Alan E. Lindsay - Associate Professor of Applied Mathematics

CONTACT INFORMATION	Dept. of Applied & Comp. Math and Stats University of Notre Dame 201G Crowley Hall, Notre Dame, IN, 46556.	*Phone:* +1 (574) 631-3511 *E-mail:* a.lindsay@nd.edu *Web:* nd.edu/~alindsa1

CURRENT APPOINTMENTS

U. of Notre Dame, Associate Professor of Applied Mathematics, 2019 - Present.
U. of Notre Dame, Director, Biophysics Graduate Program, 2021 - Present.
AIMS: Applied mathematics for modern challenges, Associate editor, 2023 - Present.

PREVIOUS APPOINTMENTS

U. of Notre Dame, Assistant Professor of Applied Mathematics, 2013 - 2019.
Heriot-Watt University, Lecturer of Applied Mathematics, 2012 - 2013.
U. of Arizona, Hanno Rund Postdoctoral Fellow, Mathematics, 2010 - 2012.
Supervisors: Prof. Joceline C. Lega, Prof. Karl B. Glasner.

EDUCATION

U. of Edinburgh, B.Sc, Mathematics, 2005.
U. of British Columbia, Ph.D Applied Mathematics, 2010. Advisor: Prof. Michael J. Ward.

RESEARCH INTERESTS

Applied and computational mathematics with applications to biological processes. Singular perturbations methods, asymptotic analysis and homogenization theory. Adaptive numerical algorithms for partial differential equations. Stochastic processes, Monte Carlo simulation and first passage time problems.

FUNDING HISTORY

NSF MODULUS award, DMS-2052636, 2021-2025.

NSF Conference award, DMS-2013192, 2020.

AMS Mathematical Research Community (MRC) award, 2018.

NSF Math Biology award, DMS-1815216, 2018-2023.

NSF Applied Math award, DMS-1516753, 2015-2019.

EPSRC (U.K.) Crucible Award, 2013-2014.

Carnegie Trust (U.K.) Travel Award 2013.

AMS - Simons Travel Award 2011-2013.

MITACS (Canada) Accelerate Award 2009-2010.

NSERC (Canada) CGS-M/PGS-D, 2006-2010.

PUBLICATIONS

1. A. J. Bernoff A. E. Lindsay,
Kinetic Monte Carlo methods for three-dimensional diffusive capture problems in exterior domains.
Submitted

2. T. Hillen, M. R. D'Orsogna, J. C. Mantooth, A. E. Lindsay
Mean first passage times for transport equations.
Submitted

3. C. Naudet, A. E. Lindsay
Numerical bifurcation analysis of post-contact states in mathematical models of Micro Electromechanical Systems.
Mathematics and Computers in Simulation, Vol. 220 (2024) pp. 296–308.

4. J. Morgan, A. E. Lindsay
Modulation of antigen discrimination by duration of immune contacts in a kinetic proofreading

model of T cell activation with extreme statistics.
PLoS Computational Biology, 9(8):e1011216 (2023).

5. A. J. Bernoff, A. Jilkine, A. Navarro Hernández, A. E. Lindsay
Single cells directional sensing from just a few receptor binding events.
Biophysical Journal Vol.122, Issue 15 (2023), pp. 3108–3116.

6. A. Navarro Hernández, A. J. Bernoff, A. E. Lindsay
Short time diffusive fluxes over membrane receptors yields the direction of signaling sources.
Royal Society Open Science, Volume 10, No. 4, (2023).

7. J. Cherry, A. E. Lindsay and A. Navarro Hernández and B. Quaife
Trapping of planar Brownian motion: Full first passage time distributions by Kinetic Monte-Carlo, asymptotic and boundary integral methods.
SIAM Multiscale Modeling and Simulation, Volume 20, Issue 4, (2022).

8. J. Morgan, J. Pettmann, O. Dushek, and A. E. Lindsay
T-cell microvilli simulations show operation near packing limit and modulation of antigen recognition.
Biophysical Journal, Volume 121, Issue 21, (2022), pp 4128–4136

9. V. Leech, J.W. Hazel, J.C. Gatlin, A.E. Lindsay, A. Manhart,
Mathematical modeling accurately predicts the dynamics and scaling of nuclear growth in discrete cytoplasmic volumes.
Journal of Theoretical Biology, Vol. 533, (2022), 110936.

