Matthias J. Ehrhardt

Contact Details

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Career

02/2021 - Reader, University of Bath, UK

05/2020 - 04/2023 Leverhulme Early Career Fellow, University of Bath, UK

09/2018 - 01/2021 Prize Fellow, University of Bath, UK

01/2016 - 09/2018 Postdoctoral Research Associate, University of Cambridge, UK

05/2015 - 12/2015 Postdoctoral Research Associate, University College London, UK

Education

04/2012 - 04/2015 PhD in Medical Imaging, University College London, UK

10/2006 - 12/2011 MSc in Industrial Mathematics, University of Bremen, Germany

Honors and Awards

2022 Paper awarded the John Ockendon Prize 2022 by the European Journal of Mathematics

2022 Paper selected as No 1 Pick for March by the Editor of Magnetic Resonance in Medicine

2020 Institute of Physics Outstanding Reviewer Award 2019

2019 Leverhulme Early Career Fellowship

2019 Recognising Excellence Award 2019, University of Bath

2018 Prize Fellowship, Bath, UK

2017 Participant of the 5th Heidelberg Laureate Forum, Heidelberg, Germany

2016 Senior Member (College Post-Doctoral Associate), Jesus College, Cambridge, UK

2015 Pump-priming award: Six months funding to explore a new field of research, funded by the CMIC-EPSRC platform grant (EP/M020533/1)

2015 Paper selected as a Highlight of 2015, IOP Inverse Problems

2014 Best Student Paper Finalist, IEEE NSS-MIC, Seattle, USA

2014 LMS Best Poster Award, Cambridge, UK

Awards as supervisor

2024 My PhD student Seb Scott was awarded the Doctoral Recognition Award from the University of Bath for his outreach work on 'Behind the Research'.

2023 My PhD student Pablo Arratia was awarded the best poster award both at the SAMBa conference 2023 and the Conference on Deep Learning for Computational Physics 2023.

2022 My Postdoc Claire Deplancke has received the CoSeC Impact Award 2022 for her collaboration with CCP SyneRBI and CCPi.

2021 My PhD student collaborator Derek Driggs was awarded a 2nd Prize at the 20th IMA Leslie Fox Prize in Numerical Analysis event for our joint paper on 'Accelerating Variance-Reduced Stochastic Gradient Methods'.

2021 My PhD student Ferdia Sherry was awarded a EPSRC Faculty of Mathematics Research Associate Award. This award will fund 9 months of his research post PhD.

2020 My PhD student Margaret Duff was awarded a Doctoral Recognition Award. Only 14 such awards were handed out to PhD students in Bath this year.

2020 My undergraduate student Samuel Cortinhas was invited to Posters in Parliament as part of BCUR 2020.

2020 My PhD student Margaret Duff was invited to the UK Parliament as part of STEM for BRITAIN 2020.

2019 My student Samuel Cortinhas won an IMI Best Poster Award, Bath, UK, value £100

2018 My PhD student Ferdia Sherry won the Best Poster Award at the Cantab Capital Institute for the Mathematics of Information – Connecting with Industry, Cambridge, UK

Third-Party Grants

My grants total £12.0M (research £6.4M, training £5.5M), of which about £1.6M support directly me and my group.

Major Awards

08/2025 - 07/2026 PI, Novel K-means clustering on historical axial spondyloartritis patient data investigating clinical questions to aide, inform and develop personalised disease treatment, NIHR, £43k (my share £32k)

10/2025 - 09/2028 PI, AI for Parameter-Free Image Reconstruction in Synchrotron X-Ray and Neutron Tomography, ALC Programme Development Studentship, £53k (my share £53k)

11/2024 - 10/2026 CoI and Bath-PI, Synergistic Reconstruction for Biomedical Imaging (SyneRBI) bridging proposal, CoSeC, £250k (my share £9k)

10/2024 - 09/2028 PI, Whole data models for imaging, tomography and ptychography, ALC Programme Development Studentship, £48k (my share £48)

10/2024 - 09/2032 CoI, Centre for Doctoral Training Statistical Applied Mathematics at Bath, EPSRC, £5,506k (my share £60k)

07/2024 - 06/2025 PI, Pilot project using RNHRD AxSpA patient databases and novel mathematical analyses to help establish treatment predictors from phenotypes and endotypes, NIHR, £33k (my share £33k)

05/2024 - 04/2028 PI, Research Exchanges in the Mathematics of Deep Learning with Applications, UKRI, £132k (my share £66k)

01/2022 - 01/2027 CoI and Deputy Director, Mathematics of Deep Learning, EPSRC, £3,358k (my share £637k)

03/2021 - 03/2022 PI, Developing mathematical models to automatically identify artefacts in CT images of patients with Chronic Thromboembolic Pulmonary Hypertension, NIHR, £29k (my share £24k)

05/2020 - 04/2023 PI, Leverhulme Early Career Fellowship, £93k

04/2020 - 03/2025 CoI and Bath-PI, Synergistic Reconstruction for Biomedical Imaging, EPSRC, £476k (my share £24k)

09/2019 - 08/2023 Co-Lead and Bath-PI, PET++: Improving Localisation, Diagnosis and Quantification in Clinical and Medical PET Imaging with Randomised Optimisation, EPSRC, £821k (my share £377k)

07/2019 - 09/2021 CoI and Bath-PI, EPSRC Battery Characterisation, Quantitative Imaging of Multi-Scale Dynamic Phenomena at Electrochemical Interfaces, £1,131k (my share £186k)

Minor Awards

Awards for workshops: 2x 2020, 2024, 2025 combined value ≈ £42k, funders: Bath Institute for Mathematical Innovation, International Centre for Mathematical Sciences, Isaac Newton Institute, London Mathematical Society, UCL

