Kaibo Hu

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Employment

Senior Research Fellow, Associate Professor
Mathematical Institute, University of Oxford, UK — September 2025 -

Royal Society University Research Fellow
University of Oxford, University of Edinburgh — October 2022 -

Reader (since August 2025)
School of Mathematics, University of Edinburgh, UK — October 2023 - August 2025

Hooke Research Fellow — January 2021 - September 2022
Mathematical Institute, University of Oxford, UK

Non-Stipendiary Postdoctoral Research Fellow — October 2021 - September 2023
Christ Church, Oxford, UK

Postdoctoral Associate — August 2018 - January 2021
Department of Mathematics, University of Minnesota, USA

Researcher — August 2017 - August 2018
Department of Mathematics, University of Oslo, Norway

Education

2017. Ph.D. in mathematics,
Beijing International Center for Mathematical Research, Peking University, China.
Advisor: Prof. Jinchao Xu
Thesis: *Finite Element Exterior Calculus for Multiphysics Problems*

2012. B.S. in mathematics,
Nankai University, Tianjin, China.

Honors and Awards

[1] Philip Leverhulme Prize, 2026.

[2] Stephen Smale Prize, FoCM, 2026.

[3] Nachdiplom lectures at ETH Zürich, 2026.

[4] Frontiers of Science Award, 2025.
— *for the paper "Complexes from Complexes" with Douglas N. Arnold, by the International Congress of Basic Sciences (ICBS).*

[5] The Feng Kang Visiting Scholar for Young Scientist, Institute of Computational Mathematics and Scientific/Engineering Computing, Chinese Academy of Sciences, 2025.

[6] ERC Starting Grant, 2024.
— *Geometric Finite Element Methods (GeoFEM).*

[7] SIAM High Impact Article Collection, 2023.
— *"A Family of Finite Element Stokes Complexes in Three Dimensions", K. Hu, Q. Zhang, Z. Zhang, SINUM 2022.*

[8] SIAM Computational Science and Engineering Early Career Prize, 2023.

[9] Royal Society University Research Fellowship, 2022-2027.

[10] Hooke Research Fellowship, Mathematical Institute, University of Oxford, UK. 2021.

[11] Non-Stipendiary Postdoctoral Research Fellowship, Christ Church, Oxford. 2021.

[12] Marie Skłodowska-Curie Individual Fellowship offer, EU, 2020.

[13] New World Mathematics Award, 2017,
— *for Ph.D. thesis*

[14] Outstanding Youth Paper Prize, Beijing Society of Computational Mathematics, September 2016,
— *for the paper "Stable Finite Element Methods Preserving* $\nabla \cdot \boldsymbol{B} = 0$ *Exactly for MHD Models"*

[15] Student Paper Prize of East Asian SIAM, June 2016,
— *for the paper "Structure-preserving Finite Element Methods for Stationary MHD Models"*

[16] Peking University President Scholarship, 2014-2017.

Research Interests

My research develops *Finite Element Exterior Calculus (FEEC)* and its generalization *Finite Element Tensor Calculus (FETC)* as a unifying algebraic / geometric framework for structure-preserving and compatible numerical discretizations.

I aim to bridge continuous mathematical structures with structure-aware formulations and structure-preserving numerical schemes. A central theme is the deep interaction between compatible discretizations and neighbouring fields such as differential geometry, topology, homological algebra, representation theory, and mathematical physics. Applications span magnetohydrodynamics, continuum mechanics, numerical relativity, and geometric PDEs.

The vision of my current and future research includes:

- *General theories of FEEC and FETC*: forging connections between numerical analysis/computation and homological algebra, geometry, representation theory; developing a comprehensive picture for finite element tensor fields on triangulations, combinatorial manifolds, and other discrete structures.
- *Computational topological (magneto)hydrodynamics*: geometric formulations, structure-preserving discretizations, long-term dynamics of fluids and plasmas, including relaxation, self-organization, knot dynamics, symmetries, dynamo action, spectra and pseudo-spectra; with applications to astrophysics, solar physics, and fusion energy sciences.
- *Algebra and geometry of generalized continua*: modelling and computation of generalized continua, microstructures, continuum defects, and mixed-dimensional models, viewed through Hilbert complexes on (combinatorial) manifolds and Lie group symmetries.
- *Structure-preserving numerical methods for the Einstein equations* in general relativity, with potential applications in computational astronomy and gravitational-wave science.
- *Discrete differential geometry and mechanics via finite elements*: new perspectives on discrete differential geometry, discrete mechanics, discrete physics, and lattice models, approached from a finite element and PDE viewpoint.

Publications

Link to Google Scholar Profile.

[1] *Global and local helicity-preservation in the finite element discretization of magnetic relaxation*, Patrick E. Farrell, Mingdong He, Kaibo Hu and Ganghui Zhang; SIAM Journal on Scientific Computing (accepted, 2026); arXiv:2603.12134.

[2] *A 2-complex containing Sobolev spaces of matrix fields*, Jay Gopalakrishnan, Kaibo Hu, Joachim Schöberl; Foundations of Computational Mathematics (accepted, 2026); arXiv:2507.11869.

