Curriculum Vitae – September 26, 2024

Ivan G. Graham, Emeritus Professor of Numerical Analysis
Department of Mathematical Sciences,
University of Bath, Bath BA2 7AY, U.K.
Email: I.G.Graham@bath.ac.uk
Homepage: `http://people.bath.ac.uk/masigg`
Qualifications: M.A. (Edinburgh, 1975), Ph.D. (UNSW, Australia, 1981).

Publications 111 scientific papers published or accepted (including 78 refereed journal articles), plus two edited books and an invited survey article in Acta Numerica 2012. For a full list of publications and preprints see: `http://people.bath.ac.uk/masigg/publications/`. A selected list is given below. Citation data is as follows:

Google Scholar (Sept 26, 2024): 5568 citations h-index 43 , i10-index 82
Math Sci Net (Sept 26, 2024): 2240 citations from 1778 authors

Major plenary lectures at large conferences: Dundee Numerical Analysis 1989 and 2005; MAFELAP (London) 2006; ENUMath (Leicester) 2011; WAVES (Tunisia) 2013; Domain Decomposition methods: Greenwich, UK, 1999 and Svalbard, Norway, 2017, ANZIAM Annual Meeting, Australia 2020, Irish Mathematical Society Annual Meeting, 2023.

Fellowships at research programmes: Isaac Newton Institute 2003 and 2007; RICAM Special Semesters, Linz, Austria, 2011 and 2018; Hausdorff Institute Bonn, 2017; Matrix Research Institute Australia, 2018; Erwin Schroedinger Institut Vienna, 2022.

Selected invited talks at international workshops: Mathematisches Forschungsinstitut Oberwolfach (16 times); Tartu, Estonia (2008); MPI Leipzig (2008); ICMS, Edinburgh (2009, 2010, 2012); NTU Singapore (2009); Heraklion, Crete (2011); Urumqi, China (2012), Bruchsal, Germany (2013); Zürich (2014); LMS Durham Symposium (2014); Woudschoten, Netherlands (2014); Chinese University of Hong Kong (2016); Hausdorff Institute Bonn (2017); Suzhou, China (2018); UNSW Sydney (2018); CIRM Marseille (2019); ANU, Canberra (2019), MPI Leipzig (2021), Hangzhou, China (2023).

Visiting positions: University of Iowa, University of Kiel, University of New South Wales, University of Queensland, Weierstrass Institute Berlin, IIT Delhi and Mumbai, Max-Planck Institute, Leipzig, Caltech (Los Angeles), Isaac Newton Institute, Cambridge, University of Zürich, Chinese University of Hong Kong, University of Hong Kong, National Taiwan University, Matrix Institute, Australia, University of Sydney Mathematical Research Institute.

Postgraduate supervision: 21 successful postgraduate research students (19 PhDs), 9 of which were financially supported by UK companies. Former students include:R. Scheichl (1997-2000, now Professor at Heidelberg University), S. Langdon (1995-1999, now Professor at Brunel University) and S. Giani (2004-2008, now Assistant Professor at Durham University).

Postdoctoral supervision: M. Ganesh (92-94), now Professor at Colorado School of Mines; M. Hagger (95-97), moved to industry; L. Stals (97-98), now Associate Professor, ANU, Canberra; E. Vainikko (99-02), now Professor at University of Tartu, Estonia; E. Spence (09-11), now Professor at Bath; T. Kim (11-12), moved to industry; S. Gong (2019-21), now Assistant Professor, Chinese University of Hong Kong, Shenzhen; S. Downing (2022), moved to industry.

Editorial Boards (current): SIAM Journal of Numerical Analysis (since January 2022); IMA Journal of Numerical Analysis (since January 2009); Journal of Computational Mathematics (since July 2017).

Editorial Boards (previous): SIAM Review (Jan 2017–Dec 2022); Mathematics of Computation (2014-2022); Advances in Computational Mathematics (2012 - 2022); Journal of Integral Equations and Applications.

Research Grant income: My research has been supported over more than 30 years by grants from: UK Engineering and Physical Sciences Research Council (EPSRC), Royal Society, London Mathematical Society, British Council and International Centre for Mathematical Sciences (Edinburgh). A recent project was: "Fast solvers for frequency-domain wave-scattering problems and applications", 2019-22, funded by UK EPSRC (£380K).

Conference organisation: Boundary Integral Methods (Salford 1997, Bath 2000 (Chair), Reading 2004); Multiscale Problems, Adaptivity and Complexity (Bath 2007); Symposium on Numerical Analysis of Multiscale Problems (LMS, Durham 2010 (Chair)); Special Semester on Multiscale Simulation & Analysis in Energy and the Environment, RICAM Institute, Austria (Autumn 2011), ESI, Vienna, workshop on uncertainty quantification in transport and in high frequency scattering (2020/22), Solvers for frequency-domain wave problems and applications, University of Strathclyde (2022), Advanced solvers for frequency domain wave problems and applications, Tsingua Sanya International Mathematics Forum, Sanya, China (joint organisation with S. Gong, C. Ma, E.A. Spence and J. Zou, January 2025).

