David Sinden

Applied Mathematician — Research Software Engineer

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Professional Experience

Fraunhofer Institute for Digital Medicine MEVIS — *Bremen, Germany*

Senior Research Scientist – Modelling & Simulation Group – Prof. Tobias Preusser — *2019 - present*

- Developed Thermal ablation simulations for microwave and ultrasound therapies
- Pharmacokinetic modelling
- Ultrasound beamforming, transcranial imaging

National Physical Laboratory — *Teddington, UK*

Senior Research Scientist – Ultrasound & Underwater Acoustics Group – Prof. Bajram Zeqiri — *2014 - 2019*

- Piezo- and pyro-electric sensor modelling using multi-physics finite-element for device design and characterisation
- Development of computational tools for ultrasound field characterisation
- Measurement-based simulation for nonlinear propagation through complex media

Institute of Cancer Research/The Royal Marsden Cancer NHS Foundation Trust — *Sutton, UK*

Post-doctoral Research Associate – Therapeutic Ultrasound Group – Prof. Gail ter Haar — *2011 - 2014*

- Design and implementation of treatment planning software for large phased-array ultrasound transducer for transcostal thermal ablation

University College London — *London, UK*

Post-doctoral Research Associate – Mechanical Engineering – Prof. Nader Safari | Prof Eleanor Stride — *2008 - 2011*

- Modelling cavitation activity in tissue during high-intensity focus ultrasound therapy.

Education

PhD – University College London

Dynamical Systems — *2004 - 2008*

- Thesis: “Intgerability, Localisation and Bifurcation of an Elastic Conducting Rod in a Uniform Magnetic Field”
- Advisor: Prof. Gert van der Heijden

MSc – University of Bath

Modern Applications of Mathematics — *2003 - 2004*

BSc – Imperial College London

Maths with Applied Mathematics & Theoretical Physics – 2.1 — *2000 - 2003*

Skills

Software:	Python	10	Contributor to open source projects, open sourcing code in papers
	C++	8	Including STL, Boost, Eigen, VTK and ITK libraries
	Accelerators	4	OpenCL, numba/cupy, jax/XLA
	Matlab/Octave	20	Was used extensively in research
	Fortran	14	Experience from MSc, PhD, post-doc (BLAS, Lapack, auto07, numerical integration)
OS:	Linux	14	Ubuntu/WSL
Presentation:	-	10	html/css (tailwind), LaTeX, BibTeX
Methods:	Software development	8	Version control (git/svn), continuous integration, build systems (CMake, qmake), testing (googletests), documentation (doxygen, sphinx)

Teaching & Dissemination

Department of Mobility - Constructor University Bremen
Bremen, Germany

Adjunct Lecturer — *2022, 2024 - present*

- Calculus and Linear Algebra for Graduate Students [MDE-MET-01]: introductory mathematics course for MSc students.
- Numerical Methods [JTMS-MAT-13]: second year mathematics course for physics, engineering and mathematics students.
- Numerical Analysis [CA-S-MATH-804]: final year course for mathematics students.

CIMPA Summer School - University of Havana
Havana, Cuba

Guest Lecturer — *June 2023*

- Delivered short lecture course on "Examples and Principles of Mathematical Modelling in Medicine", to around 50 applied mathematicians from Central and South America and Africa.

Department of Mechanical Engineering - University College London
London, UK

Seminar Teacher — *2011*

- Modelling and Analysis in Engineering I [MECH1010]: first year mathematics course for engineering students.

Department of Civil, Environmental & Geomatic Engineering - University College London
London, UK

Seminar Teacher — *2008, 2009*

- Mathematics for Engineers II [Math6502]: Second year mathematics for course for engineering students.

Nazarbayez University
Astana, Kazakhstan

Administration | Seminar Teacher — *2011*

For students on prestigious "Bolashak" scholarship and in establishing partner campus at Nazarbayez University

- Involved in construction of mathematics modules for new courses in mechanical and civil engineering degrees, design of syllabus and preparation of course notes
  - Project management skills, including liaising with host organisation and participating partner institutions from the United States
- Ran tutorials and revision classes for students in mathematics and physics foundation classes
- Marking of tests and exam scripts

PhD Industrial Supervisor

University College London — *2018–2019*

- Morgan Roberts, Dept. Medical Physics (with Prof. Ben Cox) "Ultrasound Computed Tomography of the Breast".
- Santeri Kaupinmäki, Dept. Medical Physics (with Prof. Simon Arridge) "Inverse Problems for Ultrasound Computed Tomography of the Breast".