[3] *Finite elements for symmetric and traceless tensors in three dimensions*, Kaibo Hu, Ting Lin and Bowen Shi; accepted, Mathematics of Computation (2026); arXiv:2311.16077.

[4] *Extended Regge complex for linearized Riemann-Cartan geometry and cohomology*, Snorre H. Christiansen, Kaibo Hu and Ting Lin; Foundations of Computational Mathematics (2026).

[5] *Convergence and stability of discrete exterior calculus for the Hodge Laplace problem in two dimensions*, Chengbin Zhu, Snorre H. Christiansen, Kaibo Hu and Anil N. Hirani; accepted, IMA Journal of Numerical Analysis (arXiv:2505.08966).

[6] *Helicity-preserving finite element discretization for magnetic relaxation*, Mingdong He, Patrick E. Farrell, Kaibo Hu and Boris D. Andrews; SIAM Journal on Scientific Computing, 48(2), B165–B183 (2026).

[7] *Uniformly hp-stable elements for the elasticity complex*, Francis R. A. Aznaran, Kaibo Hu and Charles Parker; SIAM Journal on Numerical Analysis, 64(3), 708–736 (2026).

[8] *Many facets of cohomology: differential complexes and structure-aware formulation*, Kaibo Hu; Royal Society Open Science, 13(3), 250728 (2026).

[9] *Intrinsic mixed finite element methods for linear Cosserat elasticity*, Andrea Dziubek, Kaibo Hu, Michael Karow and Michael Neunteufel; SIAM Journal on Numerical Analysis, 63(4), 1833–1860 (2025).

[10] *Error estimates for a helicity-preserving finite element discretisation of an incompressible magnetohydrodynamics system*, Lourenco Beirao da Veiga, Kaibo Hu and Lorenzo Mascotto; ESAIM: Mathematical Modelling and Numerical Analysis, 59(2), 1075-1094. (2025)

[11] *Intrinsic finite elements: currents, discrete geometry and periodic table*, Kaibo Hu; Mathematica Numerica Sinica, 47(3), 385–417 (2025) (invited "Young Researcher Review" section, in Chinese).

[12] *Distributional Hessian and divdiv complexes on triangulation and cohomology*, Kaibo Hu, Ting Lin and Qian Zhang; SIAM Journal on Applied Algebra and Geometry, 9(1), 108–153 (2025).

[13] *An exterior calculus framework for polytopal methods*, Francesco Bonaldi, Daniele A. Di Pietro, Jérôme Droniou and Kaibo Hu; Journal of the European Mathematical Society, published online (2025).

[14] *BGG sequences with weak regularity and applications*, Andreas Čap and Kaibo Hu; Foundations of Computational Mathematics, 24, 1145–1184 (2024).

[15] *Discrete tensor product BGG sequences: splines and finite elements*, Francesca Bonizzoni, Kaibo Hu, Guido Kanschat and Duygu Sap; Mathematics of Computation (2024).

[16] *A discrete elasticity complex on three-dimensional Alfeld splits*, Snorre H. Christiansen, Jay Gopalakrishnan, Johnny Guzmán and Kaibo Hu; Numerische Mathematik, 156, 159–204 (2024).

[17] *Quadratic and cubic Lagrange finite elements for mixed Laplace eigenvalue problems on criss-cross meshes*, Kaibo Hu, Jiguang Sun and Qian Zhang; Results in Applied Mathematics (2024).

[18] *Bounded Poincaré operators for twisted and BGG complexes*, Andreas Čap, Kaibo Hu; Journal de Mathématiques Pures et Appliquées (2023).

[19] *Structure-preserving and helicity-conserving finite element approximations and preconditioning for the Hall MHD equations*, Fabian Laakmann, Kaibo Hu and Patrick E. Farrell; Journal of Computational Physics (2023).

[20] *Finite element systems for vector bundles: elasticity and curvature*, Snorre H. Christiansen and Kaibo Hu; Foundations of Computational Mathematics (2022).

[21] *A family of finite element Stokes complexes in three dimensions*, Kaibo Hu, Qian Zhang and Zhimin Zhang; SIAM Journal on Numerical Analysis (2022).

[22] *Spurious solutions for high order curl problems*, Kaibo Hu, Qian Zhang, Jiayu Han, Lixiu Wang, Zhimin Zhang; IMA Journal of Numerical Analysis (2022).

[23] *Partially discontinuous nodal finite elements for $H(\mathrm{curl})$ and $H(\mathrm{div})$*, Jun Hu, Kaibo Hu and Qian Zhang; Computational Methods in Applied Mathematics (2022).

[24] *Complexes from complexes*, Douglas N. Arnold and Kaibo Hu; Foundations of Computational Mathematics (2021).

[25] *Helicity-conservative finite element discretization for incompressible MHD systems*, Kaibo Hu, Young-Ju Lee and Jinchao Xu; Journal of Computational Physics, 436, 110284 (2021).

[26] *Well-conditioned frames for finite element methods*; Kaibo Hu and Ragnar Winther; Journal of Computational Mathematics (2021).

[27] *Simple curl-curl-conforming finite elements in two dimensions*, Kaibo Hu, Qian Zhang and Zhimin Zhang; SIAM Journal on Scientific Computing (2020).

[28] *A characterization of supersmoothness of multivariate splines*, Michael S. Floater and Kaibo Hu; Advances in Computational Mathematics (2020).