10. Tracy L. Stepien, Cole Zmurchok, James B. Hengenius, Rocío Marilyn Caja Rivera, Maria R. D'Orsogna, Alan E. Lindsay,
Moth mating: Modeling female pheromone calling and male navigational strategies to optimize reproductive success.
Appl. Sci. (2020), 10(18), 6543.

11. Sean D. Lawley, Alan E. Lindsay, Christopher E. Miles,
Receptor organization determines the limits of single-cell source location detection,
Phys. Rev. Lett. (2020), **125**, 018102.

12. Frédéric Paquin-Lefebvre, Bin Xu, Kelsey L. DiPietro, Alan E. Lindsay, Alexandra Jilkine,
Pattern formation in a coupled membrane-bulk reaction-diffusion model for intracellular polarization and oscillations,
Journal of Theoretical Biology, (2020), Vol. 497, 21, 110242.

13. Paul Rumbach, Alan E. Lindsay, David Go,
Turing Patterns on a Plasma-Liquid Interface,
Plasma Sources Science and Technology, (2019), 28 105014.

14. R. A. Fernandes, K. A Ganzinger, J. C. Tzou, P. Jönsson, S. F. Lee, M. Palayret, V. T. Chang, M. Da Cunha Santos, C. Macleod, A. E. Lindsay, O. Dushek, A. Tilevik, S. J. Davis, D. Klenerman.
A cell topography-based mechanism for ligand discrimination by the T cell receptor.
Proceedings of the National Academy of Science, (2019) 116 (28) 14002–14010;

15. Kelsey L. DiPietro, Alan E. Lindsay.
Adaptive solution to two dimensional partial differential equations in curved domains using the Monge-Ampére equation.
SIAM Journal on Scientific Computing (2019), 41(2), pp. 1331–1356.

16. Kelsey L. DiPietro, Ronald Hayes, Weizhang Huang, Alan E. Lindsay, Yufei Yu.
Moving mesh simulation of contact sets in two dimensional models of elastic-electrostatic deflection problems.
Journal of Computational Physics (2018), 375, pp. 763–782.

17. A. J. Bernoff, A. E. Lindsay, D. D. Schmidt.
Boundary homogenization of semi-permeable membranes with periodic patterns of reactive sites.
SIAM Multiscale Modeling and Simulation, (2018) 16(3), pp. 1411–1447.

18. A. E. Lindsay, B. Quaife, L. Wendelberger.
A boundary element method for computing the vibrational modes of elastic plates with localized punctures.
Advances in Computational Mathematics, (2018) 44(4), 1249-1273.

19. A. E. Lindsay, A. J. Bernoff.
Numerical approximation of diffusive capture rates by planar and spherical surfaces with absorbing pores.
SIAM J. Applied Math., (2018), 78(1), pp. 266–290.

20. K. L. DiPietro, A. E. Lindsay.
Monge-Ampére solution of fourth order PDEs in two dimensions with applications to electrostatic interactions.
Journal of Computational Physics, 349, (2017) pp. 328–350.

21. A. E. Lindsay, J. C. Tzou, T. Kolokolnikov.
Optimization of first passage times by multiple cooperating mobile traps,
SIAM Multiscale Modeling and Simulation Vol. 15, No. 2, pp. 920–947 (2017).

22. A. E. Lindsay, A. J. Bernoff, M.J. Ward.
First Passage Statistics for the Capture of a Brownian Particle by a Structured Spherical Target with Multiple Surface Traps,
SIAM Multiscale Modeling and Simulation. Vol. 15, No. 1, pp. 74–109 (2017).

23. A. E. Lindsay, R.T. Spoonmore, J.C. Tzou.
Hybrid asymptotic-numerical approach for estimating first passage time densities of the two-dimensional narrow capture problem,
Physical Review E (2016) **94**, 042418.

24. A. E. Lindsay.
Regularized model of post-touchdown configurations in electrostatic MEMS: Bistability Analysis.
J. Engineering Math, (2016), 99(1), pp. 65–77.

25. A. E. Lindsay, W. Hao, A.J. Sommese.
Vibrations of thin plates with small clamped patches,
Proc. of the Royal Soc. A, (2015) Vol. 471 Issue 2184.