Awards for undergraduate summer projects: 2016, 2019, combined value ≈ £3k, funders: Bath Institute for Mathematical Innovation, London Mathematical Society

Pump-priming award: six months of funding received from the CMIC-EPSRC platform grant (EP/M020533/1) to explore a new field of research, value ≈ £20k, 2015

Travel awards: 2014, 4x 2019, combined value ≈ £4k, funders: Bath Institute for Mathematical Innovation, Institute for Mathematics and its Applications, Institute Henri Poincaré, Inverse Problems Network UK, Society for Industrial and Applied Mathematics

NVIDIA Hardware Support: 2013, 2016, 2017, combined value ≈ £6k

Review, Editorial & Scientific advisory activities

Associate editor (4x): SIAM Journal on Imaging Sciences (since 2025), Journal of Mathematical Learning and Computation (since 2025), Springer Journal for Mathematical Imaging and Vision (since 2023), AIMS Applied Mathematics for Modern Challenges (since 2022)

Guest editor (4x): Research Topic on Rapid Image Reconstruction for Frontiers (2024-) with C. Kolbitsch, K. Thielemans, C. Tsoumpas, "The Applied Mathematics of Machine Learning" for IMA Journal of Applied Mathematics (2022-24) with D. Lesnic, "Big Data Inverse Problems" for IOP Inverse Problems (2021-24) with M. Chung and C. Schönlieb, Special issue on "Joint Reconstruction and Multi-Modality/Multi-Spectral Imaging"

for IOP Inverse Problems (2017-18) with S. Arridge and M. Burger

Referee for journals: Acta Applicandae Mathematicae, AIMS Applied Mathematics for Modern Challenges, AIMS Journal of Computational Dynamics, IEEE Access, IEEE Geoscience and Remote Sensing Letters, IEEE Transactions on Information Theory, IEEE Transactions on Medical Imaging, IEEE Transactions on Radiation and Plasma Medical Sciences, IEEE Transactions on Signal Processing, IMA Applied Mathematics, IMA Numerical Analysis, IOP Inverse Problems, IOP Physics in Medicine and Biology, Nature Communications, SIAM Journal on Imaging Science, SIAM Journal on Numerical Analysis, SIAM Journal on Optimization, Springer Applied Mathematics & Optimization, Springer Journal of Mathematical Imaging and Vision, Springer Machine Learning, Springer Numerical Algorithms, Springer Optimization Letters, Springer Sensing and Imaging, Wiley Magnetic Resonance in Medicine

Reviewing Recognition: Outstanding Reviewer for IOP Inverse Problems for 2019; IOP Trusted Reviewer since 2023

Reviewer for books: CRC Press, Springer

Reviewer for conferences: MICCAI '18, ICML '19, NeurIPS '20, AISTATS '21, '25, Fully3D '21, '23, SSVM '23, '25, ICLR '25

Reviewer for national and international funding bodies and learned societies: Since 2018: British Council (UK), EPSRC (UK), ICMS (UK), LMS (UK), NIHR (UK), Research Grant Council (Hong Kong), Royal Society (UK), member of the UKRI EPSRC Peer Review College (since 2023)

Other reviewer activities: Royal Society Awards programme

Advisory: Member of the EPSRC Mathematical Sciences Early Career Forum (2022-24), SIAM Student Chapter Faculty Advisor, Bath, UK (since 2024)

Organisation of Meetings

Conferences (50+ attendees)

2025 Deep Learning and Inverse Problems, Bath, UK
Lead organiser for 3-day international scientific symposium.

2025 Computational Techniques and Imaging Innovations in the Age of AI, UCL, UK
Organiser for 2-day international scientific symposium.

2024 4th IMA Conference On Inverse Problems From Theory To Application, London, UK
Lead organiser for 3-day international scientific symposium with 29 national and international speakers and about 100 attendees, mostly UK and Europe.

2020 LMS-Bath Symposium on the Mathematics of Machine Learning, Bath, UK
Main organiser of virtual 5-day conference with 28 national and international speakers and about 500 attendees from 6 different continents.

Workshops

2024 Big Data Inverse Problems, ICMS, Edinburgh, UK
Organiser for 3-day international workshop.

2020 LMS-workshop: Imaging meets Computational PDEs, Bath, UK
Virtual 1-day workshop with 6 national and international speakers (with A. Paganini, Leicester).

Member of scientific advisory boards: Synergistic Reconstruction Symposium '19, IMA Conference on Inverse Problems '19, '22

Minisymposia: Inverse Problems: Modelling and Simulation '14, SIAM Imaging Science '16, '18, '22, Applied Inverse Problems '17, '19, British Applied Mathematics Colloquium '17, 19, '22, 100 Years of the Radon Transform '17, SIAM Mathematics of Data Science '22, SIAM Optimization '23

Academic supervision

Postdoctoral fellows (4x)

- Hok Shing Wong (since 11/2022). Mathematical foundations of deep learning.

- Pawel Markiewicz (10/2022-08/2023, then lecturer at London South Bank University). PET image reconstruction and clinical translation.

- Claire Delplancke (01/2020-07/2022, then research engineer at CEA). Randomized optimization for PET imaging.

- Jarrod Williams (12/2019-07/2021, then PDRA at Bath Computer Science). Multi-modality and data-driven reconstruction for battery imaging.

PhD students (10x)

- Anastasia Doan (since 10/2025; lead supervisor with Margaret Duff). AI for automatic image reconstruction.

- Clara Hawkins (since 10/2024; lead supervisor with Paul Quinn). Whole data models for imaging, tomography and ptychography.

- Amin Sabir (since 07/2024; co-supervisor with Yury Korolev). Plug-and-play algorithms for Inverse Problems.

- Patrick Fahy (since 06/2023; lead supervisor with Mohammad Golbabaee). Learning to Optimize for Inverse Problems.