[29] *Poincaré path integrals for elasticity*; Snorre H. Christiansen, Kaibo Hu and Espen Sande; *Journal de Mathématiques Pures et Appliquées* (2019).

[30] *Generalized Gaffney inequality and discrete compactness for discrete differential forms*; Juncai He, Kaibo Hu and Jinchao Xu; *Numerische Mathematik* (2019).

[31] *Nonstandard finite element de Rham complexes on cubical meshes*; Andrew Gillette, Kaibo Hu and Shuo Zhang; *BIT Numerical Mathematics* (2019).

[32] *Convergence of a B-E based finite element method for MHD models on Lipschitz domains*; Kaibo Hu, Weifeng Qiu and Ke Shi; *Journal of Computational and Applied Mathematics* (2019).

[33] *Generalized finite element systems for smooth differential forms and Stokes' problem*, Snorre H. Christiansen and Kaibo Hu, *Numerische Mathematik* (2018).

[34] *Structure-preserving finite element methods for stationary MHD models*, Kaibo Hu and Jinchao Xu, *Mathematics of Computation* (2019).

[35] *Nodal finite element de Rham complexes*; Snorre H. Christiansen, Jun Hu and Kaibo Hu, *Numerische Mathematik* (2018).

[36] *Stable magnetic field-current finite element schemes for magnetohydrodynamics systems (in Chinese)*; Kaibo Hu and Jinchao Xu, *Science China Mathematics* (2016).

[37] *Robust preconditioners for incompressible MHD models*; Yicong Ma, Kaibo Hu, Xiaozhe Hu, and Jinchao Xu, *Journal of Computational Physics* (2016).

[38] *Stable finite element methods preserving $\nabla \cdot \boldsymbol{B} = 0$ exactly for MHD models*; Kaibo Hu, Yicong Ma and Jinchao Xu, *Numerische Mathematik*, (2017, appearing online 2016).

Book chapters:

[39] *Nonlinear elasticity complex and a finite element diagram chase*, Kaibo Hu; in *Approximation Theory and Numerical Analysis Meet Algebra, Geometry, Topology*, edited by Martina Lanini, Carla Manni and Henry Schenck, Springer INdAM Series, 60, 231–252 (2024).

[40] *Supersmoothness of the Alfeld Split*, Michael S. Floater and Kaibo Hu; in *Approximation Theory and Numerical Analysis Meet Algebra, Geometry, Topology*, edited by Martina Lanini, Carla Manni and Henry Schenck, Springer INdAM Series, 60, 173–180 (2024).

Preprints:

[41] *Finite element exterior calculus for spectra and pseudospectra of advection-diffusion of differential forms*, Daniele Boffi, Kaibo Hu, Yizhou Liang and Umberto Zerbinati; arXiv:2610.01501 (2026).

[42] *Analytical properties of polygonal Stokes and BGG Hessian complexes with application to Kirchhoff–Love plates*, Daniele A. Di Pietro, Jérôme Droniou, Kaibo Hu and Arax Leroy; arXiv:2609.10150 (2026).

[43] *Optimal block preconditioners for a mass-conserving mixed stress formulation of Stokes flow*, Kaibo Hu, Jongho Park, and Jindong Wang; arXiv preprint arXiv:2607.22932 (2026).

[44] ReLU^k *neural de Rham complexes*, Kaibo Hu, Jindong Wang, and Jinchao Xu; arXiv preprint arXiv:2607.22478 (2026).

[45] *Finite element methods for isometric embedding of Riemannian manifolds*, Guangwei Gao, Kaibo Hu, Buyang Li and Ganghui Zhang; arXiv:2602.18722 (2026).

[46] *Hodge-Dirac wave systems and structure-preserving discretizations of the linearized Einstein equations*, Marien-Lorenzo Hanot, Kaibo Hu; arXiv preprint arXiv:2511.19441 (2025).

[47] *Design and homological analysis of twisted and BGG Stokes-de Rham complexes on polygonal meshes*, Daniele A. Di Pietro, Jérôme Droniou, Kaibo Hu and Arax Leroy; arXiv:2507.17333 (2025).

[48] *Finite element form-valued forms: Construction*, Kaibo Hu and Ting Lin; arXiv:2503.03243 (2025).

Talks

Invited conference/Workshop talks:

[1] One-hour keynote Lecture at the International Forum of Applied Mathematics and Artificial Intelligence, hosted by the Institute of Mathematical Sciences (IMS) at The Chinese University of Hong Kong (CUHK), China. July 2030. (upcoming) (*keynote lecture*)

[2] Invited talks in the minisymposium "Robustness in a priori and a posteriori estimates and solvers" and a minisymposium on material robustness at the 16th International Conference on Spectral and High Order Methods (ICOSAHOM 2027), Politecnico di Milano, Italy. July 5–9, 2027. (upcoming)

[3] Invited talks in the minisymposia "Computational electromagnetism" and "Innovative numerical methods for multiphysics problems" at the Eighth Chilean Workshop on Numerical Analysis of Partial Differential Equations (WONAPDE 2027), University of Concepción, Chile. January 18–22, 2027. (upcoming)

[4] Workshop on Discrete Conformal Geometry: Theory and Application at the Tsinghua Sanya International Mathematics Forum (TSIMF). January 04-08, 2027. (upcoming)

[5] Workshop "Advances in Ordered Fluids and Alignment Phenomena: Modeling, Analysis, and Numerical Methods", Oltrepò Pavese, Italy. (Organised by Andrea Medaglia and Umberto Zerbinati.) September 2026.