Service outside University of Bath: Elected President of UK and Republic of Ireland Section of SIAM (2017-19), (Elected Vice-President 2001-03). Member of EPSRC Peer Review College (2000-2022). External consultant in connection with UK Research Assessment: University of Sussex (2007, 2014, 2021), Strathclyde University (2012). External Advisor: CEMAT, Institut Superior Technico, Lisbon (since 2010).

External Examinerships: Heriot-Watt University, 1997 - 2000, Strathclyde University, 2001 - 2004, Sussex University, 2006 - 2010, Manchester University/UMIST, 2001-2004.

Departmental Service at Bath: Head of Mathematics Group, 2001-2004; Head of Department of Mathematical Sciences (i.e. Department Chair), 2012-15.

Selected publications

(Items with n Google Scholar citations (September 26, 2024) have [**n**] appended.)

Efficient solvers for frequency domain wave problems

[1] J. Galkowski, S. Gong, I.G. Graham, D. Lafontaine, E.A. Spence Convergence of overlapping domain decomposition methods with PML transmission conditions applied to nontrapping Helmholtz problems, submitted 2 April 2024, `arXiv:2404.02156`. [**1**]

[2] S. Gong, I. G. Graham and E.A. Spence, Convergence of Restricted Additive Schwarz with impedance transmission conditions for discretised Helmholtz problems, Math. Comp. 92 (2023), 175-215. [**9**]

[3] S. Gong, M.J. Gander, I.G. Graham, D. Lafontaine and E.A. Spence, Convergence of parallel overlapping domain decomposition methods for the Helmholtz equation, Numer. Math. 152 (2022), 259–306 . [**16**]

[4] I.G. Graham, E.A. Spence and J. Zou, Domain Decomposition with local impedance conditions for the Helmholtz equation with absorption. SIAM J. Numer. Anal. 58 (2020), 2515–2543 . [**52**]

[5] M. Bonazzoli, V. Dolean, I.G. Graham, E. A. Spence, P.-H. Tournier, Domain decomposition preconditioning for the high-frequency time-harmonic Maxwell equations with absorption, Math. Comp. 88 (2019), 2559-2604. [**56**]

[6] I.G. Graham, E.A. Spence and E. Vainikko, Domain decomposition preconditioning for high-frequency Helmholtz problems with absorption, Math. Comp. 86 (2017), 2089-2127. [**75**]

[7] M.J. Gander, I.G. Graham and E.A. Spence, Applying GMRES to the Helmholtz equation with shifted Laplacian preconditioning: What is the largest shift for which wavenumber-independent convergence is guaranteed? Numer. Math. 131 (2015), 567–614. [**137**]

Uncertainty quantification

[8] M. Bachmayr, I.G. Graham, V. K. Nguyen and R. Scheichl, Unified Analysis of Periodization-Based Sampling Methods for Matérn Covariances, SIAM J. Numer. Anal. 58 (2020), 2953–2980. [**14**]

[9] A.D. Gilbert, I. G. Graham, F. Y. Kuo, R. Scheichl, and I. H. Sloan, Analysis of quasi-Monte Carlo methods for elliptic eigenvalue problems with stochastic coefficients, Numer. Math. 142 (2019), 863–915. [**40**]

[10] I.G. Graham, F.Y. Kuo, D. Nuyens, R. Scheichl and I.H. Sloan, Analysis of circulant embedding methods for sampling stationary random fields SIAM J. Numer. Anal. 56 (2018), 1871–1895. [**63**]

[11] I.G. Graham, F.Y. Kuo, J.A. Nicholls, R. Scheichl, Ch. Schwab and I.H. Sloan, Quasi-Monte Carlo Finite Element Methods for Elliptic PDEs with Lognormal Random Coefficients Numer. Math. 131 (2015), 329–368. [**178**]

[12] I.G. Graham, F.Y. Kuo, D. Nuyens, R. Scheichl and I.H. Sloan, Quasi-Monte Carlo methods for elliptic PDEs with random coefficients and applications. J. Comput. Phys. 230 (2011), 3668–3694. [**205**]

Hybrid numerical-asymptotic methods for Helmholtz problems

[13] Z. Wu, I.G. Graham, D. Ma, Z. Zhang, A Filon-Clenshaw-Curtis-Smolyak rule for multi-dimensional oscillatory integrals with application to a UQ problem for the Helmholtz equation, Math. Comp., `https://doi.org/10.1090/mcom/4007`, 2024. [**2**]

[14] V. Domínguez, I. G. Graham and T. Kim, Filon-Clenshaw-Curtis rules for highly-oscillatory integrals with algebraic singularities and stationary points, SIAM J. Numer. Anal. 51 (2013), 1542-1566. [**73**]

[15] S. N. Chandler-Wilde, I. G. Graham, S. Langdon and E.A. Spence, Numerical-asymptotic boundary integral methods in high-frequency scattering, Acta Numerica 21 (2012) 89 - 305. [**267**]