- Pablo Arratia Lopez (06/2022-12/2025, then PDRA at Heriot-Watt; lead supervisor with Lisa Kreusser). Physics Informed Neural Networks for Inverse Imaging.

- Mohammad Sadegh Salehi (06/2022-2025; lead supervisor with Subhabip Mukherjee). Bilevel Learning for Inverse Problems.

- Seb Scott (06/2021-09/2024, then PDRA at Würzburg; lead supervisor with Silvia Gazzola). Learning the Regularizaton for Inverse Problems.

- Margeret Duff (06/2019-12/2022, then research engineer at STFC; lead supervisor with Neill Campbell, Computer Science). Generative Machine Learning Models for Inverse Problems.

- Eric Baruch Gutiérrez Castillo (02/2019-04/2023, then Financial Systems Software Trainer at Keyteach; sole supervisor). Randomized Algorithms for Large-Scale Convex Optimization.

- Ferdia Sherry (Cambridge, 10/2016-07/2021, then PDRA at Cambridge Maths; co-supervisor with Carola-Bibiane Schönlieb, Cambridge). Machine Learning for Inverse Problems.

PhD Examination (9x)

2025 Alexander Leatherland, Southampton, UK, Advances in multimodal tomographic reconstruction

2025 Markus Juvonen, Helsinki, Finland, Inverse Problems in Photography: From Deconvolution to Dataset Design and Creative Reconstruction

2025 Ran An, Liverpool, UK and Capital Normal University, China, Unsupervised Deep-learning Methods for Low-dose Computed Tomography Reconstruction

2024 Oliver Townsend, Bath, UK, Adaptive Undersampling in Spectromicroscopy

2023 Joshua Moo Tjun Minh, KCL, UK, Deep Learning for Radioguided Surgery with a CMOS Intraoperative Probe

2023 Dominik Narnhofer, TU Graz, Austria, Generative Models and Uncertainty for Inverse Problems in Imaging

2023 Xiaoyu Wang, Cambridge, UK, Neural Network Training and Inversion with a Bregman Learning Framework

2022 David Alejandro Villacis Proano, Quito, Ecuador, Bilevel Imaging Learning with Total Variation Regularization: Optimality Conditions and Trust-Region Solution Algorithms

2022 Shaunagh Downing, Bath, UK, Optimising Seismic Imaging via Bilevel Learning: Theory and Algorithms

Teaching Experience

Lecturer (6x)

2025/26 Numerical Linear Algebra, University of Bath, UK
Level 3 and 5 (late undergraduate and postgraduate). For more information see `www.bath.ac.uk/catalogues/2025-2026/ma/MA32065.html`.

2024/25 Numerical Linear Algebra, University of Bath, UK
Level 3 and 5 (late undergraduate and postgraduate). For more information see `www.bath.ac.uk/catalogues/2024-2025/ma/MA30051.html`.

2023/24 Numerical Linear Algebra, University of Bath, UK
Level 3 and 5 (late undergraduate and postgraduate). For more information see `www.bath.ac.uk/catalogues/2023-2024/ma/MA30051.html`.

2022/23 Numerical Linear Algebra, University of Bath, UK
Level 3 and 5 (late undergraduate and postgraduate). For more information see `www.bath.ac.uk/catalogues/2022-2023/ma/MA30051.html`.

2018/19 Inverse Problems, University of Cambridge, UK
Part III of the Mathematical Tripos (postgraduate) with Lukas Lang. For more information see `www.damtp.cam.ac.uk/research/cia/teaching/201718lentinvprob.html`.

2016/17 Inverse Problems in Imaging, University of Cambridge, UK
Part III of the Mathematical Tripos (postgraduate) with Martin Benning. For more information see `www.damtp.cam.ac.uk/research/cia/teaching/2016inverseproblems.html`.

Student Projects (24x)

Master projects (8x): Ollie Trevarthen (2025/26), Sam Smithwick (2024/25), Meitian Jiao (2023/24), Ben Bradshaw (2022/23), Luke Turton (2021/22), Varun Chhabra, Alice Smiddy (both 2018/19), Thomas Prideaux-Ghee (Cambridge, 2016/17)

Bachelor projects (2x): Cameron Wheaton (2023/24), Sam Cortinhas (2019/20)

Summer students (4x): Sam Cortinhas (2018/19), Georg Maierhofer, Chris Irving, Emile Okada (all Cambridge, 2015/16)

Reading courses (9x): Bath: 2x 2024/25, 2023/24, 2x 2021/22, 3x 2020/21; Cambridge: 2017/18

Summer schools (2x): European Summer School in Modelling, Analysis and Simulation Crime and Image Processing (Oxford, 2016), Medical Image Computing Summer School (UCL, 2015)

Teaching Assistant (8x)

Bath: 2023/24, 2020/21; UCL: 2012/13, 4x 2013/14; Bremen: 2010/11

Public Outreach

2018 Coordinator of the CIA Pop-Up Lab, Mathematical Sciences Open Day at the Science Festival, Cambridge, UK

Interactive exhibitions Puzzle Race, Beyond what the eyes can see, Face Fusion Photobooth and Shadow Tomography with Thomas Buddenkotte, Derek Driggs, Joana Grah, Pan Liu, Carola-Bibiane Schönlieb and Rob Tovey.

2017 Mathematical Sciences Open Day at the Science Festival, Cambridge, UK

Two interactive exhibitions on Face Fusion Photobooth and Shadow Tomography with Martin Benning, Veronica Corona, Chris Irving, Emile Okada, Carola-Bibiane Schönlieb, Ferdia Sherry and Rob Tovey.