Heriot–Watt University — *2017–2019*

- Katherine Baker, Dept. Mathematics, (with Prof. Lehel Banjai) "Linear and Nonlinear Wave Equation Models with Power Law Attenuation".

MSc Secondary Supervisor

Constructor University, Bremen — *2019-2021*

- Sandeep Gyawali, Dept. Mathematics, (with Prof. Tobias Preusser). "Extending Composite Finite Element Method for PDE Problems with Geometric Uncertainties".

Undergraduate Supervision

National Physical Laboratory — *2015*

- Antoine Lucquiaud, École Normale Supérieure de Cachan, "Boundary Element Methods for Bubble Activity".

University College London — *2012*

- Jade Junqua, ENSEIRB-MATMECA and Bordeaux 1, "Investigating mode conversion and heating around the ribs due to high-intensity ultrasound".

Outreach

- Scientific consultant on documentary "The healing power of sound" (2014)
- NPL "Scientific Ambassador": delivered talks at number of schools and colleges on careers in science as well as demonstrations of experiments relating to objective measurements (2016-2019).

Affiliations, Awards & Achievements

Standardiation

- Member of IEC Technical Committee 87: Ultrasonics, Working Group 6 – High Power
  Part of working group of internationally recognised experts writing the technical specification “TS 63900: Measurement-based Simulation in water and complex media”

Scholarships

- M.Sc. funded by an EPSRC scholarship (2003–4), EPSRC funding was awarded for Ph.D. (2004–7) and post-doctoral work (2014)

Awards

- Challenge Award: Joint first place in IEEE IUS Challenge on Ultrasound Beamforming with Deep Learning (CUBDL) for “Improving image quality of single plane wave ultrasound via deep learning based channel compounding (2020)”
- Conference Award: Honourable mention for paper “Studying the effect of tissue properties on radiofrequency ablation by visual simulation ensemble analysis” VCBM 2022: Eurographics Workshop on Visual Computing for Biology and Medicine (2022)

Professional Affiliations

- Member of the Society for Industrial and Applied Mathematics member (2004–present), associate member of the Institute of Mathematics (2016–present), and member of the Institute of Physics (2008–present)

Service

- Reviewer for a number of journals (Int. J. Hyperthermia · Ultrasonics · Ultrasound Med. & Biol. · Med. Phys. · Comp. Meth. Prog. Biomed. · J. Open Source Softw.), as well as funding agencies (ANR - France, FWF - Austria, Focused Ultrasound Foundation - International).
- Mentor to junior staff at NPL (2015–2019)
- Maintainer in open-source scientific code: `k-wave-python`, available via pypi
  `https://doi.org/10.5281/zenodo.10719461`

Equality, Diversity & Inclusion

- Member of Fraunhofer MEVIS diversity and inclusion task force (2021-)
- Member of ICR’s Athena Swan board (2012)

Grants

In descending chronological order:

2023	**Fraunhofer DISCOVER** CompTop: Computational Topology in Medical Imaging	*€150,000*
2023	**European Metrology Programme for Innovation and Research (EMPIR)** MAIBAI: Developing a Metrological Framework for Assessment of Image-based Artificial Intelligence Systems for Disease Detection	*€180,000*
2022	**Fraunhofer-Netzwerk: Simulation** Physics-Informed Neural Networks	*€11,000*
2019	**European Metrology Programme for Innovation and Research (EMPIR)** RaCHy: Radiotherapy Coupled with Hyperthermia – Adapting the Biological Equivalent Dose Concept	*£180,000*
2018	**Analysis for Innovators (A4I), with Deltex Medical Devices** Optimizing Oesophageal Doppler Transducers	*£26,500*
2018	**Industrial Challenge Strategy Fund, Wave 1, Metrology for Medical Imaging, with Huntleigh Diagnostics** Optimizing Fetal Doppler Transducers	*£45,500*
2016	**EPSRC Network+ Therapy Ultrasound Network for Drug Delivery & Ablation Research (ThUNDDAR) feasibility study** Machine Learning for Cavitation Detection	*£26,500*
2014	**NPL Strategic Research Award** Mathematical Modelling of Histotripsy	*£25,000*
2012	**EPSRC/ICR Platform Grant** Vascular Remodelling	*£25,000*

