David Salac, Ph.D.

CONTACT INFORMATION

Mechanical and Aerospace Engineering
University at Buffalo SUNY
326 Jarvis Hall
Buffalo, NY, 14260

Voice: (716) 645-1460
E-mail: davidsal@buffalo.edu
Website: www.buffalo.edu/~davidsal

INTERESTS

Computational fluid dynamics, material systems with moving interfaces, numerical methods, directed self-assembly, high performance computing

POSITIONS HELD

University at Buffalo, SUNY, Buffalo, NY **Aug. 2016 to Present**

- Department of Mechanical and Aerospace Engineering
- Associate Professor

University at Buffalo, SUNY, Buffalo, NY **Aug. 2010 to 2016**

- Department of Mechanical and Aerospace Engineering
- Assistant Professor

Northwestern University, Evanston, IL **Sept. 2007 to Aug. 2010**

- Department of Engineering Sciences and Applied Mathematics
- NSF Research and Teaching Grant Postdoctoral Fellow

EDUCATION

University of Michigan, Ann Arbor, MI

Ph.D., Mechanical Engineering, April 2007

- Dissertation: The Directed Self-Assembly of Nanostructures: Electric Pressure, Dipole, Double Layer and Cracking Mechanisms.
- Advisor: Dr. Wei Lu

M.S., Mathematics, January 2007

- Emphasis on numerical analysis.

Michigan Technological University, Houghton, MI

B.S., Mechanical Engineering, May 2002

- *Summa cum Laude*

PUBLICATIONS

1. Gera P. and Salac D. "Three-dimensional multicomponent vesicles: dynamics and influence of material properties", Soft Matter (14), 7690-7705, 2018.
2. Gera P. and Salac D. "Modeling of multicomponent three-dimensional vesicles", Computers & Fluids (172), 362-383, 2018.
3. Gera P. and Salac D. "Stochastic phase segregation on surfaces", Royal Society Open Science 4 (8) 170472, 2017.
4. Gera P. and Salac D. "Cahn–Hilliard on surface: A numerical study", Applied Mathematics Letters 73, 56-61, 2017.
5. Velmurugan G., Kolahdouz E.M., and Salac D. "Level set jet schemes for stiff advection equations: The SemiJet method", Computer Methods in Applied Mechanics and Engineering 310, 233-251, 2016.

6. Salac D. "A general, mass-preserving Navier–Stokes projection method", Computer Physics Communications 204, 97-106, 2016.

7. Aghakhani H., Dalbey K., Salac D. and Patra A. "Heuristic and eulerian interface capturing approaches for shallow water type flow and application to granular flows", Computer Methods in Applied Mechanics and Engineering 304, 243-264, 2016.

8. Kolahdouz E.M. and Salac D. "Electrohydrodynamics of three-dimensional vesicles: A numerical approach", SIAM Journal on Scientific Computing 37 (3), B473-B494, 2015.

9. Kolahdouz E.M. and Salac D. "Dynamics of three-dimensional vesicles in DC electric fields", Physical Review E 92, 012302, 2015.

10. Kolahdouz E.M. and Salac D. "A numerical model for the trans-membrane voltage of vesicles.", Applied Mathematics Letters 39 (1), 7-12, 2015.

11. Vogl, C.J, Miksis, M.J., Davis, S.H, and Salac D. "The effect of glass forming sugars on vesicle morphology and water distribution during drying.", Journal of the Royal Society Interface 99 (11), 20140646, 2014.

12. Kolahdouz E.M. and Salac D. "A semi-implicit gradient augmented level set method", SIAM Journal of Scientific Computing 35 (1), A231-A254, 2013.

13. Salac D. and Miksis M. "Reynolds number effects on lipid vesicles", Journal of Fluid Mechanics 711, 122-146, 2012.

14. Salac D. and Miksis M. "A level set projection model of lipid vesicles in general flows", Journal of Computational Physics 230 (22), 8192-8215, 2011.

15. Salac D. and Lu W. "A local semi-implicit level-set method for interface motion", Journal of Scientific Computing 35 (2-3), 330-349, 2008.

16. Salac D. and Lu W. "Stability and shape evolution of voids and channels due to surface misfit", International Journal of Solids and Structures 45 (13), 3793-3806, 2008.

