Matthias S. Maier

Curriculum Vitae

Department of Mathematics
Texas A&M University, 3368 TAMU
College Station, TX 77843, USA
maier@tamu.edu
https://people.tamu.edu/~maier

Academic positions

08/2025 – 08/2030 Joint appointment
T-5 *Applied Mathematics and Plasma Physics*, Los Alamos National Laboratory

09/2022 – Associate Professor (with tenure)
Department of Mathematics, Texas A&M University

08/2018 – 08/2022 Assistant Professor
Department of Mathematics, Texas A&M University

07/2015 – 08/2018 Dunham Jackson Assistant Professor
School of Mathematics, University of Minnesota

10/2011 – 06/2015 Research Associate (Wissenschaftlicher Mitarbeiter),
Numerical Analysis Group, Institute of Applied Mathematics
Ruprecht-Karls-Universität Heidelberg

Education

06/2015 Dr. rer. nat. with grade summa cum laude
Ruprecht-Karls-Universität Heidelberg
Thesis: *Duality-based adaptivity of model and discretization in multiscale finite-element methods*, supervised by Prof. Dr. Dr. h. c. Rolf Rannacher

02/2012 – 06/2015 Member (with research fellowship) of the Heidelberg Graduate School of Mathematical and Computational Methods for the Sciences, Ruprecht-Karls-Universität Heidelberg

10/2006 – 09/2011 Diplom (equivalent to M. Sc.) in Mathematics, Ruprecht-Karls-Universität Heidelberg
Final grade: "sehr gut" (excellent)
Minor subjects: Computer Science, Physics

10/2005 – 02/2011 Diplom (equivalent to M. Sc.) in Physics, Ruprecht-Karls-Universität Heidelberg
Final grade: "sehr gut" (excellent)
Diplom thesis: *Simulation of Boundary Layer Flow over Riblet Structures*
Minor subjects: Computer Science, Mathematics

Research interests

— Computational fluid dynamics: hyperbolic conservation laws, compressible Euler and Navier-Stokes equations, coupled Euler-Poisson and Euler-Maxwell systems

— *Multiscale effects in Maxwell's equations:* surface plasmon-polaritons on 2D materials, plasmonic crystals

— *Multiscale methods:* heterogeneous multiscale methods, variational multiscale methods; asymptotic analysis and homogenization theory, model adaptation

— Finite element methods and finite element software

Grants and allocations

01/2025 – 12/2025 TAMU NLO Research Seed Funding "Robust numerical methods for large scale multi-physics applications," $ 50 000.

11/2022 – 10/2025 AFOSR FA9550-23-1-0007 "Robust approximation of hyperbolic-dominated models" (co-PI with J.-L. Guermond and B. Popov, 33 %) , $ 609 386.

09/2021 – 08/2026 NSF DMS 2045636 "CAREER: Robust and high-performance computational methods for simulating metamaterial-based optical devices", $ 470 000 + $ 16 800 supplement (2025).

06/2021 – 05/2022 TACC Frontera allocation, NSF DMS 21004 "'`ryujin` — towards robust and efficient computation of supersonic hyperbolic flow at large and small scales"', 160 000 SUs (8.96M core hours).

09/2019 – 08/2022 NSF DMS 1912847 "Efficient and Adaptive Methods for Simulating Multiscale Effects in Optical Metamaterials", $ 125 000.

01/2019 – 12/2020 T3 Texas A&M Triads for Transformation, Co-PI with Q. Michaudel and M. Green, $ 30 000.

Honors and awards

2025 Departmental Teaching Award, Department of Mathematics, Texas A&M University

2025 SIAM/ACM Prize in Computational Science and Engineering (joint with the deal.II Principal Developers)

2021 NSF CAREER Award

2017 Highlight of the Year award, *On the Wiener-Hopf Method for Surface Plasmons: Diffraction from Semi-infinite Metamaterial Sheet*, Studies in Applied Mathematics, 2017

02/2012 – 06/2015 Research fellowship, Heidelberg Graduate School of Mathematical and Computational Methods for the Sciences, Ruprecht-Karls-Universität Heidelberg

Software development

Since 09/2018 Developer, `ryujin`, a high-performance high-order finite-element solver for conservation equations such as the compressible Navier-Stokes and Euler equations of gas dynamics. (`https://github.com/conservation-laws/ryujin`)

Since 10/2014 Developer, Gentoo Linux Distribution (`https://www.gentoo.org`)

Since 11/2013 Principal developer, `deal.II`, a C++ program library targeted at the computational solution of partial differential equations using adaptive finite elements. (`https://www.dealii.org`)

Submitted journal articles

1. J. Harmon, M. Kronbichler, M. Maier, and E. Tovar. A conservative invariant-domain preserving projection technique for hyperbolic systems under adaptive mesh refinement. *submitted*, 2025. URL `https://arxiv.org/abs/2507.18717`

2. M. Maier, P. Munch, and M. Nazarov. Revisiting the slip boundary condition: Surface roughness as a hidden tuning parameter. *submitted*, 2025. URL https://arxiv.org/abs/2505.13068

Journal articles (* with student)

The list of authors on mathematical publications is predominantly in alphabetical order.