[6] International Conference on Scientific Computation and Differential Equations (SciCADE2026), Edinburgh, Scotland, 29 June - 3 July, 2026.

[7] Workshop "Discrete Laplacians", Center for Systems Biology at the Max Planck Institute, Dresden, Germany. June 2026. (*keynote lecture*)

[8] Conference of the research program "Mathematical Challenges in Brain Mechanics" at the Center for Advanced Studies at the Norwegian Academy of Sciences and Letters, June 2026.

[9] Workshop "Theory of Differential Complexes and Related Models" of thematic program on "Differential Complexes: Theory, Discretization, and Applications" at the Erwin Schrödinger Institute (ESI) in Vienna. May 2026.

[10] The 2025 International Congress of Chinese Mathematicians (ICCM), Shanghai, China. January 2026. (*plenary talk*)

[11] Computational and Applied Mathematics PhD Forum, Peking University, November 2025. (*plenary talk*)

[12] Workshop on Scientific Computing and Machine Learning, Penn State University, USA, November 2025.

[13] MS "New generation methods for numerical challenges in curl-div problems: Maxwell, MHD, and derived models", Advanced Computational Methods in ENgineering and Applied Mathematics (ACOMEN 2025), Ghent, Belgium, September 2025.

[14] IMSI Workshop "Discrete Exterior Calculus: Differential Geometry and Applications", Chicago, USA. September 2025.

[15] Section on "Finite element complexes for structure-preservation in computational physics", Modern Finite Element Technologies 2025 (MFET) ECCOMAS thematic conference, Aachen, Germany, August 2025.

[16] Workshop on "Geometric Mechanics, Structure Preserving Discretization, and Discrete Differential Geometry". SUNY Polytechnic Institute, Utica, NY, USA. July 2025. (online talk)

[17] International Congress of Basic Science, Beijing, China. July 2025. (*Frontier of Science Award talk*)

[18] Scottish Fluid Mechanics Meeting, University of Glasgow, UK. May 2025.

[19] European Finite Element Fair, SISSA, Trieste, Italy. May 2025.

[20] BIRS workshop "Geometric mechanics formulations for continuum mechanics", Banff, Canada. March 2025.

[21] "New and old problems in Numerical Relativity" workshop at the Tsinghua Sanya International Mathematics Forum (TSIMF), Sanya, China. January 2025.

[22] Minisymposium "Structure-preserving discretization of multiphysics systems", 16th World Congress on Computational Mechanics and 4th Pan American Congress on Computational Mechanics, Vancouver, Canada. July 2024.

[23] Minisymposium "Numerical Methods for Geometric PDEs", The 2024 SIAM Annual Meeting, Spokane, Washington, US. July 2024.

[24] Keynote lecture at the NEMESIS project kick-off workshop, Montpellier, France. June 2024.

[25] European Finite Element Fair, London, UK. June 2024.

[26] Banff International Research Station (BIRS) "Homological Perspective on Splines and Finite Elements" workshop, University of British Columbia Okanagan (UBCO), Canada. May 2024. (*survey talk*)

[27] Opening Conference of the CNRS Occitan Research Federation in Mathematics (OcciMath), LAMPS (Laboratory of Multidisciplinary Modeling and Simulations), University of Perpignan Via Domitia, France. April 2024.

[28] The 18th UK Applied Algebra and Geometry network meeting. Swansea University, UK. February 2024.

[29] Workshop: Theory and Numerics on Some Nonlinear PDEs; University of Oslo / online. October 2023.

[30] ICIAM, Tokyo, Japan. August 2023.

[31] The 2023 International Workshop on Scientific Computing, Feng Kang Youth Forum on Scientific Computing (FKYF), The Institute of Computational Mathematics and Scientific/Engineering Computing of Chinese Academy of Sciences, Beijing, China. August 2023.

[32] PKU Mathematics Forum, Peking University, Beijing, China. July 2023.

[33] The 29th Biennial Numerical Analysis Conference, University of Strathclyde, Glasgow, UK. June 2023.

[34] Structure preserving numerical methods for partial differential equations, Bernoulli Center, EPFL, Switzerland. July 2023.

[35] SIAM Conference on Computational Science and Engineering (CSE23), Amsterdam, Netherlands. Feb/26-Mar/03/2023. (*plenary talk*)

[36] The 8th Workshop for Young Researchers in Scientific Computing, Chinese Academy of Sciences, China (online). Dec/7-8/2022.

[37] 56th Meeting of the Society for Natural Philosophy: Mechanics and Analysis, Pisa, Italy, Sep/21-23/2022.

[38] INdAM Meeting "Approximation Theory and Numerical Analysis meet Algebra, Geometry, Topology", Palazzone di Cortona, Italy, Sep/5-9/2022.

[39] International Conference on Scientific Computation and Differential Equations (SciCADE2022), Reykjavík, Iceland, Jul/25-29/2022.

