Patrick E. Farrell

+44 1865 270743
patrick.farrell@maths.ox.ac.uk
https://pefarrell.org
orcid:0000-0002-1241-7060

Research statement

My research interests centre on the numerical solution of partial differential equations arising in physics and chemistry. The goals of my research are to extend humanity's numerical simulation capabilities, to develop new numerical algorithms that are useful to science and important to society, and to collaborate with scientists and engineers to translate numerical solutions into scientific advances.

I particularly focus on the development of structure-preserving finite element discretisations in space and time, adjoint techniques and their applications, bifurcation analysis of nonlinear problems, and preconditioners and fast solvers.

I have applied the numerical techniques I develop to applications in the areas of renewable energy, cardiac electrophysiology, glaciology, magnetohydrodynamics, quantum mechanics, liquid crystals, and multicomponent flows.

Employment history

- 2022–date **Full Professor**, Mathematical Institute, University of Oxford.
- 2016–2022 **Associate Professor**, Mathematical Institute, University of Oxford.
- 2016–date **Tutorial Fellow**, Oriel College, University of Oxford.
- 2013–2018 **EPSRC Early Career Research Fellow**, Mathematical Institute, University of Oxford.
- 2013–2016 **Postdoctoral Research Fellow**, Christ Church College, University of Oxford.
- 2010–2013 **Postdoctoral Research Associate**, Earth Science & Engineering, Imperial College London.

Visiting positions

- 2021–date **Specialist Consultant**, UK Atomic Energy Authority, Culham.
- 2012–2017 **Adjunct Research Scientist**, Simula Research Laboratory, Oslo.

Notable prizes

- 2021 **Whitehead Prize**, awarded by the London Mathematical Society for the development of Reynolds-robust solvers for the three-dimensional incompressible Navier–Stokes equations.
- 2021 **Broyden Prize in Optimization**, awarded by the editorial board of Optimization Methods and Software for the development of algorithms for computing multiple solutions of variational inequalities, with M. Croci and T. M. Surowiec.
- 2015 **Wilkinson Prize for Numerical Software**, awarded by the Society for Industrial and Applied Mathematics for the development of algorithms for the automated derivation of adjoint models, with D. A. Ham, S. W. Funke and M. E. Rognes.
- 2015 **Leslie Fox Prize in Numerical Analysis**, second place, awarded by the Institute of Mathematics and its Applications for the development of algorithms for computing multiple solutions of partial differential equations.

Academic history

2006–2009 **PhD in Computational Physics**, Imperial College London.

Thesis *Galerkin projection of discrete fields via supermesh construction.* Viva: 27 Nov 2009.

Prizes Association of Computational Mechanics in Engineering award, 2010; Finalist, European Community on Computational Methods in Applied Sciences award, 2010; Imperial College Research Excellence Award, 2010; Janet Watson award, Imperial College London, 2009.

2002–2006 **BSc (Hons) in Mathematics**, University of Galway.

Thesis *Cryptographic applications of polycyclic groups.*

Prizes Hamilton Prize, Royal Irish Academy, 2005; Blayney Exhibition, University of Galway, 2006.

Research funding

2021–2024 **SysGenX: Composable software generation for system-level simulation at Exascale**, EP/W026163/1, £3.3m, Oxford PI.

2020–2021 **Gen X: ExCALIBUR working group on exascale continuum mechanics through code generation**, EP/V001493/1, £174k, Oxford PI.

2019–2020 **Leverhulme Trust Visiting Professorship for Prof. Panayotis Kevrekidis**, VP2-2018-007, £85k, PI.

2018–2023 **PRISM: Platform for Research In Simulation Methods**, EPSRC EP/R029423/1, £1.6m, Oxford PI, Platform grant.

2015–2018 **A new simulation and optimisation platform for marine technology**, EPSRC EP/M011151/1, £558k, Oxford PI, Software for the Future II.

2014–2015 **Scalable automated parallel PDE-constrained optimisation for dolfin-adjoint**, EPSRC eCSE02-03, £60k, PI, Embedded CSE support.

2013–2018 **Automating optimisation subject to partial differential equations on high-performance computers**, EPSRC EP/K030930/1, £487k, PI, Fellowship.

2012–2013 **Optimising the layout of tidal turbines for marine renewable energy**, EPSRC, £36k, Researcher Co-I, Pathways to Impact award.

Teaching

2019 **Departmental Teaching Award**, Mathematical Institute, University of Oxford.

2023–2027 **Prelims Computational Mathematics**, Mathematical Institute, University of Oxford.