17. Salac D. and Lu W. "A level set approach to model directed nanocrack patterns", Computational Materials Science 39 (4), 849-856, 2007.

18. Salac D. and Lu W. "Design nanocrack patterns in heterogeneous films", Nanotechnology 17, 5185-5191, 2006.

19. Lu W. and Salac D. "Interactions of metallic quantum dots on a semiconductor substrate", Physical Review B 74 (7), Art. No. 073304, 2006.

20. Salac D. and Lu W. "Ordering of metallic quantum dots", Applied Physics Letters 89 (7), Art. No. 073105, 2006.

21. Salac D. and Lu W. "Controlled nanocrack patterns for nanowires", Journal of Computational and Theoretical Nanoscience 3 (2), 263-268, 2006.

22. Salac D. and Lu W. "Programmable nanoscale domain patterns in multilayers", Acta Materialia 53 (11), 3253-3260, 2005.

23. Lu W. and Salac D. "Patterning multilayers of molecules via self-organization", Physical Review Letters 94 (14), Art. No. 146103, 2005.

24. Salac D., Lu W., Wang C.W. and Sastry A.M. "Pattern formation in a polymer thin film induced by an in-plane electric field", Applied Physics Letters 85 (7), 1161-1163, 2004.

Conference Session Organizer

1. The Modeling of Biological Soft Matter Systems in Fluids, SIAM Conference on Computational Science and Engineering, 2017.
2. Inverse Analysis and Uncertainty Quantification in Fluid Mechanics, SIAM Conference on Computational Science and Engineering, 2015.
3. Vesicles and Inextensible Membranes, SIAM Conference on Mathematical Aspects of Materials Science, 2013.

Invited Colloquium Talks

1. "Three-Dimensional Multicomponent Vesicles: Methods and Influence of Material Properties", Mechanical Engineering, Binghamton University, April 20, 2018.
2. "Three-Dimensional Multicomponent Vesicles: Methods and Influence of Material Properties", Department of Mathematics, University at Wisconsin, April 20, 2018.
3. "Recent Advances in the Modeling of Vesicles in Electric or Magnetic Fields", Department of Mathematics, University at Buffalo SUNY, April 5, 2016.
4. "Vesicles in Electric Fields: A Numerical Investigation", University of Michigan ME Department Seminar, April 7, 2015.
5. "Three-Dimensional Modeling of Vesicle Electrohydrodynamics", Department of Mathematics, University at Buffalo SUNY, April 8, 2014.
6. "Numerical Modeling of Vesicles: Inertial Flow and Electric Fields", Computational Mathematics and Applications Seminar, Mathematical Institute, University of Oxford, UK, May 16, 2013.

Invited Conference and Workshop Talks

1. "Three-Dimensional Multicomponent Vesicles – Methods and Electrohydrodynamics", IMA Workshop on Electrohydrodynamics and Electrodiffusion in Material Sciences and Biology, March 11-16, 2018.
2. "Three-Dimensional Multicomponent Vesicles – Modeling, Results, and Extensions", CMO Workshop on Complex Creeping Flows: Numerical Methods and Theory, Oaxaca, OX, Oct. 2-6, 2017.
3. "Advanced Level Set Jet Methods and Vesicles: Modeling Complex Dynamics", CRM Workshop on Complex Boundary and Interface Problems, Centre de Recherche Mathematique, Montreal, CA, July 4-8, 2016.
4. "Investigation of Liposome Vesicles in Flows and External Fields", Biological Membranes: Modelling, Analysis and Numerics, Department of Mathematics of Imperial College London, Jan. 6-7, 2016.
5. "Vesicles: Influence of External Electric and Magnetic Fields", Magnetically Stimulated Soft Materials, UGA, May 11-13, 2015.
6. "Advances in Vesicle Modeling", FACM 2015, NJIT, June 5-6, 2015.

Conference Presentations

1. Salac D. "Multicomponent Vesicles in Electric Fields", SIAM Conference on the Life Sciences, 2018.
2. Gera P. and Salac D. "Three-Dimensional Multicomponent Vesicles – Methods and Dynamics", SIAM Conference on Mathematical Aspects of Material Science, 2018.

3. Gera P. and Salac D. “Three-Dimensional Hydrodynamics of Multicomponent Vesicles”, Annual Meeting of the Applied Physical Society Division of Fluid Dynamics, 2017.