[40] 30 years of Acta Numerica conference at the Banach Centre in Będlewo, Poland, Jun/25-Jul/2/2022.

[41] MFO workshop "Hilbert Complexes: Analysis, Applications, and Discretizations", Oberwolfach, Germany, Jun/19-25/2022. (*survey talk*)

[42] Canadian Applied and Industrial Mathematics Society annual meeting, UBC Okanagan Canada (online), Jun/13-16/2022.

[43] European Finite Element Fair, Aalto University, Finland, Jun/3-4/2022.

[44] European Finite Element Fair, Inria, Paris, Sep/10-11/2021. (online)

[45] Mathematical and Computational Approaches for Solving the Source-Free Einstein Field Equations (virtual talk), ICERM, Brown University, USA, Oct/5-9/2020.

[46] The Second Conference on Scientific and Engineering Computing for Young Chinese Scientists, on the occasion of Professor Feng Kang's Centenary, Beijing, China, Aug/17-21/2019.

[47] International Multigrid Conference (IMG2019), Kunming, China, Aug/11-16/2019.

[48] International Conference on Scientific Computation and Differential Equations (SciCADE), Innsbruck, Austria, Jul/22-26/2019.

[49] International Congress on Industrial and Applied Mathematics (ICIAM 2019), Valencia, Spain, Jul/15-19/2019.

[50] Winther workshop in numerical methods, on the occasion of Ragnar Winther's 70th birthday, Oslo, Norway, Mar/14/2019.

[51] SIAM Minisymposium on Recent Developments in Numerical Methods for Fluids, Joint Mathematics Meeting of AMS and MAA, Baltimore, USA, Jan/16-19/2019.

[52] European Conference on Numerical Mathematics and Advanced Applications (ENUMATH2017), Voss, Norway, Sep/25-29/2017.

[53] Forum for young scholars in computational mathematics, Peking University, Beijing, China, Jul/24-28/2017.

[54] Workshop on adaptive and multigrid methods for multiphysics problems, Beijing, China, Jun/23/2017.

[55] International Conference on Domain Decomposition, Svalbard, Norway, Feb/6-10/2017.

[56] Workshop on "Structure and scaling in computational field theories", Oslo, Norway, Oct/26-28/2016.

[57] 11th East Asia SIAM Conference, Macau, China, Jun/20-22/2016. (*paper prize talk*)

[58] 14th European finite element fair, Bonn, Germany, May/20-21/2016.

[59] 14th Copper Mountain Conference on Iterative Methods, Colorado, USA, Mar/20-25/2016.

[60] The 8th International Congress on Industrial and Applied Mathematics (ICIAM), Beijing, China, Aug/10-14/2015.

[61] Workshop on Geometry and Computation, Kunming, China, Aug/3-6/2015

[62] The 2nd Peking University Computational Mathematics Student Forum, Beijing, China, Jul/11-12/2015

[63] Workshop on Numerical Methods for Elasticity and MHD Problems, Beijing, China, Dec/21/2014.

[64] 11th World Congress on Computational Mechanics & 5th European Conference on Computational Mechanics & 6th European Conference on Computational Fluid Dynamics; Barcelona, Spain, July/25/2014.

[65] The 2nd Student Forum on Numerical Method of PDEs & the 1st Beijing Computational Mathematical Student Forum, Beijing, China, Jul/13/2014.

[66] The 1st Peking University Computational Mathematics Student Forum, Beijing, China, Nov/16/2013.

Colloquium/Seminar talks:

[67] Zurich Colloquium in Applied and Computational Mathematics, ETH Zürich, Switzerland. November 11, 2026. (upcoming)

[68] Plasma Seminar at the Oxford plasma theory group. September/2026.

[69] Seminar talk at Hong Kong Polytechnic University, Hong Kong. August 8, 2026.

[70] Seminar talk at the Department of Mechanical and Aerospace Engineering, University of Manchester. June/2026.

[71] Modelling of Materials Seminar, Mathematical Institute, Charles University, Prague, Czechia, March/2026.

[72] Seminar of Numerical Mathematics, Department of Numerical Mathematics, Charles University, Prague, Czechia, March/2026.

[73] CAM Colloquium, University of Chicago, USA, March/2026.

[74] Leeds Geometry and Analysis Seminar, University of Leeds, UK, Feb/2026.

[75] Computational Mathematics and Applications Seminar, Mathematical Institute, University of Oxford, Jan/2026.

[76] Partial Differential Equations seminar, Mathematical Institute, University of Oxford, Jan/2026.

[77] Mathematics Colloquium, Yau Mathematical Sciences Center (YMSC), Tsinghua University, China, Dec/2025.

[78] Seminar talk at Jilin University, China, Dec/2025.

[79] Applied Topology Seminar, Mathematical Institute, University of Oxford, Nov/2025.

[80] Optimisation and Numerical Analysis Seminar at School of Mathematics, University of Birmingham, Oct/2025.

[81] Mathematics and Applications Colloquium, KAUST, Saudi Arabia, Sep/2025.

[82] Applied Math Seminar at University of Arkansas, USA, Sep/2025. (online)

[83] Seminar talk at Institute of Computational Mathematics and Scientific/Engineering Computing at Chinese Academy of Sciences, China, Jul/2025.

