# Curriculum Vitae: Robert I. Saye

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## Education

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|---|---|
| University of California, Berkeley | 2008–2013 |
| Ph. D. Applied Mathematics | |
| Australian National University (ANU) | 2004–2007 |
| Bachelor of Philosophy (Honours) with First Class Honours | |

## Positions

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|---|---|
| Lawrence Berkeley National Laboratory, *Research Scientist* | 2017–present |
| Lawrence Berkeley National Laboratory, *Luis W. Alvarez Postdoctoral Fellow* | 2013–2017 |
| University of California, Berkeley, *Graduate Student Researcher* | 2008–2013 |
| Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia, *6-month Research Scientist Internship* | 2008 |

## Editorial Roles

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|---|---|
| Co-Editor in Chief, Communications in Applied Mathematics and Computational Science | 2023–present |

## Honours and Awards

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| U.S. Department of Energy Early Career Research Program Awardee | 2021–2026 |
| Honoree, LBNL Director's Awards | 2021 |
| Luis W. Alvarez Postdoctoral Fellowship | 2013–2017 |
| International Science & Engineering Visualization Challenge, Science and NSF Honorable Mention for poster *The Life Cycle of a Bubble Cluster* | 2014 |
| Bernard Friedman Memorial Prize in Applied Mathematics, UC Berkeley | 2013 |
| Cozzarelli Prize, Proceedings of the National Academy of Sciences | 2011 |
| Sir Keith Murdoch Fellowship, American Australian Association | 2011–2012 |
| University Medal in Mathematics, ANU | 2007 |
| Boyapati Computer Science and Mathematics Honours Scholarship, ANU | 2007 |
| Boyapati Computer Science and Mathematics Award, ANU | 2006 |
| Hanna Neumann Prize for Mathematics, ANU | 2006 |
| Bachelor of Philosophy (Honours) Scholarship, ANU | 2004–2006 |

## Research Interests

**Broadly:** numerical methods for multi-phase multi-physics in dynamic, extremely complex geometry; numerical methods for interface dynamics; high-order algorithms; high performance computing

**Examples:** high-order discontinuous Galerkin (DG) methods; high-order algorithms for level set methods and implicitly-defined geometry; scalable and fast multigrid algorithms for elliptic interface problems and multi-phase Stokes problems; high-order quadrature algorithms in complex geometry

## Refereed Journal Articles (Published)

- L. P. Corcos, R. I. Saye, and J. A. Sethian, *A hybrid finite difference level set–implicit mesh discontinuous Galerkin method for multi-layer coating flows*, Journal of Computational Physics, **507**, 112960 (2024) doi:10.1016/j.jcp.2024.112960

- R. I. Saye, *A connected component labeling algorithm for implicitly defined domains*, Communications in Applied Mathematics and Computational Science, **18**(1), 29–54 (2023) 10.2140/camcos.2023.18.29

- R. I. Saye, J. A. Sethian, B. Petrouskie, A. Zatorsky, X. Lu, and R. Rock, *Insights from high-fidelity modeling of industrial rotary bell atomization*, Proceedings of the National Academy of Sciences, **120**(4), e2216709120 (2023) doi:10.1073/pnas.2216709120

- V. Gulizzi and R. Saye, *Modeling wave propagation in elastic solids via high-order accurate implicit-mesh discontinuous Galerkin methods*, Computer Methods in Applied Mechanics and Engineering, **395**, 114971 (2022) doi:10.1016/j.cma.2022.114971

- R. I. Saye, *High-order quadrature on multi-component domains implicitly defined by multivariate polynomials*, Journal of Computational Physics, **448**, 110720 (2022) doi:10.1016/j.jcp.2021.110720

- R. I. Saye, *On two conjectures concerning the ternary digits of powers of two*, Journal of Integer Sequences, **25**(3), 1–9 (2022) pdf

- R. I. Saye, *Fast multigrid solution of high-order accurate multiphase Stokes problems*, Communications in Applied Mathematics and Computational Science, **15**(2), 147–196 (2020) doi:10.2140/camcos.2020.15.33

- R. I. Saye, *Efficient multigrid solution of elliptic interface problems using viscosity-upwinded local discontinuous Galerkin methods*, Communications in Applied Mathematics and Computational Science, **14**(2), 247–283 (2019) doi:10.2140/camcos.2019.14.247

- D. Fortunato, C. H. Rycroft, and R. I. Saye, *Efficient operator-coarsening multigrid schemes for local discontinuous Galerkin methods*, SIAM Journal on Scientific Computing, **41**(6), A3913–A3937 (2019) doi:10.1137/ 18M1206357
  (Fortunato won best student paper prize, 2019 Copper Mountain Conf. on Iter. Methods, with an edited preprint of this paper)

- M. L. Minion and R. I. Saye, *Higher-order temporal integration for the incompressible Navier–Stokes equations in bounded domains*, Journal of Computational Physics, **375**, 797–822 (2018) doi:10.1016/j.jcp.2018.08.054

- R. I. Saye, *Implicit mesh discontinuous Galerkin methods and interfacial gauge methods for high-order accurate interface dynamics, with applications to surface tension dynamics, rigid body fluid-structure interaction, and free surface flow: Part I*, Journal of Computational Physics, **344**, 647–682 (2017) doi:10.1016/j.jcp.2017.04.076

- R. I. Saye, *Implicit mesh discontinuous Galerkin methods and interfacial gauge methods for high-order accurate interface dynamics, with applications to surface tension dynamics, rigid body fluid-structure interaction, and free surface flow: Part II*, Journal of Computational Physics, **344**, 683–723 (2017) doi:10.1016/j.jcp.2017.05.003