26. A. E. Lindsay, J. Lega, K.B. Glasner.
Regularized model of post-touchdown configurations in electrostatic MEMS: Interface Dynamics
IMA J. Applied Math, 80(6), (2015), pp. 1635–1663.

27. A. E. Lindsay, M.J. Ward, T. Kolokolnikov.
The Transition to a Point Constraint in a Mixed Biharmonic Eigenvalue Problem,
SIAM J. Applied Math., (2015), 75(3), pp. 1193–1224.

28. A. E. Lindsay, J.C. Tzou, T. Kolokolnikov.
Narrow escape problem with a mixed trap and the effect of orientation,
Physical Review E, (2015), Vol. 91, No. 3.

29. T. Kolokolnikov, A. E. Lindsay.
Recovering multiple small inclusions in a three dimensional domain using a single measurement,
Inverse Problems in Science and Engineering, (2015) Vol. 23, No. 5, pp. 377–388.

30. F. Tonolini, S. Chan, M. Agnew, A. E. Lindsay, J. Leach.
Reconstructing high-dimensional two-photon entangled states via compressive sensing,
Nature: Scientific Reports (2014) **4**, No. 6542.

31. A. E. Lindsay, J. Lega, K.B. Glasner.
Regularized model of post-touchdown configurations in electrostatic MEMS: Equilibrium analysis
Physica D: Nonlinear Phenomena, (2014), Vol. 280-281, pp. 95–108.

32. A. E. Lindsay.
An asymptotic study of blow up multiplicity in fourth order parabolic partial differential equations,
Discrete and Continuous Dynamical Systems B, (2014) Vol. 19, No. 1. pp. 189–215.

33. A. E. Lindsay, J. Lega, F.J. Sayas.
The quenching set of a MEMS capacitor in two-dimensional geometries,
Journal of Nonlinear Science, (2013) Vol. 23, No. 5, pp. 807–834.

34. A. E. Lindsay, K.B. Glasner.
The stability and evolution of curved domains arising from one dimensional localized patterns,
SIAM J. Appl. Dyn. Syst., (2013), 12(2), pp. 650–673.

35. N.D. Brubaker, A. E. Lindsay.
The onset of multi-valued solutions of a prescribed mean curvature equation with singular nonlinearity,
Euro. Journal of Applied Mathematics, (2013) Vol. 25, No. 5, pp. 631–656.

36. A. E. Lindsay, J. Lega.
Multiple quenching solutions of a fourth order parabolic PDE with a singular nonlinearity modeling a MEMS capacitor.
SIAM J. Applied Math., (2012) 72(3), pp. 935–958.

37. A. E. Lindsay, D.R. Brecher.
Simulation of the CEV process and the local martingale property.
Mathematics and Computers in Simulation, (2012) 82(5), pp. 868–878.

38. M.C. Kropinski, A. E. Lindsay, M.J. Ward.
Asymptotic Analysis of Localized Solutions to Some Linear and Nonlinear Biharmonic Eigenvalue Problems.
Studies in Applied Mathematics, (2011) Volume 126, Issue 4, pp. 347–408.

39. A. E. Lindsay, M.J. Ward.
Asymptotics of some nonlinear eigenvalue problems modelling a MEMS Capacitor. Part II: multiple solutions and singular asymptotics.
Euro. Jnl of Applied Mathematics (2011), Vol. 22, No. 2, pp. 83–123.

40. A. E. Lindsay, M.J. Ward.
An Asymptotic Analysis of the Persistence Threshold for the Diffusive Logistic Model in Spatial Environments with Localized Patches.
Discrete and Continuous Dynamical Systems B, (2010) Vol. 14, No. 3, pp. 1139–1179.

41. A. E. Lindsay, M.J. Ward.
Asymptotics of some nonlinear eigenvalue problems for a MEMS capacitor: Part I: Fold point asymptotics.
Methods and Applications of Analysis, (2008), Vol. 15, No. 3, pp. 297–326.

42. A. E. Lindsay, K.A. Lindsay, J.R. Rosenberg.
New concepts in compartmental modelling.
Computing and Visualization in Science, (2007) **10**(2), pp. 79–98.

