CURRICULUM VITAE

TASSO J. KAPER

RESEARCH AREAS: Nonlinear dynamical systems, geometric singular perturbation theory; ODEs and PDEs with multiple time scales; Pattern formation in reaction-diffusion equations; Pulse and spot dynamics, interactions, and self-replication; Applications in bubble dynamics and fluid mechanics; Analysis of reduction methods in chemical kinetics; Pattern formation on emrbyos; Analysis of renormalization group methods; Normal form theory for nonautonomous systems; Mathematical biology, neurophysiology; torus canards; Operator-splitting methods. Nonlinear Schrödinger equation; Hamiltonian systems and orbits homoclinic to resonance bands.

1992, Ph.D., Applied Mathematics, California Institute of Technology,

B.Sc. in Mathematics, June, 1986 University of Chicago.

Sep. 2004 – present Professor of Mathematics (with tenure), Boston University
Sep. 1998 – Aug. 2004 Associate Professor of Mathematics (with tenure), Boston University
Sep. 1992 – Aug. 1998 Assistant Professor of Mathematics, Boston University
Aug. 2011 – present Department Chair

Nov. 2012 – present Fellow, American Mathematical Society
Jul. 2009 – present Fellow, Society for Industrial and Applied Mathematics
Jan. 2012 – present Associate Editor, *SIAM Journal on Applied Dynamical Systems*
Jan. 2008 – present Editor, *Advances in Differential Equations*
Jan. 2008 – present Editor, *Differential and Integral Equations*

PUBLICATIONS

1. "Calculating Fourier transforms of long–tailed functions," 1987, *SIAM Journal on Scientific and Statistical Computing*, **8**, 1005, J. N. Lyness and T.J. Kaper.

2. "A commentary 'On the periodic solutions of a forced second order equation' by SP Hastings and JB McLeod," 1991, *Journal of Nonlinear Science*, **1**, 247–253, T.J. Kaper and S. Wiggins.

3. "Lobe area in adiabatic Hamiltonian systems," 1991, *Physica D*, **51**, 205–212, T.J. Kaper and S. Wiggins.

4. "On the structure of separatrix–swept regions in singularly–perturbed Hamiltonian systems," November 1992, *Journal of Differential and Integral Equations*, **5**, 1363–1381, T.J. Kaper and S. Wiggins.

5. "An analytical study of transport in Stokes flows exhibiting large–scale chaos between eccentric cylinders," 1993, *Journal of Fluid Mechanics*, **253**, 211–243, T.J. Kaper and S. Wiggins.

6. "A geometric criterion for adiabatic chaos," 1994, *Journal of Mathematical Physics*, **35**, 1202–1218, T.J. Kaper and G. Kovacic.

7. "A simple model of chaotic advection and scattering," 1995, *Chaos*, **5**, no. 4, 671–686, G. Stolovitzky, T.J. Kaper, and L. Sirovich.

8. "Wave-number transport: Scattering of small–scale internal waves by large–scale near–inertial wavepackets," 1995, *Journal of Fluid Mechanics*, **289**, 379–405, D.L. Bruhwiler and T.J. Kaper.

9. "$N-$th order operator splitting schemes and nonreversible systems." 1996, *SIAM Journal on Numerical Analysis*, **33**, no. 1, 349–367, D. Goldman and T.J. Kaper.

10. "Tracking invariant manifolds up to exponentially small errors," 1996, *SIAM Journal on Mathematical Analysis*, **27**, no. 2, 558–577, C. Jones, T.J. Kaper, and N. Kopell.

11. "Multi-bump orbits homoclinic to resonance bands," 1996, *Transactions of the American Mathematical Society*, **348**, 3835–3887, T.J. Kaper and G. Kovacic.

12. "Higher–order Melnikov theory for adiabatic systems," 1996, *Journal of Mathematical Physics*, **37**, 6220–6249, C. Soto–Treviño and T.J. Kaper.

13. "Global dynamics of a rapidly forced cart and pendulum," 1997, *Nonlinear Dynamics*, **13**, 131–170, with S. Weibel and J. Baillieul.

14. "Pattern formation in the 1–D Gray–Scott model," 1997, *Nonlinearity*, **10**, pages 523-563, A. Doelman, T.J. Kaper, and P. Zegeling.

15. "Stability analysis of singular patterns in the 1-D Gray-Scott model," 1998, *PhysicaD*, **122**, pages 1–36, A. Doelman, R. Gardner, and T.J. Kaper.