Memberships

Institute for Mathematics and its Applications, Inverse Problems International Association, SIAM (activity groups: imaging, data science and optimization)

Publications, † denotes alphabetical order of authors

Peer-Reviewed Publications

61. † M. J. Ehrhardt, Z. Kereta and G. Schramm. Fast PET reconstruction with variance reduction and prior-aware preconditioning. *Frontiers in Nuclear Medicine* 5 (2025).
60. † M. J. Ehrhardt and M. Mauritz. Complex extension of optical flow and its practical evaluation for undersampled dynamic MRI. *Applied Mathematics for Modern Challenges* 3 (2025), 117–133.
59. † L. Bogensperger, M. J. Ehrhardt, T. Pock, M. S. Salehi and H. S. Wong. An Adaptively Inexact Method for Bilevel Learning Using Primal–Dual-Style Differentiation. *Journal of Mathematical Imaging and Vision* 67.5 (2025), 1–15.
58. † P. Arratia, M. J. Ehrhardt and L. Kreusser. Enhancing dynamic CT image reconstruction with neural fields and optical flow. *Journal of Mathematical Imaging and Vision* 67.4 (2025), 42.
57. † M. J. Ehrhardt, Ž. Kereta, J. Liang and J. Tang. A guide to stochastic optimisation for large-scale inverse problems. *Inverse Problems* 41.5 (2025), 053001.
56. M. S. Salehi, S. Mukherjee, L. Roberts and M. J. Ehrhardt. An adaptively inexact first-order method for bilevel optimization with application to hyperparameter learning. *SIAM Journal on Mathematics of Data Science* 7.3 (2025), 906–936.
55. E. B. Gutierrez, C. Delplancke and M. J. Ehrhardt. Randomized Primal-Dual Algorithm with Arbitrary Sampling: Convergence Theory and Applications to Parallel MRI. *Journal of Mathematical Imaging and Vision* 67.3 (2025), 1–17.
54. M. S. Salehi, S. Mukherjee, L. Roberts and M. J. Ehrhardt. Bilevel Learning with Inexact Stochastic Gradients. *International Conference on Scale Space and Variational Methods in Computer Vision*. Springer. 2025, pp.347–359.
53. J. Tang, M. J. Ehrhardt and C.-B. Schönlieb. Stochastic Primal-Dual Three Operator Splitting Algorithm with Extension to Equivariant Regularization-by-Denoising. *International Conference on Scale Space and Variational Methods in Computer Vision*. Springer. 2025, pp.30–41.
52. † M. J. Ehrhardt, S. Gazzola and S. J. Scott. 'On optimal regularization parameters via bilevel learning'. *Data-driven Models in Inverse Problems*. Ed. by T. A. Bubba. De Gruyter, 2025, pp. 1–38.

51. F. Sherry, E. Celledoni, M. J. Ehrhardt, D. Murari, B. Owren and C. B. Schönlieb. Designing stable neural networks using convex analysis and ODEs. *Physica D: Nonlinear Phenomena* 463 (2024).

50. † D. Driggs, M. J. Ehrhardt, C.-B. Schönlieb and J. Tang. Practical Acceleration of the Condat–Vũ Algorithm. *SIAM Journal on Imaging Sciences* 17.4 (2024), 2076–2109.

49. † M. J. Ehrhardt, L. Kuger and C.-B. Schönlieb. Proximal Langevin sampling with inexact proximal mapping. *SIAM Journal on Imaging Sciences* 17.3 (2024), 1729–1760.

48. † M. J. Ehrhardt, E. S. Riis, T. Ringholm and C.-B. Schönlieb. A Geometric Integration Approach to Smooth Optimisation: Foundations of the Discrete Gradient Method. *IMA Journal of Numerical Analysis* (2024), drae037.

47. † M. J. Ehrhardt and L. Roberts. Analyzing inexact hypergradients for bilevel learning. *IMA Journal of Applied Mathematics* 89 (2024), 254–278.

46. † A. Chambolle, C. Delplancke, M. J. Ehrhardt, C.-B. Schönlieb and J. Tang. Stochastic Primal–Dual Hybrid Gradient Algorithm with Adaptive Step Sizes. *Journal of Mathematical Imaging and Vision* (2024).

45. A. M. Rambojun, H. Komber, J. Rossdale, J. Suntharalingam, J. C. Rodrigues, M. J. Ehrhardt and A. Repetti. Uncertainty quantification in computed tomography pulmonary angiography. *PNAS Nexus* 3.1 (2024).

44. D. Riccio, M. J. Ehrhardt and M. Benning. Regularization of inverse problems: deep equilibrium models versus bilevel learning. *Numerical Algebra, Control and Optimization* (2024).

43. M. A. Duff, N. D. Campbell and M. J. Ehrhardt. Regularising Inverse Problems with Generative Machine Learning Models. *Journal of Mathematical Imaging and Vision* 66.1 (2024), 37–56.

42. M. A. Duff, I. J. Simpson, M. J. Ehrhardt and N. D. Campbell. VAEs with structured image covariance applied to compressed sensing MRI. *Physics in Medicine and Biology* 68.16 (2023).

41. R. F. Ziesche, T. M. M. Heenan, P. Kumari, J. Williams, W. Li, M. E. Curd, T. L. Burnett, I. Robinson, D. J. L. Brett, M. J. Ehrhardt, P. D. Quinn, L. B. Mehdi, P. J. Withers, M. M. Britton, N. D. Browning and P. R. Shearing. Multi-Dimensional Characterization of Battery Materials. *Advanced Energy Materials* (2023).

40. † D. Chen, M. Davies, M. J. Ehrhardt, C.-B. Schönlieb, F. Sherry and J. Tachella. Imaging With Equivariant Deep Learning: From unrolled network design to fully unsupervised learning. *IEEE Signal Processing Magazine* 40.1 (2023), 134–147.