2021–2025 **Prelims Constructive Mathematics**, Mathematical Institute, University of Oxford.

2017–2022 **C6.4 Finite Element Methods for PDEs**, Mathematical Institute, University of Oxford.

2017–2021 **MMSC Python in Scientific Computing**, Mathematical Institute, University of Oxford.

2018 **Adjoints for Sensitivity, Optimisation and Control**, Montestigliano.

2018 **PMR5426 Adjoints for Sensitivity, Optimisation and Control**, Escola Politécnica, Universidade de São Paulo.

2017–2018 **PMR5412 Modelling and Numerical Simulation via Variational Calculus**, Escola Politécnica, Universidade de São Paulo.

2016–date **Tutorials in many first- and second-year subjects**, Oriel College, University of Oxford.

2016 **Frontiers in PDE-constrained Optimization**, Institute for Mathematics and its Applications, University of Minnesota.

2014 **ANADE Summer School on Receptivity, Sensitivity Analysis and Uncertainty Quantification**, Engineering Department, University of Cambridge.

Research supervision

PDRA Alberto Paganini, Thomas Roy, Duygu Sap, Pablo Brubeck.

PhD Florian Wechsung, Matteo Croci, Pablo Alexei Gazca Orozco, Hamza Alawiye, Ioannis Papadopoulos, Jingmin Xia, Fabian Laakmann, Francis Aznaran, Alexander van Brunt, Nicolas Boullé, Gonzalo Gonzalez de Diego, Pablo Brubeck, Boris Andrews, Aaron Baier-Reinio, India Marsden, Umberto Zerbinati, Kars Knook, Mingdong He.

MSc 14 students on the Mathematical Modelling and Scientific Computing MSc.

Prizes won under my supervision

2022 **International Glaciological Society student paper prize**, Gonzalo Gonzalez de Diego won a prize for the best student presentation at the 2022 IGS meeting in Bilbao.

2022 **Copper Mountain student paper prize**, Pablo Brubeck won the Student Paper Competition of the 2022 Copper Mountain Conference on Iterative Methods.

2021 **STEM for Britain**, Nicolas Boullé was a finalist and presented his work at the House of Commons.

2021 **Broyden Prize in Optimization**, awarded to Matteo Croci for our joint work on deflation for semismooth equations.

2021 **IMA Leslie Fox Prize in Numerical Analysis**, Nicolas Boullé was shortlisted for his work on learning theory.

2021 **G-Research DPhil Prize**, £5K awarded to Nicolas Boullé for his work on rational neural networks.

2020 **Mathematical Institute DPhil Thesis Prize**, awarded to Florian Wechsung for his outstanding thesis.

2018 **G-Research DPhil Prize**, £10K awarded to Florian Wechsung for our joint work on robust preconditioners for the Navier–Stokes equations.

Administrative & editorial activities

2022–2024 Acting head of the Oxford Numerical Analysis group.

2023–date Editor for the Numerical Mathematics and Scientific Computing book series, published by the Oxford University Press.

2022–2025 Member of the Committee on Applications and Interdisciplinary Relations of the European Mathematical Society.

2022–2025 Associate Editor for the SIAM Journal on Scientific Computing.

2021 Lead organiser for *Efficient simulation algorithms for viscoelastic and viscous non-Newtonian fluids*, Banff International Research Station.

2019–date Member of the Copper Mountain Conference on Iterative Methods committee.

2017–2020 Editor of the SIAM *Fundamentals of Algorithms* book series.

2018–date Departmental open access coordinator.

2017–2022 Departmental colloquium organiser.

2017–date Numerical analysis representative on the Oxford MSc in Mathematical Sciences committee.

2016–2022 Examiner's committee for the MSc in Mathematical Modelling and Scientific Computing.

2015 Member of the IMA Conference on Numerical Methods for Simulation committee.

2013–date Member of the EPSRC Peer Review College.

2013–date PhD examiner for the University of Oxford, Politecnico di Milano, Katholieke Universiteit Leuven, Queen Mary University of London, University of Bath, Imperial College London, Charles University Prague, University of Cambridge.

2010–date Peer reviewer for over 30 journals.

Scientific fieldwork

2015 Glaciological fieldwork on the Larsen ice shelf with the British Antarctic Survey, Rothera Research Station, Antarctica.

2011 Oceanographic cruise JC064 on the *RRS James Cook*, part of the RAPID programme organised by the National Oceanography Centre.