16. "On the application of geometric singular perturbation theory to some classical two point boundary value problems," 1998, *International Journal of Bifurcation and Chaos*, **8**, pages 189-209, M.G. Hayes, T.J. Kaper, N. Kopell and K. Ono.

17. "On acoustic cavitation of slightly subcritical bubbles," 1999, *Physics of Fluids*, **11**, pages 274–287, A. Harkin, T.J. Kaper, and A. Nadim.

18. "A reaction-diffusion equation with periodic front dynamics," 2000, *SIAM Journal on Applied Mathematics*, **60**, pages 1601–1638 G. Medvedev, T.J. Kaper, and N. Kopell.

19. "On axi-symmetric traveling waves and radial solutions of semi-linear elliptic equations," 2000, *Natural Resource Modeling*, **13**, pages 339–388, K. Ono, T. Witelski, and T.J. Kaper.

20. "Stationary periodic patterns in the 1-D Gray-Scott model," 2000, *Methods and Applications of Analysis*, **7**, 105–150, D.S. Morgan, A. Doelman, T.J. Kaper.

21. "Alpha-frequency rhythms desynchronize over long cortical distances: a modeling study," 2000, *J. Computational Neuroscience*, **9(3)**, 271–291, S.R. Jones, D. Pinto, T.J. Kaper, and N. Kopell.

22. "Large stable pulse solutions in reaction-diffusion equations," 2001, *Indiana University Mathematics Journal*, **50 (1)**, 443–507, A. Doelman, R. Gardner, T.J. Kaper.

23. "Critical wave speeds for a family of reaction-diffusion equations," 2001, *Applied Mathematics Letters*, **14(1)**, 65–73, K. Ono, T.J. Kaper, and T. Witelski.

24. "Slowly-modulating two pulse solutions in the Gray-Scott model, Part I: Asymptotic construction and stability," 2001, *SIAM Journal of Applied Mathematics*, **61(3)**, 1080–1102, A. Doelman, W. Eckhaus, and T.J. Kaper.

25. "Slowly-modulating two pulse solutions in the Gray-Scott model, Part II: geometric theory, bifurcations, and splitting dynamics," 2001, *SIAM Journal of Applied Mathematics*, **61(6)**, 2036–2062, A. Doelman, W. Eckhaus, T.J. Kaper.

26. "An unfolding theory approach to bursting in fast-slow systems," 2001, *Global Analysis of Dynamical Systems*, H. Broer, B. Krauskopf, and G. Vegter, eds., IOP Pub., 277-308, M. Golubitsky, K. Josic, T.J. Kaper.

27. "Spatially periodic and aperiodic multi-pulse patterns in the one-dimensional Gierer-Meinhardt equations," 2001, *Methods and Applications of Analysis*, **8**, 387-414, A. Doelman, H. v.d. Ploeg, T.J. Kaper.

28. "Coupled pulsation and translation of two gas bubbles in a liquid," 2001, *Journal of Fluid Mechanics*, **445**, 377-411, Anthony Harkin, T. J. Kaper, and Ali Nadim.

29. "Blowup in the nonlinear Schrödinger equation near critical dimension," 2002, *Journal of Mathematical Analysis and Applications*, **268**, 517-549, V. Rottschäfer and T.J. Kaper.

30. A stability index analysis of 1-D patterns in the Gray-Scott model," 2002, *Memoirs of the American Mathematical Society*, Number 737, published by the American Mathematical Society, Providence, RI, ISSN 0065-9266, A. Doelman, R.A. Gardner, and T.J. Kaper (a 64 page book).

31. "Asymptotic analysis of two reduction methods for systems of chemical reactions," 2002, *PhysicaD*, **165**, 66-93, H.G. Kaper and T.J. Kaper.

32. "Semi-strong pulse interactions in a class of coupled reaction-diffusion equations," 2003, *SIAM Journal on Applied Dynamical Systems,* **2**, 53-96, A. Doelman and T.J. Kaper.

33. "Coordination of central pattern-generating circuits that control limb movements: the sources of stable differences in intersegmental phases," 2003, *Journal of Neuroscience,* **23(8)**, 3457-3469, S.R. Jones, T.J.

Kaper, N. Kopell, and B. Mulloney.

34. "Geometric theory for multi-bump, self-similar, blowup solutions of the cubic nonlinear Schrödinger equations," 2003, *Nonlinearity*, **16**, 929-961, V. Rottschäfer and T.J. Kaper.