3. M. Kronbichler, M. Maier, and I. Tomas. Graph-based methods for hyperbolic systems of conservation laws using discontinuous space discretizations. *Communications in Computational Physics*, 38:74–108, 2025. doi: 10.4208/cicp.OA-2024-0225. URL https://arxiv.org/abs/2402.04514
4. J.-L. Guermond, M. Maier, and E. J. Tovar. A high-order explicit runge-kutta approximation technique for the shallow water equations. *Computers & Fluids*, 288:106493, 2025. doi: 10.1016/j.compfluid.2024.106493. URL https://arxiv.org/abs/2403.17123
5. P. C. Africa, D. Arndt, W. Bangerth, B. Blais, M. Fehling, R. Gassmöller, T. Heister, L. Heltai, S. Kinnewig, M. Kronbichler, M. Maier, P. Munch, M. Schreter-Fleischhacker, J. P. Thiele, B. Turcksin, D. Wells, and V. Yushutin. The deal.II Library, Version 9.6. *Journal of Numerical Mathematics*, 32(4):369–380, 2024. doi: 10.1515/jnma-2024-0137
6. M. Maier, D. Corraliza-Rodriguez, and D. Margetis. Dyakonov-Shur instability of electronic fluid: Spectral effect of weak magnetic field. *Physical Review B*, 110:165132, 2024. doi: 10.1103/PhysRevB.110.165132. URL https://arxiv.org/abs/2403.06386
7. J.-L. Guermond, M. Maier, B. Popov, L. Saavedra, and I. Tomas. First-order greedy invariant-domain preserving approximation for hyperbolic problems: Scalar conservation laws, and p-system. *Journal of Scientific Computing*, 100(46), 2024. doi: 10.1007/s10915-024-02592-4. URL https://arxiv.org/abs/2310.01713

* 8. M. Bezbaruah, M. Maier, and W. Wollner. Shape optimization of optical microscale inclusions. *SIAM Journal on Scientific Computing*, 46(4):B377–B402, 2024. doi: 10.1137/23M158262X. URL https://arxiv.org/abs/2306.13248

9. D. Arndt, W. Bangerth, M. Bergbauer, M. Feder, M. Fehling, J. Heinz, T. Heister, L. Heltai, M. Kronbichler, M. Maier, P. Munch, J.-P. Pelteret, B. Turcksin, D. Wells, and S. Zampini. The deal.II Library, Version 9.5. *Journal of Numerical Mathematics*, 31(3):231–246, 2023. doi: 10.1515/jnma-2023-0089
10. B. Clayton, J.-L. Guermond, M. Maier, B. Popov, and E. J. Tovar. Robust second-order approximation of the compressible euler equations with an arbitrary equation of state. *Journal of Computational Physics*, page 111926, 2023. doi: 10.1016/j.jcp.2023.111926. URL https://arxiv.org/abs/2207.12832
11. M. Maier, J. Shadid, and I. Tomas. Structure-preserving finite-element schemes for the Euler-Poisson equations. *Communications in Computational Physics*, 33:647–691, 2023. doi: 10.4208/cicp.OA-2022-0205. URL https://arxiv.org/abs/2207.07860
12. D. Arndt, W. Bangerth, M. Feder, M. Fehling, R. Gassmöller, T. Heister, L. Heltai, M. Kronbichler, M. Maier, P. Munch, J.-P. Pelteret, S. Sticko, B. Turcksin, and D. Wells. The deal.II Library, Version 9.4. *Journal of Numerical Mathematics*, 30(3):231–246, 2022. doi: 10.1515/jnma-2022-0054

13. J.-L. Guermond, M. Kronbichler, M. Maier, B. Popov, and I. Tomas. On the implementation of a robust and efficient finite element-based parallel solver for the compressible Navier-Stokes equations. *Computer Methods in Applied Mechanics and Engineering*, 389:114250, 2022. doi: 10.1016/j.cma.2021.114250. URL https://arxiv.org/abs/2106.02159

14. W. Li, R. Lipton, and M. Maier. Lorentz resonance in the homogenization of plasmonic crystals. *Proceedings of the Royal Society A: Mathematical, Physical, and Engineering Sciences*, 477:20210609, 2021. doi: 10.1098/rspa.2021.0609. URL https://arxiv.org/abs/2009.12166

15. D. Arndt, W. Bangerth, B. Blais, M. Fehling, R. Gassmöller, T. Heister, L. Heltai, U. Köcher, M. Kronbichler, M. Maier, P. Munch, J.-P. Pelteret, S. Proell, K. Simon, B. Turcksin, D. Wells, and J. Zhang. The deal.II Library, Version 9.3. *Journal of Numerical Mathematics*, 29(3): 171–186, 2021. doi: 10.1515/jnma-2021-0081