Articles in review

[91] C. Ham and **P. E. Farrell** (2023). *On multiple solutions of the Grad–Shafranov equation.*

[90] E. Bueler and **P. E. Farrell** (2023). *A full approximation scheme multilevel method for nonlinear variational inequalities.* DOI: 10.48550/arxiv.2308.06888

[89] F. R. A. Aznaran, **P. E. Farrell**, C. W. Monroe, and A. J. Van-Brunt (2022). *Finite element methods for multicomponent convection-diffusion.* DOI: 10.48550/arxiv.2208.11949

[88] **P. E. Farrell**, A. Hamdan, and S. P. MacLachlan (2022b). *Finite-element discretization of the smectic density equation.* DOI: 10.48550/arxiv.2207.12916

Articles to appear

[87] P. D. Brubeck and **P. E. Farrell** (2022b). *Multigrid solvers for the de Rham complex with optimal complexity in polynomial degree.* DOI: 10.48550/arxiv.2211.14284

[86] **P. E. Farrell**, L. Mitchell, and L. R. Scott (2023). "Two conjectures on the Stokes complex in three dimensions on Freudenthal meshes". In: *SIAM Journal on Scientific Computing*. DOI: 10.48550/arxiv.2211.05494

[85] I. A. P. Papadopoulos and **P. E. Farrell** (2022). "Preconditioners for computing multiple solutions in three-dimensional fluid topology optimization". In: *SIAM Journal on Scientific Computing*. DOI: 10.48550/arxiv.2202.08248

[84] N. Boullé, **P. E. Farrell**, and M. E. Rognes (2023). "Optimization of Hopf bifurcations". In: *SIAM Journal on Scientific Computing*. DOI: 10.48550/arxiv.2201.11684

Published journal articles

[83] F. Martin-Vergara, J. Cuevas Maraver, **P. E. Farrell**, F. Villatoro, and P. G. Kevrekidis (2023). "Discrete breathers in Klein–Gordon lattices: a deflation-based approach". In: *Chaos* 5 (11). DOI: 10.1063/5.0161889

[82] R. Wittmann, P. A. Monderkamp, J. Xia, L. B. G. Cortes, I. Grobas, **P. E. Farrell**, D. G. A. L. Aarts, and H. Löwen (2023). "Colloidal smectics in button-like confinements: experiment and theory". In: *Physical Review Research* 5.3, p. 033135. DOI: 10.1103/PhysRevResearch.5.033135

[81] F. Laakmann, **P. E. Farrell**, and K. Hu (2023). "Structure-preserving and helicity-conserving finite element approximations and preconditioning for the Hall MHD equations". In: *Journal of Computational Physics* 492, p. 112410. DOI: 10.48550/arxiv.2202.11586

[80] P. D. Brubeck and **P. E. Farrell** (2022a). "A scalable and robust vertex-star relaxation for high-order FEM". in: *SIAM Journal on Scientific Computing* 44.5, A2991–A3017. DOI: 10.1137/21M1444187

[79] F. Laakmann, **P. E. Farrell**, and L. Mitchell (2022). "An augmented Lagrangian preconditioner for the magnetohydrodynamics equations at high Reynolds and coupling numbers". In: *SIAM Journal on Scientific Computing* 44.4, B1018–B1044. DOI: 10.1137/21M1416539

[78] G. G. de Diego, **P. E. Farrell**, and I. J. Hewitt (2022a). "Numerical approximation of viscous contact problems applied to glacial sliding". In: *Journal of Fluid Mechanics* 938, A21. DOI: 10.1017/jfm.2022.178

[77] F. R. A. Aznaran, **P. E. Farrell**, and R. C. Kirby (2022). "Transformations for Piola-mapped elements". In: *SMAI Journal of Computational Mathematics* 8, pp. 399–437. DOI: 10.5802/smai-jcm.91

[76] A. Van-Brunt, **P. E. Farrell**, and C. W. Monroe (2022). "Structural electroneutrality in Onsager–Stefan–Maxwell models with charged species". In: *Electrochimica Acta* 441, p. 141769. DOI: 10.1016/j.electacta.2022.141769

[75] J. Xia and **P. E. Farrell** (2023). "Variational and numerical analysis of a $\mathbf{Q}$-tensor model for smectic-A liquid crystals". In: *ESIAM: Mathematical Modelling and Numerical Analysis* 57 (2), pp. 693–716. DOI: 10.1051/m2an/2022083

[74] R. Abu-Labdeh, S. P. MacLachlan, and **P. E. Farrell** (2023). "Monolithic multigrid for implicit Runge–Kutta discretizations of incompressible fluid flow". In: *Journal of Computational Physics* 478, p. 111961. DOI: 10.1016/j.jcp.2023.111961