[84] Seminar talk at Jilin University, China, Jul/2025.

[85] Seminar talk at Istituto di Matematica Applicata e Tecnologie Informatiche “Enrico Magenes" (IMATI) of the National Research Council of Italy (CNR), May/2025.

[86] Seminar talk at Michigan Technological University, USA, Feb/2025.

[87] Seminar talk at Zhejiang University, China, Jan/2025.

[88] Applied Mathematics Seminar, Peking University, China, Dec/2024.

[89] Applied Geometry, Algebra, and Topology in Edinburgh (AGATE) seminar, Edinburgh, UK, Nov/2024.

[90] Analysis and PDE Seminar, Durham University, UK, Nov/2024.

[91] ACM Seminar at the Maxwell Institute, Edinburgh, UK, Nov/2024.

[92] Seminar at Institut supérieur de l’aéronautique et de l’espace (ISAE-SUPAERO), Toulouse, France, Oct/2024.

[93] Séminaire ACSIOM, Institut Montpelliérain Alexander Grothendieck, Université de Montpellier, France, Oct/2024.

[94] Seminar talk at Shanghai University of Finance and Economics, China, Sep/2024.

[95] Seminar talk at Nanjing Normal University, China, Sep/2024.

[96] Seminar talk at Nankai University, China, Aug/2024.

[97] Seminar talk at Institute of Computational Mathematics and Scientific/Engineering Computing at Chinese Academy of Sciences, China, Aug/2024.

[98] Seminar talk at Beijing Institute of Mathematical Sciences and Applications (BIMSA), Beijing, China, Aug/2024.

[99] Zurich colloquium in applied and computational mathematics, Switzerland, Apr/2024.

[100] Applied and Computational Analysis Seminar at DAMTP, University of Cambridge, UK, Feb/2024.

[101] Mathematics Seminar at the University of Dundee, UK. Oct/2023.

[102] Seminar at the Chinese University of Hong Kong (Shenzhen), Sep/2023.

[103] Seminar at Shanghai Jiao Tong University, Shanghai, China, Aug/2023.

[104] Seminar talk at Shanghai University of Finance and Economics, China, Aug/2023.

[105] Seminar at University of Science and Technology of China, USTC, Aug/2023.

[106] Seminar at TU Delft, the Netherlands, Dec/16/2022.

[107] Gravity Seminar Series of STAG (gravity/string theory/mathematical physics group) of Mathematical Sciences, University of Southampton, Dec/8/2022.

[108] Institute of Computational Mathematics and Scientific/Engineering Computing, Chinese Academy of Sciences, Beijing, China, Nov/2022.

[109] Seminar at University of Hong Kong, China, Oct/05/2022.

[110] Scientific Afternoon, Christ Church, University of Oxford, UK, Jul/15/2022.

[111] Culham Centre for Fusion Energy, UK, Apr/26/2022.

[112] Scientific Computing Seminar, Heidelberg University, Germany, Mar/21/2022.

[113] Computational Mathematics and Applications Seminar, Mathematical Institute, University of Oxford, UK, Feb/23/2022.

[114] Imperial–UCL Numerics Seminar, London, UK, Feb/22/2022.

[115] PDE Lunch Seminar, University of Oxford, UK, Feb/17/2022.

[116] North Meets South seminar, Mathematical Institute, University of Oxford, UK, Jan/28/2022.

[117] Institute of Computational Mathematics and Scientific/Engineering Computing, Chinese Academy of Sciences, Beijing, China, Dec/14/2021. (online)

[118] Los Alamos National Lab, USA, Dec/8/2021.

[119] PDE seminar, Mathematical Institute, University of Oxford, UK, Aug/5/2021.

[120] General relativity journal club, Department of Physics, University of Oxford, UK, Jun/24/2021.

[121] Numerical analysis internal seminar, University of Oxford, UK, Feb/23/2021.

[122] Institute of Computational Mathematics and Scientific/Engineering Computing, Chinese Academy of Sciences, Beijing, China, Dec/01-02/2020.

[123] Zurich Colloquium on Applied and Computational Mathematics, ETH Zürich, Switzerland, Oct/14/2020.

[124] Applied and Computational Mathematics seminar, Department of Mathematics, University of California, Irvine, USA, Apr/13/2020.

[125] Harmonic Analysis and Differential Equations (HADES) seminar, Department of Mathematics, University of Illinois at Urbana-Champaign, USA, Sep/27/2019.

[126] Institute of Computational Mathematics and Scientific/Engineering Computing, Chinese Academy of Sciences, Beijing, China, Jul/17/2017.

[127] Institute of Computational Mathematics and Scientific/Engineering Computing, Chinese Academy of Sciences, Beijing, China, Jun/22/2017.

[128] CCMA PDEs and Numerical Methods Seminar Series, Penn State University, USA, Mar/17/2016.

[129] Lecture of CAS SIAM Student Chapter, Chinese Academy of Sciences, Beijing, China, Nov/24/2014.

Teaching

Special lectures

- Nachdiplom lectures at ETH Zürich, 2026.
- Invited lectures: *Spotlights in Computational Physics and Engineering (SCoPE)*, University of Luxembourg. March 2025.
- Invited lectures: *Differential complexes and Bernstein-Gelfand-Gelfand construction.* 2024, Institut Montpelliérain Alexander Grothendieck (IMAG), Université de Montpellier, France.

