2015.

27. "Numerical stability analysis for 1D isentropic gas." AMS Sectional Meeting at Rutgers University, 14 Nov 2015.

28. "Numerical stability analysis for thin film flow." Boston University, 14 Sept 2015.

29. "Numerical stability analysis for thin film flow." Texas A&M, May 8, 2015.

30. "Numerical stability analysis for thin film flow." RPI Applied Math Days, April 10, 2015.

31. "Numerical stability analysis for thin film flow." IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena: Computation and Theory, April 2015.

32. "Numerical bifurcation study for viscous shock and detonation waves." Workshop on stability of viscous shock waves in Paris, France, 3 Mar 2015. http://www.sciencesmaths-paris.fr/en/cours-de-kevin-zumbrun-661.htm.

33. "Numerical stability analysis for thin film flow." Workshop on stability of viscous shock waves in Paris, France, 26 Feb 2015.

34. "A Numerical Study of Stability of Periodic generalized Kuramoto-Sivashinsky Waves." Workshop on stability of viscous shock waves in Paris, France, 26 Feb 2015.

35. "Existence and Stability of Viscous Shock Profiles for Isentropic MHD with Infinite Electrical Resistivity." Workshop on stability of viscous shock waves in Paris, France, 19 Feb 2015.

36. "Stability of viscous shocks in isentropic gas dynamics." Workshop on stability of viscous shock waves in Paris, France, 19 Feb 2015.

37. "Numerical computation of the Evans function." Workshop on stability of viscous shock waves in Paris, France, 19 Feb 2015.

38. "Numerical stability analysis for thin film flow: toward rigorous verification." Brown University, Lefschetz Center for Dynamical Systems Seminar, 28 Apr 2014.

39. "Numerical stability analysis for thin film flow: toward rigorous verification." University of North Carolina, UNC PDE Graduate Mini-Schools 2013-2014, Oct 2013.

40. "Numerical stability analysis for thin film flow: toward rigorous verification." North Carolina State University, Differential Equations Seminar, September 30, 2013.

41. "Numerical stability analysis for thin film flow: toward rigorous verification." IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena: Computation and Theory, March 25-28, 2013.

42. "A Numerical Study of Stability of Periodic Kuramoto-Sivashinsky Waves." SIAM Conference on Nonlinear Waves and Coherent Structures, Seattle, June 2012.

43. "A Numerical Study of Stability of Periodic Kuramoto-Sivashinsky Waves." AMS, Spring Central Section Meeting at University of Kansas, Mar 2012.

44. "A numerical stability investigation of strong ZND detonations." IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena: Computation and Theory, April 2011.

45. "Existence and Stability of Viscous Shock Profiles for Isentropic MHD with Infinite Electrical Resistivity." SIAM Conference on Nonlinear Waves and Coherent Structures, August 2010.

46. "Stability of Viscous Shock Layers in Isentropic Gas Dynamics." AMS/MAA Joint Meeting Undergraduate Poster Session, Jan 2009.

47. "The Evans function: computational challenges and recent results." SIAM Conference on Applications of Dynamical Systems, May 2009.

48. "Stability of viscous shocks in isentropic gas dynamics." SIAM Conference on Applications of Dynamical Systems, Spring 2007.