[73] N. Boullé, I. Newell, **P. E. Farrell**, and P. G. Kevrekidis (2022). "Two-component 3D atomic Bose-Einstein condensates support complex stable patterns". In: *Physical Review A*. DOI: 10.1103/PhysRevA.107.012813

[72] **P. E. Farrell**, A. Hamdan, and S. P. MacLachlan (2022a). "A new mixed finite-element method for H^2-elliptic problems". In: *Computers and Mathematics with Applications* 128, pp. 300–319. DOI: 10.1016/j.camwa.2022.10.024

[71] G. G. de Diego, **P. E. Farrell**, and I. J. Hewitt (2022b). "On the finite element approximation of a semicoercive Stokes variational inequality arising in glaciology". In: *SIAM Journal on Numerical Analysis* 61.1, pp. 1–25. DOI: 10.1137/21m1437640

[70] N. Boullé, V. Dallas, and **P. E. Farrell** (2021). "Bifurcation analysis of two-dimensional Rayleigh–Bénard convection using deflation". In: *Physical Review E* 105 (5), p. 055106. DOI: 10.1103/PhysRevE.105.055106

[69] A. Van-Brunt, **P. E. Farrell**, and C. W. Monroe (2021). "Consolidated theory of fluid thermodiffusion". In: *AIChE Journal* 68 (5), e17599. DOI: 10.1002/aic.17599

[68] J. Dalby, **P. E. Farrell**, A. Majumdar, and J. Xia (2021). "One-dimensional ferronematics in a channel: order reconstruction, bifurcations and multistability". In: *SIAM Journal on Applied Mathematics* 82.2, pp. 694–719. DOI: 10.1137/21M1400171

[67] A. J. Ellingsrud, N. Boullé, **P. E. Farrell**, and M. E. Rognes (2021). "Accurate numerical simulation of electrodiffusion and water movement in brain tissue". In: *Mathematical Medicine and Biology*. DOI: 10.1093/imammb/dqab016

[66] **P. E. Farrell**, L. Mitchell, L. R. Scott, and F. Wechsung (2021b). "Robust multigrid for nearly incompressible elasticity using macro elements". In: *IMA Journal on Numerical Analysis*. DOI: 10.1093/imanum/drab083

[65] N. Boullé, **P. E. Farrell**, and A. Paganini (2021). "Control of bifurcation structures using shape optimization". In: *SIAM Journal on Scientific Computing* 44 (1), A57–A76. DOI: 10.1137/21M1418708

[64] **P. E. Farrell**, P. A. Gazca Orozco, and E. Süli (2022). "Finite element approximation and augmented Lagrangian preconditioning for anisothermal implicitly-constituted non-Newtonian flow". In: *Mathematics of Computation* 91, pp. 659–697. DOI: 10.1090/mcom/3703

[63] A. J. Van-Brunt, **P. E. Farrell**, and C. W. Monroe (2022). "Augmented saddle point formulation of the steady-state Stefan–Maxwell diffusion equations". In: *IMA Journal of Numerical Analysis* 42, pp. 3272–3305. DOI: 10.1093/imanum/drab067

[62] M. Croci, M. B. Giles, and **P. E. Farrell** (2021). "Multilevel quasi Monte Carlo methods for elliptic partial differential equations driven by spatial white noise". In: *SIAM Journal on Scientific Computing* 43.4, A2840–A2868. DOI: 10.1137/20M1329044

[61] J. D. Betteridge, **P. E. Farrell**, and D. A. Ham (2021). "Code generation for productive portable scalable finite element simulation in Firedrake". In: *IEEE Computing in Science and Engineering*. DOI: 10.1109/MCSE.2021.3085102

[60] **P. E. Farrell**, R. C. Kirby, and J. Marchena-Menendez (2021). "Irksome: automating Runge–Kutta time-stepping for finite element methods". In: *ACM Transactions on Mathematical Software* 47 (4). DOI: 10.1145/3466168

[59] J. Xia, S. MacLachlan, T. J. Atherton, and **P. E. Farrell** (2021). "Structural landscapes in geometrically frustrated smectics". In: *Physical Review Letters* 126.17, p. 177801. DOI: 10.1103/PhysRevLett.126.177801