Regular teaching

- 2024 Spring: Research Skills for Computational Applied Mathematics (MATH11197, Postgraduate Course), University of Edinburgh.
- 2024 spring semester: Finite element exterior calculus (advanced course for MAC-MIGS CDT), University of Edinburgh.
- 2023 Trinity Term - 2023 Hilary Term: Calculus of Variations (Christ Church, tutorials + revision), MMSC dissertation projects (Mathematical Institute), University of Oxford.
- 2022 Michaelmas Term: BSP project, University of Oxford.
- 2022 Hilary Term: MMSC Modelling Case Studies, University of Oxford.
- 2021 Michaelmas Term: Finite element exterior calculus, University of Oxford.

Supervision and mentorship

Current

Postdoctoral fellow

- 2025–. Boris Andrews
- 2025–. Yizhou Liang
- 2025–. Jia Jia Qian
- 2025–. Puchun Zhou
- 2026–. Jindong Wang (Newton International Fellow)
- 2026–. Yuyang Huang (Royal Commission 1851 Fellowship)

PhD students

- Mingdong He [joint supervision with Patrick Farrell]
- Mark Alvares Peres
- Olav Tyssvang [joint supervision with Snorre Christiansen]
- Yuechen Zhu
- Benjamín Venegas
- Yue Wu [joint supervision with Patrick Farrell]
- José Ramón Contreras Barberá

Previous

Postdoctoral fellow

- 2025–2026. Ganghui Zhang (PhD: Tsinghua University).
  Next position: postdoc, Hong Kong Polytechnic University. (mentor: Buyang Li)
- 2024. Marien Hanot (PhD: Université de Montpellier).
  Next position: Maître de conférences, Laboratoire Paul Painlevé, Université de Lille.

PhD students

- Fabian Laakmann, University of Oxford, 2021-2022 (co-supervision with Patrick Farrell).

Visiting PhD students

- Pengjie Tian, Nanjing Normal University, 2025.
- Daniel Førland Holmen, University of Bergen, 2024.

MSc dissertations

- 2026: Oscar Benton (co-supervision with Boris Andrews), Lourenco Gomes (co-supervision with Jindong Wang)
- 2024, 2025: MSc in Computational Applied Mathematics (CAM), University of Edinburgh.
  Reem Alali, Mark Alvares Peres, Lázár Bertók, Chuanhao Li, Jushui Weng
- 2023, 2021: MSc in Mathematical Modelling and Scientific Computing (MMSC), University of Oxford.
  Luna Arthur, Yu Qi, Alessandro Beninati

Undergraduate research

- 2024: Emma Fewtrell (topic: quantum graphs; supported by Vacation Scholarship, School of Maths, UoE), James Han (topic: discrete exterior calculus; supported by Vacation Scholarship, School of Maths, UoE)
- 2023: Bowen Shi, Peking University. (summer research, finite element conformal complexes)
  Next position: PhD student, Oden Institute, University of Texas at Austin.

Grants

[1] 2026. Philip Leverhulme Prize, £100k

[2] 2026, ICMS Strategic Workshop "Topology-preserving numerical computation for magnetohydrodynamics" (with Farrell, Pagliantini, Yeates), £16k

[3] 2026, Erwin Schrödinger Institute thematic program "Differential Complexes: Theory, Discretization, and Applications" (with Čap, Hiptmair, Schöberl), €60k

[4] 2024-2029, ERC Starting Grant, €1.48m

[5] 2024-2026, Royal Society International Exchanges Grant, £10.9k

[6] 2024, ICMS Research in Groups Funding (with Christiansen, Guzmán, Neilan, Q.Zhang). £11k

[7] 2022-2027, Royal Society University Research Fellowship (with extended expenses). £960.3k

Academic Leadership, Management and Citizenship

Editorial Board

- Foundations of Computational Mathematics, May 2026 –
- SIAM Journal on Numerical Analysis, January 2026 –

Service

- Reviewer for most major numerical analysis journals, such as Foundations of Computational Mathematics, IMA Journal of Numerical Analysis, Journal of Computational Physics, Journal of Elasticity, M3AS, Mathematics of Computation, Numerische Mathematik, Proceedings of the Royal Society A, SIAM Journal of Numerical Analysis, SIAM Journal of Scientific Computing, Springer Lecture Notes in Mathematics.
- Reviewer, scientific proposals for Banff International Research Station (BIRS), International Centre for Mathematical Sciences (ICMS, Edinburgh), Carl Zeiss Foundation, Czech Science Foundation.
- Judge for talk prizes, SIAM UKIE National Student Chapter Conference, June 2023, Oxford.
- DPhil/PhD thesis examiner
  - Chengbin Zhu, University of Illinois Urbana-Champaign, 2025.
  - Pablo Brubeck, University of Oxford, 2023.