Book Chapters

2024	David Sinden, “Numerical modelling for simulation and planning of focused ultrasound treatments” In *Image-guided Focused Ultrasound Therapy: Physics and Clinical Applications*, Eds. F. Wu, G. ter Haar, and I. Rivens, Series in Medical Physics and Biomedical Engineering, (CRC Press, Baton Rogue, FL, 2024) ISBN 9781498711357	—

Publications & Preprints

In descending chronological order. Citation data from Google Scholar.

2025	Christina A. Neizert, Hoang N. C. Do, Miriam Zibell, David Sinden, Christian Rieder, Jakob Albrecht, Stefan M. Niehues, Kai S. Lehmann, and Franz G. M. Poch, “Optimizing microwave ablation planning with the ablation success ratio”. *Sci. Rep.* 15, 10450	—
2022	Pauline Coralie Guillemin, David Sinden, Yacine M’Rad, Michael Schwenke, Jennifer Le Guevelou, Johan Uiterwijk, Orane Lorton, Max Scheffler, Pierre-Alexandre Poletti, Jürgen Jenne, Thomas Zilli, and Rares Salomir, “A novel concept of transperineal focused ultrasound transducer for prostate cancer local deep hyperthermia treatments”. *Cancers* 15, 163	*cites: 5*
2022	Christina A. Neizert, Hoang N. C. Do, Miriam Zibell, Christian Rieder, David Sinden, Stefan M. Niehues, Janis L. Vahldiek, Kai S. Lehmann, and Franz G. M. Poch, “Three-dimensional assessment of vascular cooling effects on hepatic microwave ablation in a standardized ex vivo model”, *Sci. Rep.* 12, 17061	*cites: 6*
2022	Karl Heimes, Marina Evers, Tim Gerrits, Sandeep Gyawali, David Sinden, Tobias Preusser, and Lars Linsen, “Studying the effect of tissue properties on radiofrequency ablation by visual simulation ensemble analysis”, in Eurographics Workshop on Visual Computing for Biology and Medicine, Eds. R. G. Raidou, B. Sommer, T. W. Kuhlen, M. Krone, T. Schultz, and H–Y. Wu (The Eurographics Association, 2022) ISBN 978-3-03868-177-9, ISSN 2070-5786	*cites: 2*
2021	Dongwoon Hyun, Alycen Wiacek, Sobhan Goudarzi, Sven Rothlübbers, Amir Asif, Klaus Eickel, Yonina C. Eldar, Jiaqi Huang, Massimo Mischi, Hassan Rivaz, David Sinden, Ruud J. G. van Sloun, Hannah Strohm, and Muyinatu A. Lediju Bell, “Deep learning for ultrasound image formation: CUBDL evaluation framework and open datasets”, *IEEE Trans. Ultrason. Ferroelectr. Freq. Control* 68, 3466-–3483	*cites: 86*
2021	Santeri Kaupinmäki, Ben Cox, Simon Arridge, Christian Baker, David Sinden, and Bajram Zeqiri, “Pyroelectric ultrasound sensor model: directional response”, *Meas. Sci. Technol.* 32, 035106	*cites: 4*
2020	Sven Rothlübbers, Hannah Strohm, Klaus Eickel, Jürgen Jenne, Vincent Kuhlen, David Sinden, and Matthias Günther, “Improving image quality of single plane wave ultrasound via deep learning based channel compounding”, *2020 IEEE International Ultrasonics Symposium (IUS)* pp. 1-–4	*cites: 30*
2020	Nadia A. S. Smith, David Sinden, Spencer A. Thomas, Marina Romanchikova, Jessica E. Talbott, and Michael Adeogun, “Building confidence in digital health through metrology”, *Br. J. Radiol.* 93, 20190574	*cites: 13*
2017	David Sinden, Srinath Rajagopal, N. Christopher Chaggares, Guofeng Pang, and Oleg Ivanytskyy, “Reducing uncertainties for spatial averaging at high frequencies”, *2017 IEEE International Ultrasonics Symposium (IUS)* (IEEE, 2017) pp. 1–4	*cites: 1*
2017	Ki Joo Pahk, Pierre Gélat, David Sinden, Dipok Kumar Dhar, and Nader Saffari, “Numerical and experimental study of mechanisms involved in boiling histotripsy”, *Ultrasound Med. Biol.* 43, 2848-–2861	*cites: 45*
2014	David Sinden and Gail ter Haar, “Dosimetry implications for correct ultrasound dose deposition: uncertainties in descriptors, planning and treatment delivery”, *Trans. Cancer Res.* 3, 459-–471	*cites: 13*
2012	David Sinden, Eleanor Stride, and Nader Saffari, “Approximations for acoustically excited bubble cluster dynamics”, *J. Phys.: Conf. Ser.*, Vol. 353 (IOP Publishing, 2012) p. 012008	*cites: 4*
2011	David Sinden and Gert H. M. van der Heijden, “The buckling of magneto-strictive Cosserat rods”, in Proc. 7th European Nonlinear Dynamics Conference (ENOC 2011), edited by D. Bernardini, G. Rega, and F. Romeo (European Mechanics Society, 2011) p. 4, ISBN 978-88-906234-2-4	—