16. M. Maier and M. Kronbichler. Efficient parallel 3d computation of the compressible euler equations with an invariant-domain preserving second-order finite-element scheme. *ACM Transactions on Parallel Computing*, 8(3):16:1–30, 2021. doi: 10.1145/3470637. URL https://arxiv.org/abs/2007.00094

17. J.-L. Guermond, M. Maier, B. Popov, and I. Tomas. Second-order invariant domain preserving approximation of the compressible Navier–Stokes equations. *Computer Methods in Applied Mechanics and Engineering*, 375(1):113608, 2021. doi: 10.1016/j.cma.2020.113608. URL https://arxiv.org/abs/2009.06022

18. D. Arndt, W. Bangerth, D. Davydov, T. Heister, L. Heltai, M. Kronbichler, M. Maier, J.-P. Pelteret, B. Turcksin, and D. Wells. The deal.II finite element library: design, features, and insights. *Computers & Mathematics with Applications*, 81(1):407–422, 2021. doi: 10.1016/j.camwa.2020.02.022. URL https://arxiv.org/abs/1910.13247

* 19. J. H. Song, M. Maier, and M. Luskin. Nonlinear eigenvalue problems for coupled Helmholtz equations modeling gradient-index graphene waveguides. *Journal of Computational Physics*, 423(15):109871, 2020. doi: 10.1016/j.jcp.2020.109871. URL https://arxiv.org/abs/2003.06531

20. M. Maier, D. Margetis, and M. Luskin. Finite-size effects in wave transmission through plasmonic crystals: A tale of two scales. *Physical Review B*, 102:075308, 2020. doi: 10.1103/PhysRevB.102.075308. URL https://arxiv.org/abs/2005.12778

21. D. Arndt, W. Bangerth, B. Blais, T. C. Clevenger, M. Fehling, A. V. Grayver, T. Heister, L. Heltai, M. Kronbichler, P. Munch, M. Maier, J.-P. Pelteret, R. Rastak, B. Turcksin, Z. Wang, and D. Wells. The deal.II Library, Version 9.2. *Journal of Numerical Mathematics*, 28(3):131–146, 2020. doi: https://doi.org/10.1515/jnma-2020-0043

22. M. Maier, D. Margetis, and A. Mellet. Homogenization of Maxwell's equations in nonhomogeneous plasmonic structures. *Journal of Computational and Applied Mathematics*, 377, 2020. doi: 10.1016/j.cam.2020.112909. URL https://arxiv.org/abs/1805.07671

23. D. Margetis, M. Maier, T. Stauber, T. Low, and M. Luskin. Nonretarded edge plasmon-polaritons in anisotropic two-dimensional materials. *Journal of Physics A: Mathematical and Theoretical*, 53(5), 2020. doi: 10.1088/1751-8121/ab5ff9. URL https://arxiv.org/abs/1910.04840

24. D. Arndt, W. Bangerth, T. C. Clevenger, D. Davydov, M. Fehling, D. Garcia-Sanchez, G. Harper, T. Heister, L. Heltai, M. Kronbichler, R. M. Kynch, M. Maier, J.-P. Pelteret, B. Turcksin, and D. Wells. The deal.II Library, Version 9.1. *Journal of Numerical Mathematics*, 27(4):203–213, 2019. doi: 10.1515/jnma-2019-0064

25. M. Maier, M. Mattheakis, E. Kaxiras, M. Luskin, and D. Margetis. Homogenization of plasmonic crystals: Seeking the epsilon-near-zero effect. *Proceedings of the Royal Society A: Mathematical, Physical, and Engineering Sciences*, 475, 2019. doi: 10.1098/rspa.2019.0220. URL `https://arxiv.org/abs/1809.08276`

* 26. J. H. Song, M. Maier, and M. Luskin. Adaptive finite element simulations of waveguide configurations involving parallel 2d material sheets. *Computer Methods in Applied Mechanics and Engineering*, 351:20–34, 2019. doi: 10.1016/j.cma.2019.03.039. URL `https://arxiv.org/abs/1809.06516`

27. G. Alzetta, D. Arndt, W. Bangerth, V. Boddu, B. Brands, D. Davydov, R. Gassmöller, T. Heister, L. Heltai, K. Kormann, M. Kronbichler, M. Maier, J.-P. Pelteret, B. Turcksin, and D. Wells. The deal.II Library, Version 9.0. *Journal of Numerical Mathematics*, 26(4): 173–184, 2018. doi: 10.1515/jnma-2018-0054

28. M. Maier, M. Mattheakis, E. Kaxiras, M. Luskin, and D. Margetis. Universal behavior of dispersive Dirac cone in gradient-index plasmonic metamaterials. *Physical Review B*, 97(3), 2018. doi: 10.1103/PhysRevB.97.035307. URL `https://arxiv.org/abs/1711.02210`

29. M. Maier and R. Rannacher. A duality-based optimization approach for model adaptivity in heterogeneous mutliscale problems. *SIAM Multiscale Modeling and Simulation*, 16(1): 412–428, 2018. doi: 10.1137/16M1105670. URL `https://arxiv.org/abs/1611.09437`