43. A. E. Lindsay, K.A. Lindsay, J.R. Rosenberg.
Increased computational accuracy in multi-compartmental cable models by a novel approach for precise point process localization.
Journal of Computational Neuroscience, (2005) **19**, pp. 21–37.

STUDENT MENTORING	<u>Graduate:</u>
	Jonathan Morgan, Ph.D, Notre Dame, 2023.
	Adrián Navarro Hernández, Ph.D, Notre Dame, 2023.
	Kelsey DiPietro (NSF Graduate Fellow), Ph.D, Notre Dame, 2019.
	Andre Kovac, M.Sc Heriot-Watt, 2013.
	<u>Undergraduate:</u>
	Gabriel Sargent, B.Sc. Notre Dame, 2021-.
	Chessley Blacklock, B.Sc. Notre Dame, 2023.
	Charles Naudet, B.Sc. Notre Dame, 2020.
	Jacob Naatz, B.Sc. Notre Dame, 2018.
	Samuel Adofo, B.Sc. Notre Dame, 2018.
	Laura Wendelberger, B.Sc. Notre Dame, 2017.
	Ryan Spoonmore, B.Sc. Notre Dame, 2017.
	Susan Chen, B.Sc. Heriot-Watt, 2013.
	Francesco Tonolini B.Sc Heriot-Watt, 2013.

INVITED LECTURES AND ADDRESSES

1. (Upcoming) June 30th 2024, Society of Mathematical Biology Annual general meeting, Seoul, South Korea

2. June 11th 2024, SIAM Life sciences, Portland, USA.

3. April 16th 2024, U Alabama Mathematics Colloquium.

4. APS March Meeting, *Physical Biology of Guided Migration*, March 4th 2024, Minneapolis, MN, USA.

5. Canadian Math Society Winder Meeting, Montreal, December 2nd 2023.

6. Mathematical Biology Seminar, University of Alberta, November 6th 2023.

7. SIAM Great Lakes, October 14th 2023.

8. Interdisciplinary conference on nuclear membrane transport, Kylemore, Ireland, August 8th 2023.

9. AIMS conference on Dynamical Systems, Differential Equations and Applications, May 31st 2023.

10. SIAM Snowbird Dynamical Systems, May 14th, 2023.

11. Quantitative Biology retreat, Notre Dame, April 8th, 2022.

12. Integrated Applied Mathematics Colloquium, U. New Hampshire, NH, December 2nd, 2021.

13. Mathematical Biology Seminar, U. Pennsylvania, PA, November 9th 2021.

14. PIMS Workshop: New Trends in Localized Patterns in PDEs, UBC, Vancouver, Canada, May 12th 2021.

15. Interdisciplinary Center for Quantitative Modeling in Biology, UC Riverside, May 11th 2021.

16. Math Bio Seminar, Brandeis University, April 21st 2021.

17. AAMP departmental seminar (Virtual), Dalhousie University, January 29th 2021.

18. Applied Math Seminar, *The mathematics of diffusive signaling and the role of receptor clustering in chemoreception*, Department of Engineering Sciences & Applied Mathematics, Northwestern University, February 24th, 2020.

19. SIAM Central States Sectional Meeting, *Adaptive Solution of Two-dimensional Partial Differential Equations in Curved Domains using the Monge-Ampére Equation*, October 19th 2019, Ames, IA.

20. Society of Math Biology Annual General meeting, *Spatial Interactions at Cell Scales*, July 23rd, 2019, Montreal, Canada.

21. ICIAM 2019, *Analytic and Computational Simulation in Biomedical Engineering and Bioscience*, July 15th, 2019, Valencia, Spain.

22. SIAM Dynamical Systems, *Recent Advances in Diffusive and Reaction-diffusion Systems*, May 20th 2019, Snowbird, UT, USA.

23. Invited lectures series in memory of Prof. Gilberto Flores, *Mathematical modeling of Micro Electro Mechanical Systems*, April 9th-12th 2019, UNAM, Mexico City, Mexico.

24. AMS Spring Southeastern Sectional Meeting, *Modeling and Analysis of Spatially Extended Structures*, March 15th 2019, Auburn, AL.

25. BIRS: Mathematics of the Cell, August 13th, 2018, Banff, AB.

26. SIAM Life Sciences, August 6th 2018, Minneapolis, MN.

27. Agent-based Modeling in Biological and Social Systems. American Mathematical Society, Mathematical Research Community, Whispering Pines, R.I., June 20th 2018.