39. M. J. Ehrhardt. 'Multi-modality Imaging with Structure-promoting Regularizers'. *Handbook of Mathematical Models and Algorithms in Computer Vision and Imaging: Mathematical Imaging and Vision*. Ed. by Chen, Ke and Schönlieb, Carola-Bibiane and Tai, Xue-Cheng and Younes, Laurent. Springer International Publishing, 2023, pp.235–272.

38. M. J. Ehrhardt, F. A. Gallagher, M. A. McLean and C.-B. Schönlieb. Enhancing the spatial resolution of hyperpolarized carbon-13 MRI of human brain metabolism using structure guidance. *Magnetic Resonance in Medicine* 87.3 (2022), 1301–1312. (**selected as the No 1 Pick for March 2022**).

37. D. Driggs, M. J. Ehrhardt and C.-B. Schönlieb. Accelerating variance-reduced stochastic gradient methods. *Mathematical Programming* 191.2 (2022), 671–715.

36. E. S. Riis, M. J. Ehrhardt, G. R. Quispel and C. B. Schönlieb. A Geometric Integration Approach to Nonsmooth, Nonconvex Optimisation. *Foundations of Computational Mathematics* 22.5 (2022), 1351–1394.

35. C. Delplancke, K. Thielemans and M. J. Ehrhardt. Accelerated Convergent Motion Compensated Image Reconstruction. *IEEE Nuclear Science Symposium and Medical Imaging Conference*. 2021.

34. R. Brown, C. Kolbitsch, C. Delplancke, E. Papoutsellis, J. Mayer, E. Ovtchinnikov, E. Pasca, R. Neji, C. Da Costa-Luis, A. G. Gillman, M. J. Ehrhardt, J. R. McClelland, B. Eiben and K. Thielemans. Motion estimation and correction for simultaneous PET/MR using SIRF and CIL. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 379 (2021), 20200208.

33. E. Cueva, A. Meaney, S. Siltanen and M. J. Ehrhardt. Synergistic multi-spectral CT reconstruction with directional total variation. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 379 (2021), 20200198.

32. † S. R. Arridge, M. J. Ehrhardt and K. Thielemans. (An overview of) Synergistic reconstruction for multimodality/multichannel imaging methods. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 379 (2021), 20200205.

31. † E. Celledoni, M. J. Ehrhardt, C. Etmann, R. I. Mclachlan, B. Owren, C. B. Schonlieb and F. Sherry. Structure-preserving deep learning. *European Journal of Applied Mathematics* 32.5 (2021), 888–936. (**awarded the John Ockendon Prize 2022**).

30. † E. Celledoni, M. J. Ehrhardt, C. Etmann, B. Owren, C.-B. Schönlieb and F. Sherry. Equivariant neural networks for inverse problems. *Inverse Problems* 37.8 (2021), 085006.

29. † M. Benning, M. M. Betcke, M. J. Ehrhardt and C.-B. Schönlieb. Choose Your Path Wisely: Gradient Descent in a Bregman Distance Framework. *SIAM Journal on Imaging Sciences* 14.2 (2021), 814–843.

28. † M. J. Ehrhardt and L. Roberts. Inexact Derivative-Free Optimization for Bilevel Learning. *Journal of Mathematical Imaging and Vision* 63.5 (2021), 580–600.

27. R. Brown, C. Kolbitsch, E. Ovtchinnikov, J. Mayer, A. G. Gillman, E. Pasca, C. Delplancke, E. Papoutsellis, G. Fardell, R. Neji, J. Mcclelland, B. Eiben, M. J. Ehrhardt and K. Thielemans. Status update on the Synergistic Image Reconstruction Framework : *16th International Meeting on Fully 3D Image Reconstruction in Radiology and Nuclear Medicine*. 2021, pp.440–443.

26. E. B. Gutiérrez, C. Delplancke and M. J. Ehrhardt. Convergence Properties of a Randomized Primal-Dual Algorithm with Applications to Parallel MRI. *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. Vol. 12679 LNCS. 2021, pp.254–266.

25. M. Benning, E. Celledoni, M. J. Ehrhardt, B. Owren and C.-B. Schönlieb. Deep learning as optimal control problems. *IFAC-Papers OnLine*. Vol. 54. 9. 2021, pp.620–623.

24. M. J. Ehrhardt and L. Roberts. Efficient hyperparameter tuning with dynamic accuracy derivative-free optimization. *OPT2020: 12th Annual Workshop on Optimization for Machine Learning*. 2020.

23. † L. Bungert and M. J. Ehrhardt. Robust image reconstruction with misaligned structural information. *IEEE Access* 8 (2020), 222944–222955.

22. F. Sherry, M. Benning, J. C. D. los Reyes, M. J. Graves, G. Maierhofer, G. Williams, C.-B. Schönlieb and M. J. Ehrhardt. Learning the Sampling Pattern for MRI. *IEEE Transactions on Medical Imaging* 39.12 (2020), 4310–4321.

21. E. Ovtchinnikov, R. Brown, C. Kolbitsch, E. Pasca, C. da Costa-Luis, A. G. Gillman, B. A. Thomas, N. Efthimiou, J. Mayer, P. Wadhwa, M. J. Ehrhardt, S. Ellis, J. S. Jørgensen, J. Matthews, C. Prieto, A. J. Reader, C. Tsoumpas, M. Turner, D. Atkinson and K. Thielemans. SIRF: Synergistic Image Reconstruction Framework. *Computer Physics Communications* 249 (2020), 107087.

20. C. Delplancke, M. Gurnell, J. Latz, P. J. Markiewicz, C.-B. Schönlieb and M. J. Ehrhardt. Improving a Stochastic Algorithm for Regularized PET Image Reconstruction. *IEEE Nuclear Science Symposium and Medical Imaging Conference*. 2020.

