

# CURRICULUM VITAE: ROBERT I. SAYE

Last updated 14 September 2018

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## Education

University of California, Berkeley 2008–2013  
Ph. D. Applied Mathematics  
Advisor: James A. Sethian  
Thesis: *The Voronoi Implicit Interface Method with Applications to Multiphase Fluid Flow and Multiscale Modelling of Foam Dynamics*

The Australian National University (ANU) 2004–2007  
Bachelor of Philosophy (Honours) with First Class Honours  
Specialising in applied mathematics and computational science  
Advisor: Stephen Roberts

## Positions

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), Melbourne, Australia, 2008  
*Full-time research scientist*

## Fellowships and Awards

Luis W. Alvarez Postdoctoral Fellowship 2013–2017  
International Science & Engineering Visualization Challenge, Science and NSF 2014  
Honorable Mention for poster *The Life Cycle of a Bubble Cluster*

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 Undergraduate Scholarship, ANU 2004–2006

## Research Interests

Broadly: evolving interface problems, multi-physics coupling, multi-scale physics, numerical methods  
Specifically: high-order accurate algorithms for implicit interface methods; discontinuous Galerkin methods for incompressible fluid flow; simulation of multiple evolving interfaces coupled to physics; foams, fluid flow, fluid-structure interaction; high performance computing methods, massively parallel simulations, multigrid techniques; level set methods

## Publications

- 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. 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*, *Journal of Computational Physics*
  - *Part I*, **344**, 647–682 (2017) doi:10.1016/j.jcp.2017.04.076
  - *Part II*, **344**, 683–723 (2017) doi:10.1016/j.jcp.2017.05.003
- R. 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
- 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
- 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
- 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
- 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
- R. I. Saye, *A Navier-Stokes Teaching Module* (online); a tutorial on the numerical solution of the incompressible Navier-Stokes equations (2006)

## In 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)
- 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
- 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

## Research Grants

- Principal Investigator – Laboratory Directed Research and Development (LDRD) program, LBNL  
*High-Order Implicit Interface Methods for Complex Fluid Flow and Multiple Interface Dynamics* 2013–2015
- Principal Investigator – High Performance Computing for Manufacturing, US Dept. of Energy,  
*Modeling Paint Behavior During Rotary Bell Atomization*, with PPG Industries, Inc. 2017–2018
- Principal Investigator – High Performance Computing for Manufacturing, US Dept. of Energy,  
*Optimizing Rotary Bell Atomization*, with PPG Industries, Inc. 2018–2019

## News Articles

- [New Math Captures Fluids in Unprecedented Detail](#), Advanced Scientific Computing Research,  
 U.S. Department of Energy Office of Science 26 Aug 2016
- [New Mathematics Accurately Captures Liquids and Surfaces Moving in Synergy](#), LBL Newscenter 10 Jun  
 2016
- [wyborcza Nauka dla każdego \(“Science for everyone”\)](#), a Polish newspaper 16 Jun 2015
- [2013 Visualization Challenge](#), *Science*, **343**(6171) (2014) doi:10.1126/science.343.6171.600 7 Feb 2014
- [Computing Sciences Supported Research Named Among 2013’s Best](#), Berkeley Lab CS News 20 Dec 2013
- [Our favourite pictures of 2013](#), IOP Physics World 18 Dec 2013
- [Multiscale Modeling of Foams](#), SIAM News 1 Nov 2013
- Media releases relating to my Science paper co-authored with J.A.Sethian: May 2013
- [Revealed! The Mysteries of Bubbles – and Clouds Too](#), Time.com
  - [When one bubble pops, why do others form around it? Unlocking a bubble mystery](#), The Washington Post
  - [Physics Get Frothy as Mathematicians Dissect Mister Bubble](#), Scientific American
  - [Pinning down the physics of bubbles](#), Los Angeles Times
  - [Heady mathematics: Describing popping bubbles in a foam](#), Berkeley Newscenter
  - [Mathematics of Popping Bubbles in a Foam](#), LBL Newscenter
  - [ScienceShot: The Life Cycle of a Bubble](#), Science AAAS
  - [Can’t Pop This: Bubble Scientists Reveal the Physics of Soap](#), KQED Science
  - [Unlocking secret lives of bubbles yields perfect foam](#), NewScientist
  - [Working Up a Lather](#), AMS Mathematical Moments
  - [Geplatzte Schäume](#), Wissen & Forschen, page 24, Der Tagesspiegel
- [Berkeley Lab Mathematicians Win Cozzarelli Prize](#), LBL Newscenter 21 Feb 2012

## Professional Activities

- Journal reviewer: Journal of Computational Physics, SIAM Journal on Scientific Computing, Proceedings A,  
 Communications in Applied Mathematics and Computational Science, International Journal of High Perfor-  
 mance Computing Applications, Transactions on Graphics, Eurographics
- American Australian Association (AAA) Fellowship application judge 2016–present
- Member of the Society for Industrial and Applied Mathematics 2008–present