[16] E.A. Spence, S. N. Chandler-Wilde, I. G. Graham and V. P. Smyshlyaev, A new frequency-uniform coercive boundary integral equation for acoustic scattering, Communications in Pure and Applied Mathematics, 64(10) (2011), 1384-1415. [**58**]

[17] V. Domínguez, I.G. Graham and V.P. Smyshlyaev, Stability and error estimates for Filon-Clenshaw–Curtis rules for highly oscillatory integrals, IMA J. Numer. Anal. 31 (2011), 1253-1280. [**133**]

[18] V. Domínguez, I.G. Graham and V.P. Smyshlyaev, A hybrid numerical-asymptotic boundary integral method for high-frequency acoustic scattering, Numer. Math. 106 (2007), 471-510. [**134**]

Numerical analysis and solvers for multiscale elliptic PDEs

[19] C.-C. Chu, I.G.Graham and T.-Y. Hou, A new multiscale finite element method for high-contrast elliptic interface problems, Math. Comp. 79 (2010) 1915-1955. [**232**]

[20] I.G. Graham, T.-Y. Hou, O. Lakkis and R. Scheichl, Editors, *Numerical Analysis of Multiscale Problems*, Springer Lecture Notes in Computational Science and Engineering 83, (2011). [**25**]

[21] I.G. Graham, P. Lechner and R. Scheichl, Domain Decomposition for Multiscale PDEs, Numer. Math. 106 (2007), 589–626. [**207**]

[22] K.A. Cliffe, I.G. Graham, R. Scheichl and L. Stals, Parallel computation of flow in heterogeneous media modelled by mixed finite elements, J. Comp. Phys. 164 (2000), 258-282. [**75**]

[23] I.G. Graham and M.J. Hagger, Unstructured additive Schwarz-CG method for elliptic problems with highly discontinuous coefficients, SIAM J. Sci. Comp. 20 (1999), pp. 2041-2066. [**96**]

Numerical analysis of boundary integral methods

[24] I.G. Graham, W. Hackbusch and S.A. Sauter, Finite elements on degenerate meshes: inverse-type inequalities and applications. IMA J. Numer. Anal. 25 (2005), 379-407. [**106**]

[25] M. Ganesh and I.G. Graham, A high-order algorithm for obstacle scattering in three dimensions, J. Comp. Physics, 198 (2004), 211–242. [**164**]

[26] I.G. Graham and I.H. Sloan, Fully discrete spectral boundary integral methods for Helmholtz problems on smooth closed surfaces in $\mathbf{R}^3$, Numer. Math. 92 (2002), 289-323. [**119**]

[27] I.G. Graham, W. Hackbusch and S.A. Sauter, Discrete boundary element methods on general meshes in 3D, Numer. Math. 86 (2000), 103-137. [**31**]

[28] G.A. Chandler and I.G. Graham, The calculation of water waves modelled by Nekrasov's equation, SIAM J. Numer. Anal. 30 (1993), 1041- 1065. [**31**]

Boundary integral equations on non-smooth domains

[29] J. Elschner and I.G. Graham, An optimal order collocation method for first kind boundary integral equations on polygons, Numer. Math. 70 (1995), 1–31. [**78**]

[30] K.E. Atkinson and I.G. Graham, Iterative solution of linear systems arising from the boundary integral method, SIAM J. Sci. Stat. Comp. 13 (1992), 694-722. [**44**]

[31] I.G.Graham and G.A.Chandler, High order methods for linear functionals of solutions of second kind integral equations, SIAM J. Numer. Anal. 25 (1988), 1118-1137. [**108**]

[32] G.A. Chandler and I.G. Graham, Product integration-collocation methods for noncompact integral operator equations, Math. Comp. 50 (1988), 125-138. [**103**]

Other topics in Numerical Mathematics

[33] S. Downing, S. Gazzola, I.G. Graham and E.A. Spence, Optimisation of seismic imaging via bilevel learning, Inverse Problems, to appear 2024. `arXiv:2301.10762`

[34] I.G. Graham and S.A. Sauter, Stability and error analysis for the Helmholtz equation with variable coefficients, Math. Comp. 89 (2020), 105-138. [**78**]

[35] S. Giani and I.G. Graham, A convergent adaptive method for elliptic eigenvalue problems, SIAM J Numer Anal, 47 (2009), 1067-1091. [**96**]

[36] W. Dahmen, B. Faermann, I.G. Graham, W. Hackbusch and S.A. Sauter, Inverse Inequalities on Non-Quasiuniform Meshes and Application to the Mortar Element Method, Math. Comp., 73 (2004), 1107-1138. [**106**]

[37] M.A.J. Chaplain, M. Ganesh and I.G. Graham, Spatio-temporal pattern formation on spherical surfaces: numerical simulation and application to solid tumour growth. J. Math. Biol. 42 (2001), 387–423. [**304**]

[38] K.E. Atkinson, I.G. Graham, I.H. Sloan, Piecewise continuous collocation for integral equations. SIAM J. Numer. Anal. 20 (1983), 172–186. [**146**]