19. M. J. Ehrhardt, P. Markiewicz and C.-B. Schönlieb. Faster PET Reconstruction with Non-Smooth Priors by Randomization and Preconditioning. *Physics in Medicine & Biology* 64.22 (2019), 225019.

18. † M. Benning, E. Celledoni, M. J. Ehrhardt, B. Owren and C.-B. Schönlieb. Deep learning as optimal control problems: models and numerical methods. *Journal of Computational Dynamics* 6.2 (2019), 171–198.

17. V. Kolehmainen, M. J. Ehrhardt and S. R. Arridge. Incorporating Structural Prior Information and Sparsity into EIT using Parallel Level Sets. *Inverse Problems and Imaging* 13.2 (2019), 285–307.

16. V. Corona, M. Benning, M. J. Ehrhardt, L. F. Gladden, R. Mair, A. Reci, A. J. Sederman, S. Reichelt and C.-B. Schönlieb. Enhancing joint reconstruction and segmentation with non-convex Bregman iteration. *Inverse Problems* 35.5 (2019), 055001.

15. D. Kazantsev, E. Pasca, M. Basham, M. Turner, M. J. Ehrhardt, K. Thielemans, B. A. Thomas, E. Ovtchinnikov, P. J. Withers and A. W. Ashton. Versatile regularisation toolkit for iterative image reconstruction with proximal splitting algorithms. *Proceedings of the 15th International Meeting on Fully Three-Dimensional Image Reconstruction in Radiology and Nuclear Medicine*. 2019.

14. † A. Chambolle, M. J. Ehrhardt, P. Richtárik and C.-B. Schönlieb. Stochastic Primal-Dual Hybrid Gradient Algorithm with Arbitrary Sampling and Imaging Applications. *SIAM Journal on Optimization* 28.4 (2018), 2783–2808.

13. † L. Bungert, D. A. Coomes, M. J. Ehrhardt, J. Rasch, R. Reisenhofer and C.-B. Schönlieb. Blind Image Fusion for Hyperspectral Imaging with the Directional Total Variation. *Inverse Problems* 34.4 (2018), 044003.

12. Y. J. Tsai, A. Bousse, M. J. Ehrhardt, C. W. Stearns, S. Ahn, B. F. Hutton, S. Arridge and K. Thielemans. Fast Quasi-Newton Algorithms for Penalized Reconstruction in Emission Tomography and Further Improvements via Preconditioning. *IEEE Transactions on Medical Imaging* 37.4 (2018), 1000–1010.

11. P. J. Markiewicz, M. J. Ehrhardt, K. Erlandsson, P. J. Noonan, A. Barnes, J. M. Schott, D. Atkinson, S. R. Arridge, B. F. Hutton and S. Ourselin. NiftyPET: a High-throughput Software Platform for High Quantitative Accuracy and Precision PET Imaging and Analysis. *Neuroinformatics* 16.1 (2018), 95–115.
10. M. J. Ehrhardt, P. J. Markiewicz, P. Richtárik, J. Schott, A. Chambolle and C.-B. Schönlieb. Faster PET Reconstruction with a Stochastic Primal-Dual Hybrid Gradient Method. *SPIE Optics+Photonics: Wavelets and Sparsity XVII, San Diego, USA*. 2017.
9. P. Markiewicz, M. J. Ehrhardt, N. Burgos, D. Atkinson, S. R. Arridge, B. F. Hutton and S. Ourselin. Unified Acquisition Modelling across PET Imaging Systems: Unified Scatter Modelling. *IEEE Nuclear Science Symposium and Medical Imaging Conference*. 2016.
8. M. J. Ehrhardt, P. Markiewicz, M. Liljeroth, A. Barnes, V. Kolehmainen, J. Duncan, L. Pizarro, D. Atkinson, B. F. Hutton, S. Ourselin, K. Thielemans and S. R. Arridge. PET Reconstruction with an Anatomical MRI Prior using Parallel Level Sets. *IEEE Transactions on Medical Imaging* 35.9 (2016), 2189–2199.
7. M. J. Ehrhardt and M. M. Betcke. Multi-Contrast MRI Reconstruction with Structure-Guided Total Variation. *SIAM Journal on Imaging Sciences* 9.3 (2016), 1084–1106.
6. Y.-J. Tsai, A. Bousse, M. J. Ehrhardt, B. F. Hutton, S. R. Arridge and K. Thielemans. Performance Evaluation of MAP Algorithms with Different Penalties, Object Geometries and Noise Levels. *IEEE Nuclear Science Symposium and Medical Imaging Conference*. 2015.
5. M. J. Ehrhardt, K. Thielemans, L. Pizarro, D. Atkinson, S. Ourselin, B. F. Hutton and S. R. Arridge. Joint Reconstruction of PET-MRI by Exploiting Structural Similarity. *Inverse Problems* 31.1 (2015), 015001. (**selected as a Highlight of 2015, IOP Inverse Problems**).
4. M. J. Ehrhardt, K. Thielemans, L. Pizarro, P. Markiewicz, D. Atkinson, S. Ourselin, B. F. Hutton and S. R. Arridge. Joint Reconstruction of PET-MRI by Parallel Level Sets. *IEEE Nuclear Science Symposium and Medical Imaging Conference*. 2014. (**best student paper finalist**).
3. P. Markiewicz, K. Thielemans, M. J. Ehrhardt, J. Jiao, N. Burgos, D. Atkinson, S. R. Arridge, B. F. Hutton and S. Ourselin. High Throughput CUDA Implementation of Accurate Geometric Modelling for Iterative Reconstruction of PET Data. *IEEE Nuclear Science Symposium and Medical Imaging Conference*. 2014.
2. M. J. Ehrhardt and S. R. Arridge. Vector-Valued Image Processing by Parallel Level Sets. *IEEE Transactions on Image Processing* 23.1 (2014), 9–18.
1. M. J. Ehrhardt, H. Villinger and S. Schiffler. Evaluation of Decomposition Tools for Sea Floor Pressure Data: A Practical Comparison of Modern and Classical Approaches. *Computers & Geosciences* 45 (2012), 4–12.