30. M. Maier, A. Nemilentsau, T. Low, and M. Luskin. Ultracompact amplitude modulator by coupling hyperbolic polaritons over a graphene-covered gap. *ACS Photonics*, 5(2):544–551, 2018. doi: 10.1021/acsphotonics.7b01094. URL `https://arxiv.org/abs/1709.06626`

31. M. Maier, D. Margetis, and M. Luskin. Generation of surface plasmon-polaritons by edge effects. *Communications in Mathematical Sciences*, 16(1):77–95, 2018. doi: 10.4310/CMS.2018.v16.n1.a4. URL `https://arxiv.org/abs/1702.00848`

32. D. Margetis, M. Maier, and M. Luskin. On the Wiener-Hopf method for surface plasmons: Diffraction from semi-infinite metamaterial sheet. *Studies in Applied Mathematics*, 139(4): 599–625, 2017. doi: 10.1111/sapm.12180. URL `https://arxiv.org/abs/1701.02784`

33. D. Arndt, W. Bangerth, D. Davydov, T. Heister, L. Heltai, M. Kronbichler, M. Maier, B. Turcksin, and D. Wells. The deal.II Library, Version 8.5. *Journal of Numerical Mathematics*, 25 (3):137–145, 2017. doi: 10.1515/jnma-2017-0058

34. M. Maier, D. Margetis, and M. Luskin. Dipole excitation of surface plasmon on a conducting sheet: finite element approximation and validation. *Journal of Computational Physics*, 339: 126–145, 2017. doi: 10.1016/j.jcp.2017.03.014. URL `https://arxiv.org/abs/1605.08456`

35. M. Maier and R. Rannacher. Duality-based adaptivity in finite element discretization of heterogeneous multiscale problems. *Journal of Numerical Mathematics*, 24(3):167–187, 2016. doi: 10.1515/jnma-2014-0074. URL `https://www-users.math.umn.edu/~msmaier/preprint-maierrannacher-jnma14.pdf`

36. M. Maier, M. Bardelloni, and L. Heltai. LinearOperator—a generic, high-level expression syntax for linear algebra. *Computers & Mathematics with Applications*, 72(1):1–24, 2016. doi: 10.1016/j.camwa.2016.04.024. URL `https://www-users.math.umn.edu/~msmaier/preprint-maierbardelloniheltai-camwa15.pdf`

37. W. Bangerth, D. Davydov, T. Heister, L. Heltai, G. Kanschat, M. Kronbichler, M. Maier, B. Turcksin, and D. Wells. The deal.II Library, Version 8.4. *Journal of Numerical Mathematics*, 24(3):135–141, 2016. doi: 10.1515/jnma-2016-1045

38. W. Bangerth, T. Heister, L. Heltai, G. Kanschat, M. Kronbichler, M. Maier, and B. Turcksin. The deal.II Library, Version 8.3. *Archive of Numerical Software*, 4, 2016. doi: 10.11588/ans.2016.100.23122

39. W. Bangerth, T. Heister, L. Heltai, G. Kanschat, M. Kronbichler, M. Maier, and B. Turcksin. The deal.II Library, Version 8.2. *Archive of Numerical Software*, 3, 2015. doi: 10.11588/ans.2015.100.18031

Publications in conference proceedings (* with student)

* 40. T. G. Mattson, M. Bezbaruah, M. Maier, S. McMillan, M. Peletier, E. Welch, and T. A. Davis. Indexed binary operations in the graphblas. In *2024 IEEE High Performance Extreme Computing Conference (HPEC)*, pages 1–7. IEEE, 2024. doi: 10.1109/HPEC62836.2024.10938456

* 41. M. Mattheakis, M. Maier, W. X. Boo, and E. Kaxiras. Graphene epsilon-near-zero plasmonic crystals. In *Proceedings of the Sixth Annual ACM International Conference on Nanoscale Computing and Communication*, NANOCOM '19, pages 2:1–2:6, 2019. doi: 10.1145/3345312.3345496. URL `https://arxiv.org/abs/1906.00018`

Preprints, reports and software publications

42. M. Bezbaruah, M. Maier, and W. Wollner. Inversehomogenization: shape optimization for optical metamaterials with low-dimensional interfaces, 2024. URL `https://github.com/tamiko/InverseHomogenization/`

43. I. Tomas, J. Shadid, M. Maier, and A. Salgado. Final report of activities for the LDRD-CIS project 226834 titled: Asymptotic preserving methods for fluid electron-fluid models in the large magnetic field limit with mathematically guaranteed properties. Technical report, Sandia National Laboratories, Albuquerque, NM, 2022

44. M. Bezbaruah and M. Maier. deal.II step-81: A time-harmonic Maxwell solver for lower-dimensional inclusions, 2022. URL `https://github.com/tamiko/step-81`

45. I. Tomas, J. Shadid, M. Crockatt, R. Pawlowski, M. Maier, and J.-L. Guermond. Final report of activities for the LDRD-express project 223796 titled: Fluid models of charged species transport: numerical methods with mathematically guaranteed properties. Technical report, Sandia National Laboratories, Albuquerque, NM, 2021