28. Equadiff 2017, Singular perturbations and singularities: theory and applications, July 26th 2017, Bratislava, Slovakia.

29. CAIMS 2017, July 20th, 2017, Topics in the Dynamics and Stability of Pattern Forming Systems, Halifax, NS, Canada.

30. CAIMS 2017, July 20th, 2017, Collective behaviour in complex systems, Halifax, NS, Canada.

31. NIST: National Institute of Standards and Technology, Applied and Computational Math Division Seminar, June 13th 2017, Gaithersburg, MD, USA.

32. SIAM Dynamical Systems, *Stochastic processes in heterogeneous environments*, May 25th 2017, Snowbird, UT, USA.

33. Math Department Seminar, Harvey Mudd College, April 12th 2017, Claremont, CA, USA.

34. AMS Spring Sectional Meeting, Indiana University, April 2nd 2017, Bloomington, IN, USA.

35. MAA Michigan Sectional Meeting, Ferris State University, Big Rapids, April 1st 2017, MI, USA.

36. Department of Scientific Computing Colloquium, Florida State University, February 1st 2017, Tallahassee, FL, USA.

37. AARMS-CRM Workshop on Numerical Analysis of Singularly Perturbed Differential Equations, July 26th 2016, Halifax, NS, Canada.

38. Coherent Structures in PDEs and their applications, June 22nd 2016, CMO-BIRS, Oaxaca, Mexico.

39. TU Wien, *Mathematical modeling of micro-electro mechanical systems - III of III.*, March 10th 2016, Vienna, Austria.

40. TU Wien, *Mathematical modeling of micro-electro mechanical systems - II of III.*, March 8th 2016, Vienna, Austria.

41. TU Wien, *Mathematical modeling of micro-electro mechanical systems - I of III.*, March 7th 2016, Vienna, Austria.

42. SIAM Analysis of PDEs, *Self-organization Phenomena in Elliptic and Parabolic Systems*, December 7th 2015, Phoenix, AZ, USA.

43. AARMS Workshop on Pattern Formation, July 18th 2015, Dalhousie University, Halifax, Canada.

44. SIAM Dynamical Systems *First Passage Times in Discrete and Continuous Systems*, May 20th 2015, Snowbird, UT, USA.

45. Applied Math Seminar, Notre Dame, April 30th 2015, Notre Dame, IN, USA.

46. SIAM: Nonlinear Waves, August 13th 2014, Cambridge, UK.

47. CAIMS 2014, June 26th 2014, Saskatoon, SK, Canada.

48. PDE Seminar, University of Notre Dame, December 3rd 2013, IN, USA.

49. University of Glasgow Mathematics Seminar, July 25th 2013, Glasgow, UK.

50. Canadian Mathematical Society, Nonlocal interactions in social, physical, and biological sciences, June 5th 2013, Halifax, NS, Canada.

51. Scottish Partial Differential Equation Colloquium, ICMS, May 17th 2013, Edinburgh, UK.

52. University of Delaware, March 19th, 2013, Newark, DE, USA.

53. University of Notre Dame, February 22nd 2013, South Bend, IN, USA.

54. University of Queensland, December 17th 2012, Brisbane, Australia.

55. Heriot-Watt University, September 28th 2012, Edinburgh, UK.

56. 9th AIMS conference on dynamical systems, Dispersal in Heterogeneous Landscape Session, July 3rd 2012, Orlando, FL, USA.

57. 9th AIMS conference on dynamical systems, Self-organization Behavior of Nonlinear Elliptic Equations and Systems Session, July 3rd 2012, Orlando, FL, USA.

58. CAIMS 2012, June 25th 2012, Toronto, ON, Canada.

59. Multi-particle systems with non-local interactions, BIRS, January 23rd 2012, Banff, AB, Canada.

60. Dalhousie University, January 9th 2012, Halifax, N.S., Canada.

61. Heriot Watt University, November 24th 2011, Edinburgh, UK.

62. SIAM conference on Analysis of Partial Differential Equations, November 15th 2011, San Diego, CA, USA.

63. Geometric methods for infinite-dimensional dynamical systems, November 4th, 2011, Brown University, Providence, R.I., USA.

