Curriculum vitæ

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personalia

Name: Klas Erik Finn Modin

affiliation

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education

PhD, Mathematics — May 2010
Lund University, Sweden
Title: Adaptive Geometric Numerical Integration of Mechanical Systems
Supervisors: Claus Führer and Gustaf Söderlind

Master of Science, Mathematics — Feb 2004
Lund University, Sweden

academic positions

Professor, *Chalmers University of Technology* — Since Nov 2020

Associate Professor, *Chalmers University of Technology* — Nov 2017–Oct 2020

Assistant Professor, *Chalmers University of Technology* — Nov 2013–Oct 2017

Post-doc, *University of Toronto*, Canada — Jul 2012–Jun 2014
Funded by the Swedish Research Council.

Post-doc, *Massey University*, New Zealand — Jul 2009–Jan 2012
Funded by the Marsden Fund and the Royal Physiographical Society in Lund.

other positions

Numerical Analyst, *SKF Sverige AB*, Göteborg — 2004–2005
Employment on a project basis.

invitations as guest researcher

University of Toronto, Canada (host: Boris Khesin)	Feb 2020
Massey University, New Zeeland (host: Robert McLachlan)	Jan–Apr 2018
Massey University, New Zeeland (host: Robert McLachlan)	Jan–Mar 2016
Imperial College, UK (host: Darryl Holm)	Oct 2013
University of Vienna, Austria (host: Peter Michor)	May 2013
Imperial College, UK (host: Darryl Holm)	Apr 2012
NTNU, Norway (host: Brynjulf Owren)	Feb–Mar 2012

workshop organizer at research institutes

Sophus Lie Conference Center for Mathematics, Norway	Jul 2024
Banff International Research Station (BIRS), Canada	Nov 2023
Institute Mittag–Leffler (IML), Stockholm, Sweden	July 2018

invitations to research institutes

Mathematisches Forschungsinstitut Oberwolfach (MFO), Germany	May 2026
International Centre for Mathematical Sciences (ICMS), Edinburgh, UK	Jun 2025
Gran Sasso Science Institute (GSSI), L'Aquila, Italy	May 2025
Erwin Schrödinger Institute (ESI), Vienna, Austria	Feb 2025
Centre International de recontres mathématiques (CIRM), Luminy, France	May 2024
Institute Mittag–Leffler (IML), Stockholm, Sweden	Nov 2023
Max Planck Institute (MPL), Leipzig, Germany	Apr 2023
Simon Center for Geometry and Physics (SCGP), New York, USA	Jul 2022
International Center for Mathematical Science (ICMS), Edinburgh, UK	Apr 2021
Mathematisches Forschungsinstitut Oberwolfach (MFO), Germany	Mar 2021
Fields Institute (FI), Toronto, Canada	Sep 2020
Princeton Center of Theoretical Sciences (PCTS), Princeton, USA	Feb 2020
Hausdorff Research Institute (HIM), Bonn, Germany	Nov 2019
Isaac Newton Insitute (INI), UK	Nov 2019
Banff International Research Station (BIRS), Canada	Dec 2018
Isaac Newton Insitute (INI), UK	Nov 2017
Mathematisches Forschungsinstitut Oberwolfach (MFO), Germany	Mar 2016
Erwin Schrödinger Institute (ESI), Vienna, Austria	Jan 2015
Simon Center for Geometry and Physics (SCGP), New York, USA	May 2014
Fields Institute (FI), Toronto, Canada	Jul–Aug 2012

tutoring experience

Supervision of Post-docs	Geir Bogfjellmo (2015–2017) Sagy Ephrati (2023–2025) Eugen Bronasco (2025–2027)
Supervision of PhD students	Michael Roop (2021–today) Erik Jansson (2020–2025) Milo Viviani (2015–2020)
Co-supervision of PhD students	currently: 3 past: 2
Supervision of master students	Chalmers and GU: 14 ENS Paris: 2

Pedagogical training
2024. Chalmers EER course "Diversity and Inclusion for Learning" (3 ECTS).
2014–2020. Chalmers "Diploma of Higher Education" (17 ECTS).