- R. I. Saye, *Interfacial gauge methods for incompressible fluid flow*, Science Advances, **2**(6), 1–14 (2016) doi:10.1126/sciadv.1501869

- R. I. Saye and J. A. Sethian, *Multiscale modelling of evolving foams*, Journal of Computational Physics, **315**, 273–301 (2016) doi:10.1016/j.jcp.2016.02.077

- R. I. Saye, *High-order quadrature methods for implicitly defined surfaces and volumes in hyperrectangles*, SIAM Journal on Scientific Computing, **37**(2), A993–A1019 (2015) doi:10.1137/140966290

- R. I. Saye and J. A. Sethian, *The Life Cycle of a Bubble Cluster: Insight from Mathematics, Algorithms, and Supercomputers – 2013 NSF and Science journal International Science and Engineering Visualization Challenge*, Science, **343**(6171), 600–610 (2014) doi:10.1126/science.343.6171.600

- R. I. Saye, *High-order methods for computing distances to implicitly defined surfaces*, Communications in Applied Mathematics and Computational Science, **9**(1), 107–141 (2014) doi:10.2140/camcos.2014.9.107

- R. I. Saye and J. A. Sethian, *Multiscale modeling of membrane rearrangement, drainage, and rupture in evolving*

*foams*, Science, **340**(6133), 720–724 (2013) [doi:10.1126/science.1230623](doi:10.1126/science.1230623)

- R. I. Saye, *An algorithm to mesh interconnected surfaces via the Voronoi interface*, Engineering with Computers, **31**(1), 123–139 (2013) [doi:10.1007/s00366-013-0335-9](doi:10.1007/s00366-013-0335-9)

- R. I. Saye and J. A. Sethian, *Analysis and applications of the Voronoi Implicit Interface Method*, Journal of Computational Physics, **231**(18), 6051–6085 (2012) [doi:10.1016/j.jcp.2012.04.004](doi:10.1016/j.jcp.2012.04.004)

- R. I. Saye and J. A. Sethian, *The Voronoi Implicit Interface Method and computational challenges in multiphase physics*, Milan Journal of Mathematics, **80**(2), 369–379 (2012) [doi:10.1007/s00032-012-0187-6](doi:10.1007/s00032-012-0187-6)

- R. I. Saye and J. A. Sethian, *The Voronoi Implicit Interface Method for computing multiphase physics*, Proceedings of the National Academy of Sciences, **108**(49), 19498–19503 (2011) [doi:10.1073/pnas.1111557108](doi:10.1073/pnas.1111557108)

## Book Chapters

- M. Garzon, R. I. Saye, and J. A. Sethian, *Efficient Algorithms for Tracking Moving Interfaces in Industrial Applications: Inkjet Plotters, Electrojetting, Industrial Foams, and Rotary Bell Painting*, in Chacón Rebollo, T., Donat, R., Higueras, I. (eds), Recent Advances in Industrial and Applied Mathematics, **1**, 173–194 (2022) [doi:10.1007/978-3-030-86236-7_10](doi:10.1007/978-3-030-86236-7_10)

- R. I. Saye and J. A. Sethian, *A review of level set methods to model interfaces moving under complex physics: Recent challenges and advances*, in A. Bonito and R. H. Nochetto (eds.), Geometric Partial Differential Equations - Part I, Handbook of Numerical Analysis, **21**, 509–554 (2020) [doi:10.1016/bs.hna.2019.07.003](doi:10.1016/bs.hna.2019.07.003)

## Conference Proceedings

- J. A. Sethian and R. I. Saye, *Modeling of Paint Atomization in Rotary Bell Spray Painting*, in C. Elliott, H. Garcke, B. Niethammer, G. Simonett (orgs.) Interfaces, Free Boundaries and Geometric Partial Differential Equations. Oberwolfach Reports **8**, 49–52 (2024) [doi:10.14760/OWR-2024-8](doi:10.14760/OWR-2024-8)

- R. I. Saye and J. A. Sethian, *New Interface Methods for Tracking Multiphase Physics*, in F. Ancona, A. Bressan, P. Marcati, A. Marson (eds.) Hyperbolic Problems: Theory, Numerics, Applications. Proceedings of the 14th International Conference on Hyperbolic Problems (Padova, 2012). AIMS Series on Applied Mathematics **8**, 81–87 (2014) [pdf link](pdf link)

- R. I. Saye and J. A. Sethian, *Voronoi Implicit Interfaces: Method and Applications*, in C. M. Elliott, Y. Giga, M. Hinze, V. Styles (eds.) Interfaces and Free Boundaries: Analysis, Control and Simulation. Oberwolfach Reports **10**(1), 867–950 (2013) [doi:10.4171/OWR/2013/15](doi:10.4171/OWR/2013/15)

- R. I. Saye and J. A. Sethian, *Applications of the Voronoi Implicit Interface Method*, in M. Hintermüller, G. Leugering, J. Sokolowski (eds.) Mini-Workshop: Geometries, Shapes and Topologies in PDE-based Applications. Oberwolfach Reports **9**(4), 3375–3415 (2012) [doi:10.4171/OWR/2012/57](doi:10.4171/OWR/2012/57)

## Open-Source Code

- Creator and lead developer, *Algoim – Algorithms for implicitly defined geometry, level set methods, and Voronoi Implicit Interface Methods*, C++ code, [https://algoim.github.io](https://algoim.github.io)