

# CURRICULUM VITAE: ROBERT I. SAYE

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## Education

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

## Positions

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

## Editorial Roles

Co-Editor in Chief, <a href="#">Communications in Applied Mathematics and Computational Science</a>	2023–present
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## Honours and Awards

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 <i>The Life Cycle of a Bubble Cluster</i>	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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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., Higuera, I. (eds), *Recent Advances in Industrial and Applied Mathematics*, **1**, 173–194 (2022) doi:[10.1007/978-3-030-86236-7\\_10](https://doi.org/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](https://doi.org/10.1016/bs.hna.2019.07.003)

### Conference Proceedings

- 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](#)
- 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](https://doi.org/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](https://doi.org/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>