46. M. Maier and M. Kronbichler. Ryujin: High-performance second-order collocation-type finite-element scheme for solving the compressible euler equations of gas dynamics on unstructured meshes, 2020. URL `https://github.com/conservation-laws/ryujin`

47. M. Maier and I. Tomas. deal.II step-69: A first-order hydrodynamics code for the compressible Euler equations, 2020. URL `https://github.com/tamiko/step-69`
48. M. Maier. rspa-2019: Computational resources for "homogenization of plasmonic crystals: Seeking the epsilon-near-zero effect", 2020. URL `https://github.com/tamiko/rspa-2019`
49. M. Licht and M. Maier. Robust global and goal-oriented a posteriori error estimation for reaction-diffusion equations. 2017. URL `https://arxiv.org/abs/1707.09659`
50. M. Maier, M. Bardelloni, and L. Heltai. LinearOperator Benchmarks, Version 1.0.0, 2016
51. W. Bangerth, T. Heister, L. Heltai, G. Kanschat, M. Kronbichler, M. Maier, B. Turcksin, and T. D. Young. The deal.II Library, Version 8.1. 2013. URL `https://arxiv.org/abs/1312.2266v4`
52. W. Bangerth, T. Heister, L. Heltai, G. Kanschat, M. Kronbichler, M. Maier, B. Turcksin, and T. D. Young. The deal.II Library, Version 8.0. 2013. URL `https://arxiv.org/abs/1312.2266v3`

Theses

53. M. Maier. *Duality-based adaptivity of model and discretization in multiscale finite-element methods*. Doctoral thesis, Heidelberg University, 2015
54. M. Maier. Simulation von Grenzschichtströmungen über Ribletstrukturen (simulation of boundary layer flow over riblet structures). Diplom thesis, Heidelberg University, 2011

Service

I have reviewed articles for a number of journals (last 4 years): ACM Trans. Math. Softw. (four times); ACM Trans. Parallel Comput. (two times); Comput. Math. Appl. (two times); Comput. Methods Appl. Mech. Eng. (four times); J. Math. Anal. Appl. (one time); J. Open Source Softw. (one time); J. Opt. Soc. Am (two times); Numer. Math. (one time); SIAM J. Appl. Math. (two times); Stud. Appl. Math. (two times)

Since 05/2025	Secretary of the SIAM Texas-Louisiana Section
2025	Grant review panelist, National Science Foundation
3/2025	Organizer (with I. Tomas) of Minisymposium *Structure preserving numerical methods of fluid dynamic equations* , SIAM Conference on Computational Science and Engineering (CSE25), Fort Worth, TX, USA
2024	Grant review panelist, National Science Foundation
11/2024	Organizer (with J. Chan) of Minisymposium *Accurate, robust, and efficient methods for computational fluid dynamics*, SIAM Texas-Louisiana Sectional Conference in Applied Mathematics, Waco, TX, USA
Since 9/2024	Member of the *Excecutive Committee*, Department of Mathematics, Texas A&M University, College Station, TX, USA
4/2024 - 05/2025	SIAM District Liaison for the Texas Central region

11/2023	Organizer (with I. Tomas and J. Chan) of Minisymposium *Accurate, robust, and structure-preserving methods for computational fluid dynamics*, SIAM Texas-Louisiana Sectional Conference in Applied Mathematics, Lafayette, LA, USA
3/2023	Workshop organizer of the *Finite Element Rodeo* 2023, Texas A&M University, College Station, TX, USA
2/2023	Organizer (with I. Tomas and J. Chan) of Minisymposium *Structure Preserving and Robust Techniques for the Simulation of Transport Phenomena and Fluid Flow*, SIAM Conference on Computational Science and Engineering (CSE23) Amsterdam, Netherlands
11/2022	Organizer (with D. Massatt) of Minisymposium *Advances in theory and computation of functional optical materials*, SIAM Texas-Louisiana Sectional Conference in Applied Mathematics, Houston, TX, USA
9/2022 – 8/2024	Member of the *Undergraduate Studies Committee*, Department of Mathematics, Texas A&M University, College Station, TX, USA
2022	Grant review panelist (two times), National Science Foundation
7/2021	Organizer (with J. Lin) of Minisymposium *Mathematical Theories and Computational Algorithms for Novel Optical Materials*, SIAM AN 2021, USA (online)
3/2021	Organizer (with P. Cazeaux) of Minisymposium *Frontiers in Material Modeling and Device Simulation: From Nano- to Meso-Scale*, SIAM CSE 2021, USA (online)
2021	Grant review panelist, National Science Foundation
10/2020	Organizer (with J.-L. Guermond and B. Popov) of Minisymposium *Structure preserving techniques for nonlinear conservation equations*, 3rd SIAM Texas-Louisiana Sectional Conference in Applied Mathematics, College Station, TX, USA (online)
10/2020	Organizer (with R. Lipton) of Minisymposium *Analytic and computational approaches for metamaterial and nanoscale optics*, 3rd SIAM Texas-Louisiana Sectional Conference in Applied Mathematics, College Station, TX, USA (online)
10/2020	Organizing Committee, 3rd SIAM Texas-Louisiana Sectional Conference in Applied Mathematics, College Station, TX, USA
11/2013 – 06/2015	Deputy member of the Diplom Examination Board, Ruprecht-Karls-Universität Heidelberg
08/2013	Organizing Committee, 4th deal.II Workshop, College Station, TX, USA
08/2012	Organizing Committee, 3rd deal.II Workshop, Heidelberg, Germany