Undergraduate teaching
2019–today. Developing and teaching course on "Architectural Geometry".
2018–2023. Developing and teaching course on "Scientific Visualization".
2014–today. Basic calculus courses at Chalmers. (Teacher and examiner.)
2010–2012. Various mathematics courses at Massey. (Teacher and examiner.)

Post-graduate teaching
2025. Mini-course on "Information geometry of diffeomorphism groups" at the Erwin Schrödinger Institute, Vienna, Austria, February 3–7, 2025.
2024. Course on "Numerical Methods for ODEs" at Chalmers and GU.
2023. Mini-course on "Geometric Hydrodynamics on Flatland" at the University of Santiago de Compostella, Spain, September 4–8, 2023.
2018. Mini-course on "Geometric Hydrodynamics" at the University of Coimbra, Portugal, December 6–8, 2018.
2013. Course on "Geometric Numerical Integration" at Chalmers and GU.

Written lecture notes
2013. "Geometric Mechanics and Geometric Integration".

Selection of honours and grants

2026. *Plenary speaker*, Foundations of Computational Mathematics (FoCM), Vienna, July 2026.

2025. *Göran Gustafsson Award in Mathematics*, Göran Gustafsson Foundation.

2024. *Wallenberg Academy Fellow (extension)*, Knut and Alice Wallenberg Foundation (KAW).

2024. *International post-doc recruitment grant*, Knut and Alice Wallenberg Foundation (KAW).

2022. *Project Grant*, Swedish Research Council (VR).

2019. *Wallenberg Academy Fellow*, Knut and Alice Wallenberg Foundation (KAW).

2017. *Starting Grant*, Swedish Research Council (VR).

2015. *International post-doc recruitment grant*, Knut and Alice Wallenberg Foundation (KAW).

2015. *Stenbäckska Stipendiet*, Finnish Society of Sciences and Letters.

2015. *Marie Skłodowska-Curie Individual Fellowship*, EU Horizon 2020.

2015. *Transition Grant*, Swedish Foundation for International Cooperation in Research and Higher Education (STINT).

2013. *Ingvar Carlsson Award*, Swedish Foundation of Strategic Research (SSF).

2012. *International Post-doc grant*, Swedish Research Council (VR).

2010. *Post-doctoral scholarship* Royal Physiographic Society in Lund.

2009. *Travel scholarship* Royal Swedish Academy of Science (KVA).

2007. *Young researcher scholarship* Royal Physiographic Society in Lund.

Peer-reviewed publications

For updates and other publications, see klasmodin.github.io/publications

54. Ephrati, S., Jansson, E. & Modin, K. On spectral scaling laws for averaged turbulence on the sphere. *Phys. D* **481,** 134808 (2025).
53. Jansson, E., Krook, J., Modin, K. & Öktem, O. Geometric shape matching for recovering protein conformations from single-particle Cryo-EM data. *SIAM J. Imaging Sci.* (2025).
52. Jansson, E. & Modin, K. Sub-Riemannian landmark matching and its interpretation as residual neural networks. *J. Comput. Dyn.* **12,** 467–490 (3 2025).
51. Modin, K. & Preston, S. C. Zeitlin's model for axisymmetric 3-D Euler equations. *Nonlinearity* **38,** 025008 (2025).
50. Modin, K. & Roop, M. Spatio-temporal Lie-Poisson discretization for incompressible magnetohydrodynamics on the sphere. *IMA J. Numer. Anal.,* draf024 (2025).
49. Jansson, E. & Modin, K. Convergence of the vertical gradient flow for the Gaussian Monge problem. *J. Comput. Dyn.* **11,** 1–9 (2024).
48. Khesin, B., Modin, K. & Volk, L. Simple unbalanced optimal transport. *Int. Math. Res. Not.* **2024,** 8839–8855 (10 2024).
47. Modin, K. On the geometry and dynamical formulation of the Sinkhorn algorithm for optimal transport. *J. Comput. Dyn.* (2024).
46. Modin, K. & Perrot, M. Eulerian and Lagrangian stability in Zeitlin's model of hydrodynamics. *Comm. Math. Phys.* **405,** 177 (2024).
45. Cifani, P., Viviani, M. & Modin, K. An efficient geometric method for incompressible hydrodynamics on the sphere. *J. Comput. Phys.* **473,** 111772 (2023).
44. Khesin, B. & Modin, K. The Toda flow as a porous medium equation. *Comm. Math. Phys.* **401,** 1879–1898 (2023).