[58] **P. E. Farrell**, L. Mitchell, L. R. Scott, and F. Wechsung (2021a). "A Reynolds-robust preconditioner for the Scott–Vogelius discretization of the stationary incompressible Navier–Stokes equations". In: *SMAI Journal of Computational Mathematics* 7, pp. 75–96. DOI: 10.5802/smai-jcm.72

[57] K. Tůma, M. Rezaee-Hajidehi, J. Hron, **P. E. Farrell**, and S. Stupkiewicz (2021). "Phase-field modelling of multivariant martensitic transformation at finite-strain: computational aspects and large-scale finite-element simulations". In: *Computer Methods in Applied Mechanics and Engineering* 377, p. 113705. DOI: 10.1016/j.cma.2021.113705

[56] I. A. P. Papadopoulos, **P. E. Farrell**, and T. M. Surowiec (2021). "Computing multiple solutions of topology optimization problems". In: *SIAM Journal on Scientific Computing* 43.3, A1555–A1582. DOI: 10.1137/20M1326209

[55] **P. E. Farrell**, M. G. Knepley, L. Mitchell, and F. Wechsung (2021). "PCPATCH: Software for the topological construction of multigrid relaxation methods." In: *ACM Transactions on Mathematical Software* 47 (3), pp. 1–22. DOI: 10.1145/3445791

[54] J. Xia, **P. E. Farrell**, and F. Wechsung (2020). "Augmented Lagrangian preconditioners for the Oseen–Frank model of cholesteric liquid crystals". In: *BIT Numerical Mathematics*. DOI: 10.1007/s10543-020-00838-9

[53] **P. E. Farrell**, L. F. Gatica, B. P. Lamichhane, R. Oyarzuá, and R. Ruiz-Baier (2020). "Mixed Kirckhhoff stress–displacement–pressure formulations for incompressible hyperelasticity". In: *Computer Methods in Applied Mechanics and Engineering* 374, p. 113562. DOI: 10.1016/j.cma.2020.113562

[52] J. H. Adler, T. Benson, E. C. Cyr, **P. E. Farrell**, S. MacLachlan, and R. Tuminaro (2021). "Monolithic multigrid for magnetohydrodynamics". In: *SIAM Journal on Scientific Computing*, S70–S91. DOI: 10.1137/20M1348364

[51] N. Boullé, E. G. Charalampidis, **P. E. Farrell**, and P. G. Kevrekidis (2020). "Deflation-based Identification of Nonlinear Excitations of the 3D Gross–Pitaevskii equation." In: *Physical Review A* 102 (5), p. 053307. DOI: 10.1103/PhysRevA.102.053307

[50] **P. E. Farrell** and P. A. Gazca-Orozco (2020). "An augmented Lagrangian preconditioner for implicitly-constituted non-Newtonian incompressible flow". In: *SIAM Journal on Scientific Computing* 42.6, B1329–B1349. DOI: 10.1137/20M1336618

[49] J. G. Williams, A. A. Castrejon-Pita, B. W. Turney, **P. E. Farrell**, S. J. Tavener, D. E. Moulton, and S. L. Waters (2020). "Cavity flow characteristics and applications to kidney stone removal". In: *Journal of Fluid Mechanics* 902, A16. DOI: 10.1017/jfm.2020.583

[48] H. A. Alawiye, **P. E. Farrell**, and A. Goriely (2020). "Revisiting the wrinkling of elastic bilayers II: post-bifurcation analysis". In: *Journal of the Mechanics and Physics of Solids* 143, p. 104053. DOI: 10.1016/j.jmps.2020.104053

[47] **P. E. Farrell**, Y. He, and S. P. MacLachlan (2021). "A local Fourier analysis of additive Vanka relaxation for the Stokes equations". In: *Numerical Linear Algebra with Applications* 28.3, e2306. DOI: 10.1002/nla.2306

[46] M. Croci and **P. E. Farrell** (2020). "Complexity bounds on supermesh construction for quasi-uniform meshes." In: *Journal of Computational Physics* 414, p. 109459. DOI: 10.1016/j.jcp.2020.109459

[45] E. G. Charalampidis, N. Boullé, **P. E. Farrell**, and P. G. Kevrekidis (2020). "Bifurcation analysis of stationary solutions of two-dimensional coupled Gross-Pitaevskii equations using deflated continuation". In: *Communications in Nonlinear Science and Numerical Simulation* 87, p. 105255. DOI: 10.1016/j.cnsns.2020.105255

[44] J. Xia, **P. E. Farrell**, and S. G. P. Castro (2020). "Nonlinear bifurcation analysis of stiffener profiles via deflation techniques". In: *Thin Walled Structures* 149, p. 106662. DOI: 10.1016/j.tws.2020.106662