2011 Gert H. M. van der Heijden and David Sinden, “Localisation of a twisted conducting rod in a uniform magnetic field: the Hamiltonian-Hopf-Hopf bifurcation”, in Proc. 7th European Nonlinear Dynamics Conference (ENOC 2011), edited by D. Bernardini, G. Rega, and F. Romeo (European Mechanics Society, 2011) p. 4, ISBN 978-88-906234-2-4 *cites: 2*

2009 David Sinden, Eleanor Stride, and Nader Saffari, “The effects of nonlinear wave propagation on the stability of inertial cavitation”, *J. Phys.: Conf. Ser.*, Vol. 195 (IOP Publishing, 2009) p. 012008 *cites: 3*

2009 David Sinden and Gert H. M. van der Heijden, “Spatial chaos of an extensible conducting rod in a uniform magnetic field”, *J. Phys. A: Math. Theor.* 42, 375207 *cites: 10*

2008 David Sinden and Gert H. M. van der Heijden, “Integrability of a conducting elastic rod in a magnetic field”, *J. Phys. A: Math. Theor.* 41, 045207 *cites: 10*

Presentations

In descending chronological order.

2025 Nonlinear dynamics of microbubbles in tissue, Dynamical Systems and Geometry Seminary, University of Bremen, 23 January 2025 [Abstract] [Presentation] *Invited*

2023 Integrability, localisation and bifurcation of an elastic conducting rod in a magnetic field, 7th Workshop on Dynamical Systems & Ergodic Theory in Northern Germany, 9 June 2023 [Abstract] [Presentation] *Invited*

Artificial intelligence in therapeutic ultrasound, 22nd International Symposium on Therapeutic Ultrasound, Lyon, 17–20 April 2023 [Abstract] *Invited*

2022 Patient-specific modelling of microwave ablation, Society for Thermal Medicine 2022 Annual Meeting, 1–4 May 2022 [Abstract] [Presentation]

2020 Factors for validation of measurement-based simulation, ASA 179, ASA Acoustics Virtually Everywhere, 8 December 2020. [Abstract][Presentation]

2018 Machine learning for cavitation detection, British Medical Ultrasound Symposium, 5 December 2018

2016 Acceleration techniques for acoustic holography, British Medical Ultrasound Symposium, 8 December 2016

Computational challenges in high-intensity focused ultrasound, University of Strathclyde, 25 October 2016 *Invited*

Absorption of ultrasound by tissue: fractional operators and integral equations Maxwell Institute for Applied Analysis, International Centre for Mathematical Sciences, Edinburgh, 7 October 2016 *Invited*

Mathematical challenges of high-intensity focused ultrasound, Leslie Comrie Lecture, University of Greenwich, 11 April 2016 *Invited*