35. "Analysis of state-dependent transitions in frequency and long-distance coordination in a model oscillatory cortical circuit," 2003, *Journal of Computational Neuroscience*, **15**, 283–298, D. Pinto, S.R. Jones, T.J. Kaper, and N. Kopell.

36. "Axisymmetric ring solutions of the 2-D Gray-Scott model and their destabilization into spots," 2004, *PhysicaD*, **192**, 33–62, D.S. Morgan and T.J. Kaper.

37. "Analysis of the CSP reduction method for chemical kinetics," 2004, *Journal of Nonlinear Science,* **14**, 59–91, A. Zagaris, H.G. Kaper, T.J. Kaper.

38. "Fast and slow dynamics of the Computational Singular Perturbation method," 2004, *SIAM Journal on Multiscale Modeling and Simulation*, **2**, 613–638, A. Zagaris, H.G. Kaper, T.J. Kaper.

39. "Two perspectives on reduction of ordinary differential equations," 2005, *Mathematische Nachrichten*, **278**, 1629–1642, A. Zagaris, H.G. Kaper, T.J. Kaper.

40. "Projecting to a slow manifold: singularly perturbed systems and legacy codes," 2005, *SIAM Journal on Applied Dynamical Systems*, **4**, 711–731, C.W. Gear, T.J. Kaper, Y. Kevrekidis, and A. Zagaris.

41. "Rigorous asymptotics for critical wave speeds in a family of reaction-diffusion equations," 2006, *Journal of Dynamics and Differential Equations*, **18**, 103–139, N. Popovic and T.J. Kaper.

42. "A geometric construction of traveling waves in a bioremediation model," 2006, *Journal of Nonlinear Science*, **16**, 329–349, M.A. Beck, A. Doelman, and T.J. Kaper.

43. "Homoclinic bifurcations at the onset of pulse self-replication," 2006, *Journal of Differential Equations*, **231**, 359–423, A. Doelman, T.J. Kaper, and L.A. Peletier.

44. "The asymptotic critical wave speed in a family of scalar reaction-diffusion equations," 2007, *Journal of Mathematical Analysis and Applications*, **326**, 1007-1023, F. Dumortier, N. Popovic, and T.J. Kaper.

45. "The critical wave speed for the FKPP equation with cutoff," 2007, *Nonlinearity*, **20**, 855-877, F. Dumortier, N. Popovic, and T.J. Kaper.

46. "Nonlinear asymptotic stability of the semi-strong pulse dynamics in a regularized Gierer-Meinhart model," 2007, *SIAM Journal on Mathematical Analysis*, **38**, 1760–1787, A. Doelman, T.J. Kaper, and K. Promislow.

47. "Reduction for the Michaelis-Menten-Henri mechanism in the presence of diffusion," 2007, *Electronic Journal of Differential Equations*, **C 16**, L. Kalachev, H. Kaper, T.J. Kaper, N. Popovic, and A. Zagaris.

48. "Analysis of a renormalization group method and normal form theory for perturbed ordinary differential equations," 2008, *Physica D*, **237**, 1029–1052, with R.E.L. DeVille, A. Harkin, M. Holzer, and K. Josic.

49. "Pulse dynamics in a three-component system: stability and bifurcations," 2008, *PhysicaD*, **237**, 3335-3368, with P. van Heijster and A. Doelman. doi:10.1016/j.physd.2008.07.014

50. "Pulse dynamics in a three-component system: existence analysis," 2009, *Journal of Dynamics and Differential Equations*, **21**, 73–116, with A. Doelman and P. van Heijster.

51. "Analysis of the accuracy and convergence of equation-free projection to a slow manifold," 2009, *Modelisation Mathematiques et Analyse Numerique,* **43**, 757–784, with A. Zagaris, C.W. Gear, and I.G. Kevrekidis.

52. "Canards and bifurcation delays of spatially homogeneous and inhomogeneous types in reaction-diffusion equations," 2009, *Advances in Differential Equations*, **14**, 943–962, with P. de Maesschalck and N. Popovic.

53. "Front interactions in a three-component system," 2010, *SIAM Journal on Applied Dynamical Systems*, **9**, 292–332, with A. Doelman, P. van Heijster, and K. Promislow.

54. "A geometric approach to bistable front propagation in scalar reaction-diffusion equations with cut-off," *Physica D*, **239**, 1984–1999, with F. Dumortier and N. Popovic.

55. "Pinned fronts in heterogeneous media of jump type," 2011, *Nonlinearity*, **24**, 127–157, with P. van Heijster, A. Doelman, Y. Nishiura, and K.-I. Ueda.