Short courses, research stays and visits

03/2024	Visitor, *Workshop on Mathematical Models of Electronic Charge Transport and Phases in Low-Dimensional Material*, Brin Mathematics Research Center, University of Maryland, College Park, MD, USA March 11 – March 15, 2024
01/2020	Visitor, *Workshop on Theory and Computation for 2D Materials*, IPAM, UCLA, Los Angeles, CA, USA, Jan 12 – Jan 21, 2020
05/2019 – 06/2019	Visitor, *IMA Workshop on Hydrodynamic Models for Transport in 2D Materials*, University of Minnesota, Minneapolis, MN, USA, May 06 - June 07, 2019

06/2017 Invited lecturer, *Advanced topics in *nix software development - toolchain, build systems and software testing*, Short course in the Master in High Performance Computing program, SISSA, Trieste, Italy

03/2014 Assistance and exercises, DAAD *Summer School on Numerical Methods with the Finite Element Method*, Universidad Nacional de Trujillo, Peru

Outreach

05/2025 *Undergraduate Summer School on Modeling and Simulation with PDEs*, Texas A&M University, College Station, TX, USA

- The summer school is targeting external undergraduate students interested in scientific computing. It serves as a *teaser* for future graduate-level (collaborative) research in scientific computing. The summer school is structured into two phases. The first one revolves around a condensed short course in computational techniques for partial differential equations and is supplemented by practical lab sessions. The second part of the summer school features project-oriented work.

05/2024 *Undergraduate Summer School on Modeling and Simulation with PDEs*, Texas A&M University, College Station, TX, USA

03/2023 *Mathematical Modeling, Fluids, and Airplanes that Shouldn't Fly*, AMUSE Seminar, Texas A&M University, College Station, TX, USA

02/2023 *Mathematical Modeling, Fluids, and Airplanes that Shouldn't Fly*, Aggieland Saturday, Texas A&M University, College Station, TX, USA

02/2019 *Fractals*, K12 Math Club, Texas A&M University, College Station, TX, USA

10/2019 *Potential flow and why does an airplane fly?*, AMUSE Seminar, Texas A&M University, College Station, TX, USA

02/2019 *Finite element methods and adaptive strategies for multiscale problems*, Industrial and Applied Seminar, Texas A&M University, College Station, TX, USA

10/2016 *Finite element methods and adaptive strategies for multiscale problems*, AMS Student Chapter Seminar, University of Minnesota, Minneapolis, MN, USA

4/2016 *Potential flow and why does an airplane fly?*, Undergratue Math Club, University of Minnesota, Minneapolis, MN, USA

Talks and presentations (last 4 years, * invited talk)

03/2025 *Structure-preserving finite-element schemes for the Euler-Poisson equations*, SIAM CSE 2025, Dallas, TX, USA

02/2025 *Modeling and optimization of optical layered heterostructures*, Finite Element Rodeo 2025, Louisiana State University, Baton Rouge, LA, USA

11/2024 *Modeling and optimization of optical layered heterostructures*, ISC Workshop on Data-Driven Model Reduction, Scientific Frontiers, and Applications, Texas A&M University, College Station, TX, USA

10/2024 *Structure-preserving finite-element schemes for the Euler-Maxwell and Euler-Poisson equations*, SIAM TX-LA Sectional Meeting 2024, Waco, TX, USA *

08/2024 *On implementing stencil based methods in deal.II* 11th deal.II Workshop, Fort Collins, CO, USA

06/2024 *High-performance high-order finite element solver for hyperbolic conservation equations* CNLS Seminar, Los Alamos National Laboratory, Los Alamos, NM, USA *

04/2024 *Structure-preserving finite-element schemes for coupled hyperbolic systems*, Oden Seminar, University of Texas at Austin, Austin, TX, USA *

03/2024 *Spectral effect of a magnetic field on the electronic instability of 2D materials*, BRIN Workshop on Mathematical Models of Electronic Transport and Phases in Low-Dimensional Materials, University of Maryland, College Park, MD, USA *

11/2023 *Homogenization of Layered Heterostructures*, ISC Workshop on Data-Driven Model Reduction, Scientific Frontiers, and Applications, Texas A&M University, College Station, TX, USA

11/2023 *Lorentz Resonance in the Homogenization of Plasmonic Crystals*, SIAM TX-LA Sectional Meeting 2023, Lafayette, LA, USA