43. Maurelli, M., Modin, K. & Schmeding, A. Incompressible Euler equations with stochastic forcing: a geometric approach. *Stochastic Process. Appl.* **159,** 101–148 (2023).

42. Balehowsky, T., Karlsson, C.-J. & Modin, K. Shape analysis via gradient flows on diffeomorphism groups. *Nonlinearity* **36,** 862 (2022).

41. Cifani, P., Viviani, M., Luesink, E., Modin, K. & Geurts, B. Casimir preserving spectrum of two-dimensional turbulence. *Phys. Rev. Fluids* **7,** L082601 (2022).

40. Modin, K. & Viviani, M. Canonical scale separation in two-dimensional incompressible hydrodynamics. *J. Fluid Mech.* **943,** A36 (2022).

39. Khesin, B., Misiolek, G. & Modin, K. Geometric hydrodynamics and infinite-dimensional Newton's equations. *Bull. Amer. Math. Soc.* **58,** 377–442 (2021).

38. Modin, K. & Viviani, M. Integrability of point-vortex dynamics via symplectic reduction: a survey. *Arnold Math. J.* **7,** 357–385 (2021).

37. Bauer, M. & Modin, K. Semi-invariant Riemannian metrics in hydrodynamics. *Calc. Var. Partial Differential Equations* **59,** 65 (2020).

36. Modin, K. & Verdier, O. What makes nonholonomic integrators work? *Numer. Math.* **145,** 405–435 (2020).

35. Modin, K. & Viviani, M. A Casimir preserving scheme for long-time simulation of spherical ideal hydrodynamics. *J. Fluid Mech.* **884,** A22 (2020).

34. Modin, K. & Viviani, M. Lie-Poisson methods for isospectral flows. *Found. Comput. Math.* **20,** 889–921 (2020).

33. Benn, J., Marsland, S., McLachlan, R., Modin, K. & Verdier, O. Currents and finite elements as tools for shape space. *J. Math. Imaging Vis.* **61,** 1197–1220 (2019).

32. Hellsvik, J. *et al.* General method for atomistic spin-lattice dynamics with first-principles accuracy. *Phys. Rev. B* **99,** 104302 (2019).

31. Khesin, B., Misiolek, G. & Modin, K. Geometry of the Madelung transform. *Arch. Ration. Mech. Anal.* **234,** 549–573 (2019).

30. Bogfjellmo, G., Modin, K. & Verdier, O. A Numerical Algorithm for C2-splines on Symmetric Spaces. *SIAM J. Numer. Analysis* **56,** 2623–2647 (2018).

29. Khesin, B., Misiolek, G. & Modin, K. Geometric Hydrodynamics via Madelung Transform. *Proc. Natl. Acad. Sci. USA* **115,** 6165–6170 (2018).

28. Modin, K., Nachman, A. & Rondi, L. A Multiscale Theory for Image Registration and Nonlinear Inverse Problems. *Adv. Math.* **346,** 1009–1066 (2018).

27. Bauer, M., Joshi, S. & Modin, K. *Diffeomorphic random sampling using optimal information transport* in *Nielsen F., Barbaresco F. (eds) Geometric Science of Information. GSI 2017. Lecture Notes in Computer Science, vol 10589. Springer* (2017).

26. Bauer, M., Joshi, S. & Modin, K. On Geodesic Completeness of Riemannian Metrics on Smooth Probability Densities. *Calc. Var. Partial Differential Equations* **56,** 113 (2017).

25. McLachlan, R., Modin, K., Munthe-Kaas, H. & Verdier, O. Butcher series: A story of rooted trees and numerical methods for evolution equations. *Asia Pacific Mathematics Newsletter* **7,** 1–11 (2017).

24. McLachlan, R., Modin, K. & Verdier, O. A minimal-variable symplectic integrator on spheres. *Math. Comp.* **86,** 2325–2344 (2017).

23. Modin, K. Geometry of Matrix Decompositions Seen Through Optimal Transport and Information Geometry. *J. Geom. Mech.* **9,** 335–390 (2017).

22. McLachlan, R., Modin, K., Munthe-Kaas, H. & Verdier, O. B-series methods are exactly the affine equivariant methods. *Numer. Math.* **133,** 599–622 (2016).