Wave3D: A parallelised three-dimensional nonlinear acoustic wave propagation solver, Anglo-French Physical Acoustics Conference 15, London, 13–15 January 2016

2015 Computational challenges in high-intensity focused ultrasound treatment planning, University of Surrey, 15 December 2015 *Invited*

2014 Computational challenges in high-intensity focused ultrasound treatment planning, 14th International Symposium on Therapeutic Ultrasound, Las Vegas, Nevada, 2–4 April 2014

2013 Treatment planning of high-intensity focused ultrasound, Medical Modelling Group, University College London, 30 September 2013 *Invited*

2012 The challenges in boundary element modelling for high-intensity focused ultrasound treatment planning, Boundary Integral Equation Methods for High-Frequency Scattering, University of Reading, 25 May 2012 *Invited*

The effects of nonlinear wave propagation on thermal ablation high-intensity focused ultrasound, Department of Electrical Engineering, Stanford University, California, 11 April 2012 *Invited*

2011 The buckling of magneto-strictive Cosserat rods, 7th European Mechanics Society European Nonlinear Oscillations Conference, Rome, Italy, 24–29 July 2011

Localisation of a twisted conducting rod in a uniform magnetic field: the Hamiltonian-Hopf-Hopf bifurcation, 7th European Mechanics Society European Nonlinear Oscillations Conference, Rome, Italy, 24–29 July 2011

Cavitation in tissue under high-intensity focused ultrasound, SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, 22–26 May 2011

The effect of fluid compressibility on multi-bubble cavitation for high-intensity focused ultrasound, 161st Meeting of the Acoustical Society of America, Seattle, Washington, 23–27 May 2011

Modelling cavitation in liver tissue under high-intensity focused ultrasound, British Applied Mathematics Colloquium, University of Birmingham, 11–13 April 2011

Cavitation in models of wave propagation through tissue under high-intensity focused ultrasound, Anglo-French Physical Acoustics Conference 11, Fréjus, France, 19–21 January 2011

2010 The influence of liquid viscosity and compressibility on multi-bubble cavitation, UK Therapeutic Ultrasound Interest Group, University College London, 20 December 2010

Multi-bubble interactions, and high-intensity focused ultrasound therapy, 10th International Symposium on Therapeutic Ultrasound, Tokyo, 9–12 June 2010

On the stability of interacting bubbles, UK Therapeutic Ultrasound Interest Group, Institute of Cancer Research, 11 May 2010

Cavitation in high-intensity focused ultrasound treatment, Medical Modelling Group, University College London, 4 May 2010

Integrability, spatially complex localisation and bifurcation of an elastic conducting rod in a uniform magnetic field, London Dynamical Systems Workshop, Imperial College, 29 April 2010 *Invited*

Phase synchronisation and the collective instability oscillating bubble clouds, 159th Meeting of the Acoustical Society of America, Baltimore, Maryland, 19–23 April 2010. *J. Acoust. Soc. Am*. 127(3), 1865–1865

On multi-bubble interactions, Anglo-French Physical Acoustics Conference 10, Kendal, 18–22 January 2010

2009 On multi-bubble interactions, UK Therapeutic Ultrasound Interest Group, University College London, 11 November 2009

The effects of viscoelasticity on the stability of inertial cavitation, 9th International Symposium on Therapeutic Ultrasound, Aix-en-Province, 23–26 September 2009

2008 The effects of nonlinear wave propagation on inertial cavitation, UK Therapeutic Ultrasound Interest Group, University College London, 18 December 2008

The effects of nonlinear wave propagation on inertial cavitation, Anglo-French Physical Acoustics Conference 9, Arcachon, 8–10 December 2008

Integrability, spatially complex localisation and bifurcation of an elastic conducting rod in a uniform magnetic field, University of Surrey, 3 October 2008 *Invited*

Spatially complex localisation of an elastic conducting rod in a uniform magnetic field, Bifurcations in Dynamical Systems with Applications, University of Bielefeld, 19–21 May 2008

2007 The integrability of a conducting elastic rod in a magnetic field, British Applied Mathematics Colloquium, Bristol University, 17–19 April 2007