09/2023 *Lorentz Resonance in the Homogenization of Plasmonic Crystals*, MPHA Seminar, Texas A&M University, College Station, TX, USA

09/2023 *Parallelization of a stencil-based method for the compressible Navier-Stokes equations*, 10th deal.II Workshop, Hannover, Germany *

7/2023 *Robust and efficient approximation of the compressible Euler and Navier-Stokes equations*, USNCCM17, Albuquerque, NM, USA *

7/2023 *Structure-preserving finite-element schemes for the Euler-Poisson equations*, Eulerian Application Project Colloquium, Los Alamos National Laboratory, Los Alamos, NM, USA *

4/2023 *Structure-preserving finite-element schemes for the Euler-Poisson equations*, Computational Mathematics Seminar, Louisiana State University, Baton Rouge, LA, USA *

4/2023 *Robust and approximation of the compressible Navier-Stokes equations*, Finite Element Rodeo 2023, Texas A&M University, TX, USA *

3/2023 *Robust and efficient approximation of the compressible Navier-Stokes equations*, SIAM CSE 2023, Amsterdam, Netherlands *

11/2022 *Robust and efficient approximation of the compressible Navier-Stokes equations*, SIAM TX-LA Sectional Meeting 2022, Houston, TX, USA *

10/2022 *Structure-preserving finite-element schemes for the Euler-Poisson equations*, CAM Seminar, University of Tennessee, Knoxville, TN, USA *

10/2022 *Robust and efficient approximation of the compressible Euler and Navier-Stokes equations*, CNLS Seminar, Los Alamos National Laboratory, Los Alamos, NM, USA *

09/2022 *Robust and efficient approximation of the compressible Euler and Navier-Stokes equations*, GCEC Seminar, University of Glasgow, UK (online) *

09/2022 *Structure-preserving finite-element schemes for the Euler-Poisson equations*, AMS Sectional Meeting, El Paso, TX, USA *

08/2022	*Robust and efficient approximation of the compressible Euler and Navier-Stokes equations*, Applied and Computational Math Seminar, University of Minnesota, Minneapolis, MN, USA *
07/2022	*Robust and efficient approximation of the compressible Euler and Navier-Stokes equations*, Oberseminar Mathematische Strömungsmechanik, University of Würzburg, Würzburg, Germany *
07/2022	*Robust and efficient approximation of the compressible Euler and Navier-Stokes equations*, IWR Scientific Computing Seminar, Heidelberg University, Heidelberg, Germany *
03/2022	*Efficient parallel 3d computation of the compressible Navier-Stokes equations*, Computational Math Seminar, Clemson University, SC, USA *
02/2022	*Optical Phenomena, Resonances, and Homogenization of Layered Heterostructures*, Oberseminar Numerische Mathematik, Bochum University, Bochum, Germany *
12/2021	*Efficient parallel 3d computation of the compressible Navier-Stokes equations*, Math Colloquium, University of Houston, TX, USA *
11/2021	*Optical Phenomena, Resonances, and Homogenization of Layered Heterostructures*, SIAM TX-LA Sectional Meeting 2021, South Padre Island, TX, USA *
05/2021	*Efficient parallel 3d computation of the compressible Navier-Stokes equations*, Oberseminar Mathematische Strömungsmechanik, University of Würzburg, Würzburg, Germany (online) *
04/2021	*Efficient parallel 3d computation of the compressible Navier-Stokes equations*, Seminar Special Topics in Numerics, Otto von Guricke University Magdeburg, Magdeburg, Germany (online) *
03/2021	*Optical Phenomena and Resonances in Layered Heterostructures*, SIAM CSE, Dallas, TX, USA (online)
02/2021	*Resonances in Homogenization of Layered Heterostructures*, DMS Applied Mathematics Seminar, Auburn University (online) *

Graduate advising

Currently serving on eight graduate committees at TAMU.

Since 12/2023	Crystal Farris, Texas A&M University; Ph. D. program (advisor)
Since 1/2023	David Pecoraro, Texas A&M University; Ph. D. program (advisor)
3/2022 – 12/2022	Brett Caldwell, Texas A&M University; Master program (advisor)
Since 11/2021	Jordan Hoffart, Texas A&M University; Ph. D. program (advisor)
09/2019 – 05/2025	Manaswinee Bezbaruah, Texas A&M University; Ph. D. program (advisor)
09/2020 – 08/2021	Drew Macha, Texas A&M University; Distance Master program (advisor)
07/2015 – 06/2020	Jung Heon Song, University of Minnesota: *Surface plasmon polaritons in waveguide configurations*, Ph. D. program (co-advisor); now working for KLA Corporation
05/2013 – 05/2014	Niloufar Rahi, Ruprecht-Karls-Universität Heidelberg: *A Priori L^∞-Error Estimation for FE-Galerkin Approximations of linear and non-linear elliptic Partial Differential Equations on Locally Refined Meshes*, Diplom thesis (co-advisor)