[43] E. Medina, **P. E. Farrell**, K. Bertoldi, and C. Rycroft (2020). "Navigating the landscape of nonlinear mechanical metamaterials for advanced programmability." In: *Physical Review B* 101.6, p. 064101. DOI: 10.1103/PhysRevB.101.064101

[42] **P. E. Farrell**, P. A. Gazca-Orozco, and E. Süli (2020). "Numerical analysis of unsteady implicitly constituted incompressible fluids: three-field formulation". In: *SIAM Journal on Numerical Analysis* 58.1, pp. 757–787. DOI: 10.1137/19M125738X

[41] **P. E. Farrell**, L. Mitchell, and F. Wechsung (2019). "An augmented Lagrangian preconditioner for the 3D stationary incompressible Navier–Stokes equations at high Reynolds number". In: *SIAM Journal on Scientific Computing* 41.5, A3073–A3096. DOI: 10.1137/18M1219370

[40] **P. E. Farrell**, M. Croci, and T. M. Surowiec (2019). "Deflation for semismooth equations". In: *Optimization Methods and Software* 35.6, pp. 1248–1271. DOI: 10.1080/10556788.2019.1613655

[39] M. Croci, M. B. Giles, M. E. Rognes, and **P. E. Farrell** (2018). "Efficient white noise sampling and coupling for multilevel Monte Carlo with nonnested meshes". In: *SIAM/ASA Journal on Uncertainty Quantification* 6.4, pp. 1630–1655. DOI: 10.1137/18M1175239

[38] A. Paganini, F. Wechsung, and **P. E. Farrell** (2018). "Higher-order moving mesh methods for PDE-constrained shape optimization". In: *SIAM Journal on Scientific Computing* 40.4, A2356–A2382. DOI: 10.1137/17m1133956

[37] T. M. Kyrke-Smith, G. H. Gudmundsson, and **P. E. Farrell** (2018). "Relevance of detail in basal topography for basal slipperiness inversions: a case study on Pine Island Glacier, Antarctica". In: *Frontiers in Earth Science* 6, p. 33. DOI: 10.3389/feart.2018.00033

[36] T. M. Kyrke-Smith, G. Hilmar Gudmundsson, and **P. E. Farrell** (2017). "Can seismic observations of bed conditions on ice streams help constrain parameters in ice flow models?" In: *Journal of Geophysical Research: Earth Surface* 122.11, pp. 2269–2282. DOI: 10.1002/2017JF004373

[35] E. G. Charalampidis, P. G. Kevrekidis, and **P. E. Farrell** (2018). "Computing stationary solutions of the two-dimensional Gross-Pitaevskii equation with deflated continuation." In: *Communications in Nonlinear Science and Numerical Simulation* 54, pp. 482–499. DOI: 10.1016/j.cnsns.2017.05.024

[34] M. E. Rognes, **P. E. Farrell**, S. W. Funke, J. E. Hake, and M. M. C. Maleckar (2017). "cbcbeat: an adjoint-enabled framework for computational cardiac electrophysiology". In: *The Journal of Open Source Software* 2.13. DOI: 10.21105/joss.00224

[33] S. W. Funke, **P. E. Farrell**, and M. D. Piggott (2017). "Reconstructing wave profiles from inundation data". In: *Computer Methods in Applied Mechanics and Engineering* 322, pp. 167–186. DOI: 10.1016/j.cma.2017.04.019

[32] D. B. Emerson, J. H. Adler, **P. E. Farrell**, S. P. MacLachlan, and T. J. Atherton (2017). "Computing equilibrium states of cholesteric liquid crystals in elliptical channels with deflation algorithms." In: *Liquid Crystals* 45.3, pp. 341–350. DOI: 10.1080/02678292.2017.1365385

[31] S. J. Chapman and **P. E. Farrell** (2017). "Analysis of Carrier's problem." In: *SIAM Journal on Applied Mathematics* 77.3, pp. 924–950. DOI: 10.1137/16M1096074

[30] M. Robinson, C. Luo, **P. E. Farrell**, R. Erban, and A. Majumdar (2017). "From molecular to continuum modelling of bistable liquid crystal devices." In: *Liquid Crystals* 44.14-15, pp. 2267–2284. DOI: 10.1080/02678292.2017.1290284

[29] **P. E. Farrell** and J. W. Pearson (2016). "A preconditioner for the Ohta-Kawasaki equation". In: *SIAM Journal on Matrix Analysis and Applications* 38.1, pp. 217–225. DOI: 10.1137/16M1065483