64. Mathematics Physics Seminar, University of Arizona, November 2nd, 2011, Tucson, AZ, USA.

65. Workshop for Young Researchers in Mathematical Biology, MBI, August 31st 2011, Columbus, OH, USA.

66. International Congress on Industrial and Applied Mathematics (ICIAM), July 19th 2011, Vancouver B.C. (Poster), Canada.

67. Frontiers in Applied and Computational Mathematics, June 10th 2011, New Jersey Institute of Technology, Newark, NJ, USA.

68. University of Delaware, Applied Mathematics Seminar, April 19th 2011, Newark, DE, USA.

69. Los Arizonas Day, April 1st 2011, University of Arizona, Tucson, AZ, USA.

70. Analysis and Dynamics Seminar, January 25th 2011, University of Arizona, Tucson, AZ, USA.

71. St. Francis Xavier University, July 28th 2010, Antigonish, N.S., Canada.

72. CAIMS 2010, July 18th 2010, St. Johns NL, Canada.

73. Western Canadian Conference for Young Researchers in Mathematics, May 2007, Calgary, AB, Canada.

NOTRE DAME TEACHING	Applied Partial Differential Equations (F [13 14 15], S [18 19 20 21 22 23 24]). Applied Linear Algebra (F [15 16 17 18 19 20 23], S [16]). Asymptotic and Perturbation Methods (F [16]). Methods of Applied Mathematics I (S [14 15], F [14 21]) Stochastic Simulation Algorithms (F [22 23])
SERVICE	• NSF Panel reviewer (Multiple occasions).

- NSF Panel reviewer (Multiple occasions).

- Committee: Heriot Watt Edinburgh Mathematical Society (EMS) representative (2012-2013), ACMS Notre Dame Graduate Committee (2016-), Notre Dame Biophysics Steering Committee (2017-)

- PhD Committees: Nick Brubaker (Delaware), Ryan Thompson (ND Math), Liang Wu (ND), Alan Liddel (ND), Nate Rupprecht (ND) Ryan Pyle (ND), Kelsey DiPietro (ND), Xinyue Zhao (ND), Xue Li (ND), Yihao Hu (ND), Lauren Hensley (ND), Annalisa Iuorio (TU Wien), Emma Cobian (ND), Erin Brossard (ND BPHY), Arjun Vijaywargiya (ND), Jonathan Morgan (ND BPHY), Adrián Navarro Hernández (ND), Christian Villatoro (ND), Jingyi Liu (ND).

- Organizer of Scottish Partial Differential Equation Colloquium, ICMS, May 17th 2013, Edinburgh, UK.

- Co-Organizer of Applied Math Seminar at Notre Dame.

- Co-Organizer of mini symposium *Analysis and Applications of Pattern Forming Systems*, August 13th-14th 2014, SIAM: Nonlinear Waves, Cambridge, UK.

- Co-Organizer of mini symposium *First Passage times in Discrete and Continuous Systems*, May 17th-21st 2015, SIAM: Dynamical Systems, Snowbird, UT.

- Co-Organizer of mini symposium *Stochastic Processes in Heterogeneous Environments*, May 21st-25th 2017, SIAM: Dynamical Systems, Snowbird, UT.

- Co-Organizer of AMS Mathematical Research Community *Agent-based Modeling in Biological and Social Systems*, June 17th-23rd 2018.

- Co-Organizer of mini symposium *Agent-based Modeling in the Life Sciences*, August 6th-9th 2018, SIAM Life Sciences, Minneapolis, MN.

- Co-Organizer of *New trends in Localized Patterns of PDEs.* May 10th-May 13th 2021.

- Co-Organizer of mini symposium *Stochastic Processes in Biology*, May 14th-18th 2023, SIAM: Dynamical Systems, Portland, OR.

- Organizer of *Interdisciplinary conference on nuclear morphology and dynamics*, August 7th-11th 2023, Kylemore Abbey, Ireland.

- Organizer of mini symposium *PDE models in Mathematical Biology*, October 14th 2023, SIAM: Great Lakes, Lansing MI.

- Organizer of mini symposium *Stochastic processes in cellular biology*, June 11th 2024, SIAM: Life sciences, Portland, OR.