Preprints

10. J. Hertrich, H. S. Wong, A. Denker, S. Ducotterd, Z. Fang, M. Haltmeier, Ž. Kereta, E. Kobler, O. Leong, M. S. Salehi et al. 'Learning Regularization Functionals for Inverse Problems: A Comparative Study'. 2025.
9. P. Arratia, M. J. Graves, M. McLean, C. Pirkl, C.-B. Schönlieb, T. Schirmer, F. Wiesinger and M. J. Ehrhardt. 'Neural Fields for Highly Accelerated 2D Cine Phase Contrast MRI'. 2025.
8. † M. J. Ehrhardt, D. Murari and F. Sherry. 'Stable neural networks and connections to continuous dynamical systems'. 2025.
7. M. S. Salehi, S. Mukherjee, L. Roberts and M. J. Ehrhardt. 'Bilevel Learning via Inexact Stochastic Gradient Descent'. 2025.
6. † C. da Costa-Luis, M. J. Ehrhardt, C. Kolbitsch, E. Ovtchinnikov, E. Pasca, K. Thielemans and C. Tsoumpas. 'PET Rapid Image Reconstruction Challenge (PETRIC)'. 2025.
5. A. Perelli, C.-B. Schönlieb and M. J. Ehrhardt. 'Stochastic Multiresolution Image Sketching for Inverse Imaging Problems'. arxiv:2412.10249. 2024.
4. † M. J. Ehrhardt, S. Gazzola and S. J. Scott. 'Efficient gradient-based methods for bilevel learning via recycling Krylov subspaces'. arxiv:2412.08264. 2024.
3. H. S. Wong, M. J. Ehrhardt and S. Mukherjee. 'A Primal-dual algorithm for image reconstruction with ICNNs'. arxiv:2410.12441. 2024.
2. † M. Burger, M. J. Ehrhardt, L. Kuger and L. Weigand. 'Coupling Analysis of the Asymptotic Behaviour of a Primal-Dual Langevin Algorithm'. arxiv:2405.18098. 2024.
1. † M. J. Ehrhardt, P. Fahy and M. Golbabaee. 'Greedy Learning to Optimize with Convergence Guarantees'. arxiv:2406.00260. 2024.

Miscellaneous

7. D. Lesnic and M. J. Ehrhardt. Editorial Forward to the Special Issue on "The Applied Mathematics of Machine Learning". *IMA Journal of Applied Mathematics* 89.1 (2024), 1.
6. † S. R. Arridge, M. Burger and M. J. Ehrhardt. Preface to special issue on joint reconstruction and multi-modality/multi-spectral imaging. *Inverse Problems* 36.2 (2020), 020302.
5. S. Cortinhas, M. Golbabaee and M. J. Ehrhardt. 'A temporal multiscale approach for tissue quantification using MR Fingerprinting acquisitions'. 2020.
4. † L. Bungert, M. J. Ehrhardt and R. Reisenhofer. Robust Blind Image Fusion for Misaligned Hyperspectral Imaging Data. *Proceedings in Applied Mathematics & Mechanics*. Vol. 18. 1. 2018.
3. † M. Benning, M. Betcke, M. J. Ehrhardt and C.-B. Schönlieb. Gradient Descent in a Generalised Bregman Distance Setting. *Geometric Numerical Integration and its Applications, Melbourne, Australia*. 2016.
2. M. J. Ehrhardt. 'Joint Reconstruction for Multi-Modality Imaging with Common Structure'. PhD Thesis. University College London, 2015.
1. M. J. Ehrhardt. 'Sparsity in Geosciences Sparse Decomposition for Analysis of Sea Floor Pressure Data'. MSc Thesis. University of Bremen, 2011.

Communication, * denotes invited presentations

Oral Presentations at Conferences and Seminars

73. * Statistics Seminar, Bristol, UK, 2024.
72. * Applied Mathematics and Statistics Postdoc Seminar, John Hopkins Univesity (virtual), USA, 2024.
71. * SQUIDS Seminar, Manchester, UK, 2024.
70. * Optimisation Techniques for Inverse Problems, Modena, Italy, 2024.
69. * MRC Regional University Meeting, Bath, UK, 2024.
68. BIG Data Inverse Problems, ICMS, UK, 2024.
67. * Data Science Seminar, Oxford, UK, 2023.
66. Numerical Analysis Seminar, Bath, UK, 2023.
65. * Inverse Biophysical Modeling and Machine Learning in Personalized Oncology, Dagstuhl, Germany, 2023.
64. * Deep learning for Industry workshop, Bath, UK, 2023.
63. * Data-Enabled Science Seminar, Houston (virtual), USA, 2022.
62. * Computing Seminar, Buckingham (virtual), UK, 2022.
61. * Mathematics of Data Science Seminar, Graz (virtual), Austria, 2022.
60. * Advanced Image Reconstruction Methods, UCL, London, UK, 2022.
59. * HCM Workshop: Synergies between Data Science and PDE Analysis, Bonn, Germany, 2022.
58. * Analytic and Geometric Approaches to Machine Learning, Bath, UK, 2022.
57. * SIAM Imaging Science, Berlin (virtual), Germany, 2022.
56. * Inverse Problems Methods, Applications and Synergies, Pontificia Universidad Católica de Chile (virtual), Chile, 2022.
55. * One World Seminar Series on the Mathematics of Machine Learning, virtual, 2021.
54. * Clinical Molecular Imaging Group, Cambridge (virtual), UK, 2021.
53. * Signal and Image Processing Laboratory Seminar, Heriot-Watt (virtual), UK, 2021.
52. * Differential Equations and Numerical Analysis Seminar, NTNU (virtual), Norway, 2021.
51. * Centre for Inverse Problems Seminar, UCL (virtual), UK, 2021.
50. * International SPINlab Users Webconference, San Francisco (virtual), USA, 2021.
49. * Mathematical Optimization Group Research Seminar, Tübingen (virtual), Germany, 2021.
48. * Mathematics of Deep Learning Seminar, FAU Erlangen-Nürnberg (virtual), Germany, 2021.
47. * Deep learning and inverse problems, INI, Cambridge, UK, 2021.
46. * Theory of Deep Learning, INI, Cambridge (virtual), UK, 2021.
45. * ICMS-LMS Analytic and Geometric Approaches to Machine Learning, virtual, 2021.
44. * SIAM Mathematics of Data Science, virtual, 2020.
43. * Scottish Numerical Methods Network 2020: Inverse problems and optimisation for PDEs, virtual, 2020.