[28] A. Beskos, M. Girolami, S. Lan, **P. E. Farrell**, and A. M. Stuart (2016). "Geometric MCMC for infinite-dimensional inverse problems". In: *Journal of Computational Physics* 335, pp. 327–351. DOI: 10.1016/j.jcp.2016.12.041

[27] J. H. Adler, D. B. Emerson, **P. E. Farrell**, and S. P. MacLachlan (2017). "Combining deflation and nested iteration for computing multiple solutions of nonlinear variational problems". In: *SIAM Journal on Scientific Computing* 39.1, B29–B52. DOI: 10.1137/16M1058728

[26] **P. E. Farrell** and C. Maurini (2016). "Linear and nonlinear solvers for variational phase-field models of brittle fracture". In: *International Journal for Numerical Methods in Engineering* 109.5, pp. 648–667. DOI: 10.1002/nme.5300

[25] **P. E. Farrell** (2016). "The number of distinct eigenvalues of a matrix after perturbation". In: *SIAM Journal on Matrix Analysis and Applications* 37.2, pp. 572–576. DOI: 10.1137/15M1037603

[24] **P. E. Farrell**, Á. Birkisson, and S. W. Funke (2015). "Deflation techniques for finding distinct solutions of nonlinear partial differential equations". In: *SIAM Journal on Scientific Computing* 37.4, A2026–A2045. DOI: 10.1137/140984798

[23] **P. E. Farrell**, C. J. Cotter, and S. W. Funke (2014). "A framework for the automation of generalised stability theory". In: *SIAM Journal on Scientific Computing* 36.1, pp. C25–C48. DOI: 10.1137/120900745

[22] J. R. Maddison and **P. E. Farrell** (2014). "Rapid development and adjoining of transient finite element models". In: *Computer Methods in Applied Mechanics and Engineering* 276.0, pp. 95–121. DOI: 10.1016/j.cma.2014.03.010

[21] H. R. Hiester, M. D. Piggott, **P. E. Farrell**, and P. A. Allison (2014). "Assessment of spurious mixing in adaptive mesh simulations of the two-dimensional lock-exchange". In: *Ocean Modelling* 73, pp. 30–44. DOI: 10.1016/j.ocemod.2013.10.003

[20] S. W. Funke, **P. E. Farrell**, and M. D. Piggott (2014). "Tidal turbine array optimisation using the adjoint approach". In: *Renewable Energy* 63.0, pp. 658–673. DOI: 10.1016/j.renene.2013.09.031

[19] A. G. Buchan, **P. E. Farrell**, G. J. Gorman, A. J. H. Goddard, M. D. Eaton, E. T. Nygaard, P. L. Angelo, R. P. Smedley-Stevenson, S. R. Merton, and P. N. Smith (2014). "The immersed body supermeshing method for modelling reactor physics problems with complex internal structures". In: *Annals of Nuclear Energy* 63.0, pp. 399–408. DOI: 10.1016/j.anucene.2013.07.044

[18] C. M. J. Baker, A. G. Buchan, C. C. Pain, **P. E. Farrell**, M. D. Eaton, and P. Warner (2013). "Multimesh anisotropic adaptivity for the Boltzmann transport equation". In: *Annals of Nuclear Energy* 53.0, pp. 411–426. DOI: 10.1016/j.anucene.2012.07.023

[17] **P. E. Farrell**, D. A. Ham, S. W. Funke, and M. E. Rognes (2013). "Automated derivation of the adjoint of high-level transient finite element programs". In: *SIAM Journal on Scientific Computing* 35.4, pp. C369–C393. DOI: 10.1137/120873558

[16] A. Viré, J. Xiang, F. Milthaler, P. E. Farrell, M. D. Piggott, J.-P. Latham, D. Pavlidis, and C. C. Pain (2012). "Modelling of fluid–solid interactions using an adaptive mesh fluid model coupled with a combined finite discrete element model". In: *Ocean Dynamics* 62.10–12, pp. 1487–1501. DOI: 10.1007/s10236-012-0575-z

[15] J. R. Maddison and **P. E. Farrell** (2012). "Directional integration on unstructured meshes via supermesh construction". In: *Journal of Computational Physics* 231.12, pp. 4422–4432. DOI: 10.1016/j.jcp.2012.02.009

[14] G. J. Gorman, J. Southern, **P. E. Farrell**, M. D. Piggott, G. Rokos, and P. H. J. Kelly (2012). "Hybrid OpenMP/MPI anisotropic mesh smoothing". In: *Procedia Computer Science* 9.0, pp. 1513–1522. DOI: 10.1016/j.procs.2012.04.166