- 2025- , Co-organiser (with Leandro Sánchez Betancourt) of Friday@4 at Mathematical Institute, University of Oxford.
- 2023-2025, Co-organiser of the weekly Applied and Computational Mathematics (ACM) Seminar at the Maxwell Institute (joint between University of Edinburgh and Heriot-Watt University).
- 2024-2025, Postdoc Champion, School of Mathematics, University of Edinburgh.
- 2021–2023, 2023–, Early Career Researchers (ECR) Committee Member, Mathematical Institute, University of Oxford.
- (Co-)organiser of professional meetings and workshops and schools:

  [1] MFO workshop "Spline-Based Finite Element Tensor Calculus", Oberwolfach, Germany. July 23–28, 2028. (with Ralf Hiptmair, Carla Manni and Tatyana Sorokina, upcoming)

  [2] ICMS Strategic Workshop "Topology-preserving numerical computation for magnetohydrodynamics", Edinburgh, UK, 2027. (with Patrick Farrell, Cecilia Pagliantini and Anthony Yeates, upcoming)

  [3] European Finite Element Fair 2027, University of Oxford. May 28–29, 2027. (with Ana Djurdjevac and Patrick Farrell, upcoming)

  [4] ERC GeoFEM workshop "Finite Element Tensor Calculus: Discrete Structures and Compatible Discretizations", Oxford, UK. May 24–28, 2027. (with Boris Andrews, Jia Jia Qian and Puchun Zhou, upcoming)

  [5] SciCADE, the International Conference on Scientific Computation and Differential Equations, Edinburgh, UK, 2026.

  [6] Thematic program on "Differential Complexes: Theory, Discretization, and Applications" at the Erwin Schrödinger Institute (ESI) in Vienna. (with Andreas Čap, Ralf Hiptmair and Joachim Schöberl)

  [7] Workshop on Finite Element Tensor Calculus at the Tsinghua Sanya International Mathematics Forum (TSIMF) during January 12-16, 2026. (with Marien Hanot, Shuo Zhang and Weiying Zheng)

  [8] Conference on Structure-Preserving Finite Element Methods, held at the Institute of Computational Mathematics and Scientific/Engineering Computing (ICMSEC), Chinese Academy of Sciences, Beijing, China, during January 8-10, 2026. (with Shuo Zhang and Weiying Zheng)

  [9] IMSI Workshop "Discrete Exterior Calculus: Differential Geometry and Applications", Chicago, USA, Sep/3-5/2025. Co-organizer, with Anil Hirani and Kaushik Kalyanaraman.

  [10] Two-Week School in Mathematical Physics, within the Mathematics for Humanities program at ICMS, Edinburgh. June/2025. Co-organizer, with Sujay Ashok, Nabamita Banerjee, Babak Haghighat, Yang-Hui He, Shailesh Lal, Wei Li, Sameer Murthy.

  [11] Mac-Migs PhD Programme Deep Dive event "finite element software", Maxwell Institute, Edinburgh, UK. Nov/12-13/2024. Co-organizer, with Lehel Banjai, Emmanuil Georgoulis and John Pearson.

  [12] Mini-symposium, *Finite element complexes and multivariate splines*, ICIAM, Tokyo, Japan, Aug/20-25/2023. Co-organizer, with Nelly Villamizar.

  [13] Mini-symposium, *Structure-preserving discretization of Hilbert complexes*, the 29th Biennial Numerical Analysis Conference, University of Strathclyde, Glasgow, UK, Jun/27-30/2023. Co-organizer, with Deepesh Toshniwal.

  [14] Scientific Afternoon, Christ Church, University of Oxford, UK, Apr/27/2023. Co-organizer, with Davide Spriano.

  [15] Mini-symposium, *Exterior Calculus in Numerical Computing, Modeling, and Simulation*, SIAM Conference on Computational Science and Engineering (CSE23), Amsterdam, Netherlands. Co-organizer, with Ari Stern, James P. Fairbanks, Ingebord Gjerde.

  [16] Mini-symposium, *Structure-preserving numerical methods for plasma models*, International Conference on Scientific Computation and Differential Equations (SciCADE2022), Reykjavík, Iceland, Jul/25-29/2022. Co-organizer, with Cecilia Pagliantini.

[17] Scientific Afternoon, Christ Church, University of Oxford, UK, Jul/15/2022. Co-organizer, with Davide Spriano.

[18] Mini-symposium, *Geometric numerical methods for fluids and electromagnetic fields*, International Multigrid Conference (IMG2019), Kunming, China, Aug/11-16/2019. Co-organizer, with Yajuan Sun.

[19] Mini-symposium, *Finite element exterior calculus and applications*, International Congress on Industrial and Applied Mathematics (ICIAM 2019), Valencia, Spain, Jul/15-19/2019. Co-organizer, with Shuo Zhang.

[20] Workshop on FEEC and High Order Methods; University of Oslo, Norway, Jun/04-06/2018. Co-organizer, with Ragnar Winther.

[21] The 3rd Student Forum on Numerical Method of PDEs & the 2nd Beijing Computational Mathematical Student Forum; Peking University, Beijing, China, Aug/18-19/2015.

[22] Workshop on Geometry and Computation, Kunming, China, Aug/3-6/2015. Co-organizer, with Gang Tian, Jinchao Xu, Xiao Zhang.

[23] The 2nd Student Forum on Numerical Method of PDEs & the 1st Beijing Computational Mathematical Student Forum; Peking University, Beijing, China, Jul/13/2014.