56. "An elementary model of torus canards," 2011, *CHAOS*, **21**, 023131, with G.N. Benes, A.M. Barry, M.A. Kramer, and J. Burke.

57. "Stability and stabilization of the constrained runs schemes for equation-free projection to a slow manifold," 2012, *Discrete and Continuous Dynamical Systems A*, **32(8)**, 2759–2803, with A. Zagaris, C. Vandekerckhove, C.W. Gear, and I.G. Kevrekidis.

58. "Wave speeds for pushed fronts in scalar reaction-diffusion equations with cut-off," 2012, *RIMS Kokyuroku Bessatsu,* **B31**, 117–134, with F. Dumortier.

59. "Canards of mixed type in a neural burster," 2012, *Physical Review E*, **85**, article 021920, with M. Desroches, J. Burke, and M. A. Kramer.

60. "A showcase of torus canards in neuronal bursters," 2012, *Journal of Mathematical Neuroscience*, **2(3)**, with J. Burke, M. Desroches, A. M. Barry, and M. A. Kramer.

61. "Existence and stability of traveling pulses in a reaction-diffusion-mechanics system," 2012, *Journal of Nonlinear Science* **23**, 129–177, with M. Holzer and A. Doelman.

62. "Adiabatic stability under semi-strong interactions: the weakly damped regime," 2013, *Indiana University Mathematics Journal*, with T. Bellsky, A. Doelman, and K. Promislow.

63. "The dynamics of hybrid metabolic-genetic oscillators," 2013, *Chaos*, **23**, 013132, with E. Reznik and D. Segre.

64. "Energy transfer between the shape and volume modes of a nonspherical bubble," 2013, *Physics of Fluids A*, **25**, 062101, with A. Harkin and A. Nadim.

65. "Geometric desingularization of a cusp singularity in slow-fast systems with applications to Zeeman's examples," 2013, *J. Dynamics and Differential Equations*, **25**, 925–958, with H. Broer and M. Krupa.

66. "Mixed-mode bursting oscillations: dynamics created by a slow passage through spike-adding canard explosions in a square-wave burster," 2013, *Chaos*, **23**, 046106, with Mathieu Desroches and Martin Krupa.

67. "An analysis of the renormalization group method for asymptotic expansions with logarithmic switchback terms," 2014, *Advances in Differential Equations*, **19**, 245–282, with Matt Holzer.

PAST Ph.D. THESIS ADVISEES:

* Matt Holzer, Ph.D. in Mathematics, May 2010. Renormalization group methods for singularly perturbed systems, normal forms, anmd stability of traveling waves in a reaction-diffusion-mechanics system.

* Oleg Mikittchenko (co-advised by C.E. Wayne), Application of resolution of singularities to asymptotic analysis of differential equations.

* Margaret Beck, Ph.D. in Mathematics, May 2006 (coadvised by C.E. Wayne). Topics in stability theory for partial differential equations.

* Marina Bevzushenko, Ph.D. in Mathematics, Dec 2006. Mathematical modeling of an integro-differential equation arising in neuroscience.

* Antonios Zagaris, Ph.D. in Mathematics, May 2005 (co-advised by H. Kaper). Analysis of reduction methods for multiscale phenomena.

* David Morgan, Ph.D. in Mathematics, 2001. On the existence and stability of spatial patterns in an activator-inhibitor system that exhibits self-replication.

* Stephanie R. Jones, Ph.D. in Mathematics, 2001 (coadvised by N. Kopell). Rhythms in the neocortex and in CPG networks: dynamical systems analyses.

* Kinya Ono, Ph.D. in Mathematics, December 2000. Analytical methods for reaction-diffusion equations: critical wave speeds and axisymmetric phenomena.

* Anthony Harkin, Ph.D. in Mathematics, 2001 (coadvised by A. Nadim, Mech. Eng.). Nonlinear dynamics of gas bubbles in liquids.

* Michael G. Hayes, Ph.D. in Mathematics, July 1999. Geometric analysis of delayed bifurcations.

* Georgiy S. Medvedev, Ph.D. in Mathematics, May 1999 (coadvised by N. Kopell). Problems on oscillations and pattern formation in mathematical biology.

* Cristina Soto-Treviño, Ph.D. in Mathematics, July 1997 (coadvised by N. Kopell). Geometric methods for periodic orbits in singularly perturbed systems.

* Steven P. Weibel, Ph.D. in Mechanical Engineering (principal advisor J. Baillieul) May 1997. Applications of qualitative methods in the nonlinear control of superarticulated systems.
August, 2013