21. McLachlan, R., Modin, K. & Verdier, O. Geometry of discrete-time spin systems. *J. Nonlin. Sci.* **26,** 1507–1523 (2016).

20. McLachlan, R., Modin, K. & Verdier, O. Symmetry reduction for central force problems. *Eur. J. Phys.* **37,** 0055003 (2016).

19. Bauer, M., Joshi, S. & Modin, K. Diffeomorphic density matching by optimal information transport. *SIAM J. Imaging Sci.* **8,** 1718–1751 (2015).

18. McLachlan, R., Modin, K. & Verdier, O. Collective Lie-Poisson integrators on R3. *IMA. J. Num. Anal.* **35,** 546–560 (2015).

17. Modin, K. Generalized Hunter-Saxton equations, optimal information transport, and factorization of diffeomorphisms. *J. Geom. Anal.* **25,** 1306–1334 (2015).

16. Rottman, C., Bauer, M., Modin, K. & Joshi, S. *Weighted Diffeomorphic Density Matching with Applications to Thoracic Image Registration* in *Proc. 5th MICCAI Workshop on Mathematical Foundations of Computational Anatomy (MFCA), Munich, Germany, October 9* (2015).

15. Marsland, S., McLachlan, R., Modin, K. & Perlmutter, M. On conformal variational problems and free boundary continua. *J. Phys. A* **47,** 145204 (2014).

14. McLachlan, R., Modin, K. & Verdier, O. Collective symplectic integrators. *Nonlinearity* **27,** 1525–1542 (2014).

13. McLachlan, R., Modin, K. & Verdier, O. Symplectic integrators for spin systems. *Phys. Rev. E* **89,** 061301 (2014).

12. McLachlan, R., Modin, K., Verdier, O. & Wilkins, M. Geometric Generalisations of SHAKE and RATTLE. *Found. Comput. Math.* **14,** 339–370 (2014).

11. Marsland, S., McLachlan, R., Modin, K. & Perlmutter, M. Geodesic Warps by Conformal Mappings. *Int. J. Comput. Vis.* **105,** 144–154 (2013).

10. McLachlan, R., Modin, K., Verdier, O. & Wilkins, M. Symplectic integrators for index 1 constraints. *SIAM J. Sci. Comput.* **35,** A2150–A2162 (2013).

9. Modin, K. & Verdier, O. Integrability of Nonholonomically Coupled Oscillators. *Discrete Contin. Dyn. Syst.* **34,** 1121–1130 (2013).

8. Marsland, S., McLachlan, R., Modin, K. & Perlmutter, M. *On a Geodesic Equation for Planar Conformal Template Matching* in *Proc. MFCA'11* (2011).

7. Modin, K., Perlmutter, M., Marsland, S. & McLachlan, R. On Euler-Arnold Equations and Totally Geodesic Subgroups. *J. Geom. Phys.* **61,** 1446–1461 (2011).

6. Modin, K. & Söderlind, G. Geometric Integration of Hamiltonian Systems Perturbed by Rayleigh Damping. *BIT Num. Math.* **51,** 977–1007 (2011).

5. Modin, K. Time-transformation and reversibility of Nambu-Poisson systems. *J. Gen. Lie Theory Appl.* **3,** 39–52 (2009).

4. Modin, K. On explicit adaptive symplectic integration of separable Hamiltonian systems. *J. Mult. Body Mech.* **222,** 1464–1493 (2008).

3. Modin, K., Fritzson, D. & Führer, C. *Semiexplicit Numerical Integration by Splitting with Application to Dynamic Multibody Problems with Contacts* in *Proceedings of The 48th Scandinavian Conference on Simulation and Modeling (SIMS 2007), Linköping University Electronic Press* (2007).

2. Modin, K. & Führer, C. Time-step adaptivity in variational integrators with application to contact problems. *ZAMM Z. Angew. Math. Mech.* **86,** 785–794 (2006).

1. Modin, K., Fritzson, D., Führer, C. & Söderlind, G. *A new class of variable step-size methods for multibody dynamics* in *Proceedings of Multibody Dynamics 2005, ECCOMAS Thematic Conference, Madrid, June 21-24* (2005).