Undergraduate advising and mentoring

01/2020 – 04/2020 Jack Dahlberg and Jordan Hoffart, Texas A&M University: *Numerical study of decay rates of the 1D Klein-Gordon equations*, co-advised with Jonas Lührmann, MATH 491 Undergraduate research project

01/2020 – 04/2020 Zhiyu Song, Texas A&M University: *Computation of propagating modes in 2D waveguide configurations*, MATH 491 Capstone project

06/2018 – 08/2018 Wei Xi Boo, University of Minnesota: *Computation of Dispersion Curves for Optical Phenomena in Layered Structures*, Undergraduate Research Opportunities Program stipend

01/2018 – 05/2018 Noah Wong, University of Minnesota: *Modeling and Simulation of Potential Flow*, Independent Study, B. S. program

01/2017 – 05/2017 Victor Wright, University of Minnesota: *Linear programming in operations research*, Independent Study, B. S. program

09/2016 – 12/2016 Evan Henke, University of Minnesota: *Monte-carlo simulation of optimal game strategies*, Independent Study, B. S. program

Curriculum development

- Collaborative undergraduate research project (CRP)
  - The CRP program is funded by Career Award DMS-2045636 and organized within a larger Directed Reading Program (DRP) at the Department organized by Dr. A. Shiu. It pairs a team of undergraduate mentees and graduate mentors to work together on a research topic with the goal of teaching core competences in computational sciences and highlighting *collaborative* research.
- Math 676
  - Pioneering project-based, flipped classroom, graduate level course highlighting practical aspects of the finite element method and scientific software development: The course is designed for students involved in research in numerical methods, or students who want to use the finite element method for simulations in their graduate research.

Teaching (Texas A&M University)

Spring 2025 Finite Element Methods in Scientific Computing (Math 676, 11 students)
- Pioneering project-based graduate level course highlighting practical aspects of the finite element method and scientific software development.

Fall 2024 Collaborative research program (DRP/CRP, 2 students, 1 team)
- Undergraduate research for teams consisting of two undergraduate mentees (and a graduate mentor) with an emphasis on teaching core competences in computational sciences and highlighting collaborative research.

Numerical Partial Differential Equations (Math 610, 12 students)
- Graduate level course covering introductory and advanced topics in numerical analysis of finite difference and finite element approximations of partial differential equations.

Numerical Methods (Math 417, 21 students)
- Upper-division undergraduate-level course covering introductory topics centered around numerical methods and their application.

Spring 2024 —

Fall 2023 Collaborative research program (DRP/CRP, 4 students, 2 teams)

	Numerical Partial Differential Equations (Math 610, 5 students)
	Numerical Partial Differential Equations (Distance course, Math 610, 5 students)
	Numerical Methods (Math 417, 22 students)
Spring 2023	Finite Element Methods in Scientific Computing (Math 676, 15 students)
Fall 2022	Collaborative research program (DRP/CRP, 6 students, 3 teams)
	Numerical Partial Differential Equations (Math 610, 8 students)
	Numerical Partial Differential Equations (Distance course, Math 610, 4 students)
Spring 2022	—
Fall 2021	Numerical Partial Differential Equations (Math 610, 14 students)
	Principles of Numerical Analysis (Math 437, 18 students)
	○ Upper-division undergraduate-level course covering introductory topics centered around mathematical principles of numerical analysis and their application to the study of particular methods.
Spring 2021	Finite Element Methods in Scientific Computing (Math 676, 8 students)
Fall 2020	Numerical Partial Differential Equations (Math 610, 6 students)
Spring 2020	Iterative Methods (Distance course, Math 639, 5 students)
	○ Graduate level course covering development and analysis of iterative methods applied to the solution of large sparse systems of linear equations.
Fall 2019	Numerical Partial Differential Equations (Math 610, 6 students)
Spring 2019	Finite Element Methods in Scientific Computing (Math 676, 12 students)
Fall 2018	Mathematical Modeling (Math 442, 25 students)
	○ Upper-division undergraduate-level course covering introductory topics in mathematical models based on optimization, dynamical systems and probability theory.

Teaching (University of Minnesota)

Spring 2018 &	Introduction to Numerical Methods (Math 5485 & 5486, 37 students)
Fall 2017	○ Upper-division undergraduate-level course sequence covering introductory topics in numerical methods about numerical integration, nonlinear equations, systems of linear equations, ordinary and partial differential equations.
Spring 2017 &	Numerical Analysis and Scientific Computing (Math 8441 & 8442, 10 students)
Fall 2016	○ Graduate level course sequence covering introductory and advanced topics in numerical analysis and scientific computing about approximation theory, optimization problems, ordinary and partial differential equations.
Spring 2016	Mathematical Modeling (Math 4428, 30 students)
	○ Upper-division undergraduate-level course covering introductory topics in mathematical models based on optimization, dynamical systems and probability theory.
Fall 2015	Differential Equations and Linear Algebra (Math 2243, 178 students)
	○ Introductory undergraduate-level course about linear algebra and ordinary differential equations.