42. * Synergistic Reconstruction Symposium, Chester, UK, 2019.
41. * Applied Mathematics Seminar, Leicester, UK, 2019.
40. * Quantitative Imaging of Electrochemical Interfaces, Diamond Light Source, UK, 2019.
39. 2nd IMA Conference On Inverse Problems From Theory To Application, London, UK, 2019.
38. * Applied Inverse Problems, Grenoble, France, 2019.
37. * Inverse Problems Seminar, UCL, UK, 2019.
36. * SAMBa's 9th Integrative Think Tank, Bath, UK, 2019.
35. * Bath/RAL Numerical Analysis Day, Bath, UK, 2019.
34. * Numerical Analysis Seminar, Bath, UK, 2018.
33. * ISMP 2018: International Symposium on Mathematical Programming, Bordeaux, France, 2018.
32. SIAM Conference on Imaging Science, Bologna, Italy, 2018.
31. * Applied and Interdisciplinary Mathematics Seminar, Bath, UK, 2018.
30. * Scientific Computing Seminar, DTU, Denmark, 2018.
29. * Optimization and Big Data, KAUST, Saudi Arabia, 2018.
28. * Mathematics and Applications Seminar, Sussex, UK, 2017.
27. 5th Heidelberg Laureate Forum, Heidelberg, Germany, 2017.
26. IMA Conference on Inverse Problems from Theory to Application, Cambridge, UK, 2017.
25. * SPIE Optics+Photonics: Wavelets and Sparsity XVII, San Diego, USA, 2017.
24. * 27th Biennial NA Conference in Strathclyde, Glasgow, UK, 2017.
23. * Mini Workshop on Bayesian Inverse Problems and Imaging, Shanghai, China, 2017.
22. * Applied Inverse Problems, Hangzhou, China, 2017.
21. British Applied Mathematics Colloquium, Guildford, UK, 2017.
20. * 100 Years of the Radon Transform, Linz, Austria, 2017.
19. * Mathematical Imaging with Partially Unknown Models, Cambridge, UK, 2017.
18. * UCL PET/MR Symposium, London, UK, 2016.
17. * Numerical Analysis Seminar, KTH Stockholm, Sweden, 2016.
16. * SIAM Conference on Imaging Science, Albuquerque, USA, 2016.
15. * Edinburgh Research Group in Optimization, University of Edinburgh, UK, 2016.
14. * Big Data, Multimodality & Dynamic Models in Biomedical Imaging, INI, Cambridge, UK, 2016.
13. Applied Inverse Problems Conference, Helsinki, Finland, 2015.
12. * The 4th Joint BMC and BAMC, Cambridge, UK, 2015.
11. * Data Processing Challenges in PET-MR, London, UK, 2015.
10. * STIR User Meeting at IEEE NSS-MIC, Seattle, USA, 2014.
9. IEEE Medical Imaging Conference (NSS-MIC), Seattle, USA (**best student paper finalist**), 2014.
8. * Institute for Nuclear Medicine Seminar, UCL, UK, 2014.
7. * Oberseminar Angewandte Mathematik, Münster, Germany, 2014.
6. Imaging with Modulated/Incomplete Data, Graz, Austria, 2014.
5. * Centre for Medical Image Computing Seminar, UCL, UK, 2014.
4. SIAM Conference on Imaging Science, Hong Kong, China, 2014.
3. Inverse Problems: Modelling and Simulation, Fethiye, Turkey, 2014.
2. Inverse Days, Inari, Finland, 2013.
1. * Image Reconstruction in Emission Tomography and Hybrid Imaging, London, UK, 2013.

Poster Presentations

12. * Interfacing Bayesian statistics, machine learning, applied analysis, and blind and semi-blind imaging inverse problems, Edinburgh, UK, 2023.
11. Royal United Hospital, Bath, UK, 2019.
10. Developments in Healthcare Imaging - Connecting with Industry, Cambridge, UK, 2017.
9. Generative Models, Parameter Learning and Sparsity, Cambridge, UK, 2017.

8. Variational Methods, New Optimisation Techniques and New Fast Numerical Algorithms, Cambridge, UK, 2017.
7. CCIMI Launch Event, Cambridge, UK, 2016.
6. University of Cambridge Mathematics and Big Data Showcase, Cambridge, UK, 2016.
5. High-dimensional Statistics, Inverse Problems and Convex Analysis, London, UK, 2016.
4. EPSRC CMiH Launch Event, Cambridge, UK, 2016.
3. LMS Inverse Day: Big Inverse Problems, Nottingham, UK, 2016.
2. LMS Inverse Day: Sparse Regularisation for Inverse Problems, Cambridge, UK (**best poster award**), 2014.
1. Applied Inverse Problem Conference, KAIST, Daejeon, South Korea, 2013.