[13] J. Southern, G.J. Gorman, M.D. Piggott, and **P. E. Farrell** (2012). "Parallel anisotropic mesh adaptivity with dynamic load balancing for cardiac electrophysiology". In: *Journal of Computational Science* 3.1–2, pp. 8–16. DOI: 10.1016/j.jocs.2011.11.002

[12] **P. E. Farrell**, S. Micheletti, and S. Perotto (2011). "An anisotropic Zienkiewicz-Zhu error estimator for 3D applications". In: *International Journal for Numerical Methods in Engineering* 85.6, pp. 671–692. DOI: 10.1002/nme.2980

[11] **P. E. Farrell** (2011). "The addition of fields on different meshes". In: *Journal of Computational Physics* 230.9, pp. 3265–3269. DOI: 10.1016/j.jcp.2011.01.028

[10] J. R. Maddison, C. J. Cotter, and **P. E. Farrell** (2011). "Geostrophic balance preserving interpolation in mesh adaptive linearised shallow-water ocean modelling". In: *Ocean Modelling*. DOI: 10.1016/j.ocemod.2010.12.007

[9] **P. E. Farrell** and J. R. Maddison (2011). "Conservative interpolation between volume meshes by local Galerkin projection". In: *Computer Methods in Applied Mechanics and Engineering* 200.1-4, pp. 89–100. DOI: 10.1016/j.cma.2010.07.015

[8] J. Southern, G. J. Gorman, M. D. Piggott, **P. E. Farrell**, M. O. Bernabeu, and J. Pitt-Francis (2010b). "Simulating cardiac electrophysiology using anisotropic mesh adaptivity". In: *Journal of Computational Science* 1.2, pp. 82–88. DOI: 10.1016/j.jocs.2010.03.010

[7] J. Southern, G. J. Gorman, M. D. Piggott, **P. E. Farrell**, M. O. Bernabeu, and J. Pitt-Francis (2010a). "Anisotropic mesh adaptivity for cardiac electrophysiology". In: *Procedia Computer Science* 1.1, pp. 935–944. DOI: 10.1016/j.procs.2010.04.103

[6] **P. E. Farrell**, M. D. Piggott, G. J. Gorman, D. A. Ham, C. R. Wilson, and T. M. Bond (2011). "Automated continuous verification for numerical simulation". In: *Geoscientific Model Development* 4.2, pp. 435–449. DOI: 10.5194/gmd-4-435-2011

[5] M. D. Piggott, **P. E. Farrell**, C. R. Wilson, G. J. Gorman, and C. C. Pain (2009). "Anisotropic mesh adaptivity for multi-scale ocean modelling". In: *Philosophical Transactions of the Royal Society A* 367.1907, pp. 4591–4611. DOI: 10.1098/rsta.2009.0155

[4] D. A. Ham, **P. E. Farrell**, G. J. Gorman, J. R. Maddison, C. R. Wilson, S. C. Kramer, J. Shipton, G. S. Collins, C. J. Cotter, and M. D. Piggott (2009). "Spud 1.0: generalising and automating the user interfaces of scientific computer models". In: *Geoscientific Model Development* 2.1, pp. 33–42. DOI: 10.5194/gmd-2-33-2009

[3] F. Fang, C. C. Pain, I. M. Navon, G. J. Gorman, M. D. Piggott, P. A. Allison, **P. E. Farrell**, and A. J. H. Goddard (2009). "A POD reduced order unstructured mesh ocean modelling method for moderate Reynolds number flows". In: *Ocean Modelling* 28.1-3, pp. 127–136. DOI: 10.1016/j.ocemod.2008.12.006

[2] **P. E. Farrell**, M. D. Piggott, C. C. Pain, G. J. Gorman, and C. R. G. Wilson (2009). "Conservative interpolation between unstructured meshes via supermesh construction". In: *Computer Methods in Applied Mechanics and Engineering* 198.33-36, pp. 2632–2642. DOI: 10.1016/j.cma.2009.03.004

[1] F. Fang, C. C. Pain, I. M. Navon, M. D. Piggott, G. J. Gorman, **P. E. Farrell**, P. A. Allison, and A. J. H. Goddard (2008). "A POD reduced-order 4D-Var adaptive mesh ocean modelling approach". In: *International Journal for Numerical Methods in Fluids* 60.7, pp. 709–732. DOI: 10.1002/fld.1911