4. Salac D. “Soft Matter and Fluids: An Overview and Challenges”, SIAM Conference on Computational Science and Engineering, 2017.

5. Gera P. and Salac D. “Domain Dynamics of Lipid Vesicle Membranes”, SIAM Conference on Life Sciences, 2016.

6. Salac D. “Electro-Magneto-Hydrodynamics of Vesicles”, SIAM Annual Meeting, 2016.

7. Salac D. and Gera P. “Recent Advances in Modeling of Liposomes in Electric and Magnetic Fields”, SIAM Conference on Mathematical Aspects of Materials Science, 2016.

8. Gera P. and Salac D. “Electrohydrodynamics Of Multicomponent Vesicles”, Annual Meeting of the Applied Physical Society Division of Fluid Dynamics, 2015.

9. Salac D., “Magnetohydrodynamics of Vesicles”, Annual Meeting of the Applied Physical Society Division of Fluid Dynamics, 2015.

10. Salac D., Kolahdouz E.M., Gera P. “Electrohydrodynamics of Three-Dimensional Vesicles”, 89th ACS Colloid and Surface Science Symposium.

11. Salac D. “Liposome Vesicles in the Presence of Uncertainty”, 2015 SIAM Conference on Computational Science and Engineering.

12. Salac D. and Kolahdouz E.M. “Three Dimensional Vesicle Electrohydrodynamics: A Numerical Investigation”, 2014 SIAM Conference on the Life Sciences.

13. Salac D. and Kolahdouz E.M. “Three-Dimensional Vesicle Electrohydrodynamics: A Level Set Method”, 2014 SIAM Annual Meeting.

14. Salac D. and Kolahdouz E.M. “Level Set Jet Schemes for Stiff Advection Equations”, Annual Meeting of the Applied Physical Society Division of Fluid Dynamics, 2013.

15. Kolahdouz E.M. and Salac D. “Electrohydrodynamics of Three-Dimensional Vesicles”, Annual Meeting of the Applied Physical Society Division of Fluid Dynamics, 2013.

16. Seifi S. and Salac D. “Phase-Field Modeling of Lipid Vesicles With Pores”, Annual Meeting of the Applied Physical Society Division of Fluid Dynamics, 2013.

17. Gera P. and Salac D. “Three-Dimensional Immersed Interface Method Based Vesicle Simulations”, Annual Meeting of the Applied Physical Society Division of Fluid Dynamics, 2013.

18. Salac D., Kolahdouz E.M., and Prerna G. “Three Dimensional Vesicles in Fluid Flow and Electric Fields: Jump Conditions and a Numerical Method”, SIAM Conference on Mathematical Aspects of Materials Science, 2013.

19. Salac D., Kolahdouz E.M., and Prerna G., “Sharp Interface Three-Dimensional Electrohydrodynamic Vesicle Simulations: Formulation and Numerical Methods”, SES 50th Annual Technical Meeting, 2013.

20. Salac D. “An Augmented Fast Marching Method for Level Set Reinitialization”, SIAM Conference on Computational Science and Engineering, 2013.

21. Kolahdouz E.M. and Salac D. "A Semi-implicit Gradient-augmented Level Set Method", SIAM Conference on Computational Science and Engineering, 2013.

22. Salac D. and Gera P. "Jump Conditions for the Stokes Equations with Discontinuous Viscosity and an Incompressible Interface with Singular Forces in 3D", Annual Meeting of the Applied Physical Society Division of Fluid Dynamics, 2012.

23. Vogl C., Miksis M., Davis S., and Salac D. "Modeling Cell Desiccation with Glass Formation", Annual Meeting of the Applied Physical Society Division of Fluid Dynamics, 2012.

24. Kolahdouz E.M. and Salac D. "Diffusion of molecules along incompressible interfaces due to electric fields", Annual Meeting of the Applied Physical Society Division of Fluid Dynamics, 2012.

25. Salac D. and Gera P. "Jump Conditions for the Stokes Equations with Discontinuous Viscosity and an Incompressible Interface with Singular Forces in 3D." AMS Fall Eastern Sectional Meeting, Rochester, NY, 2012.

26. Salac D. "The Augmented Fast Marching Method for Level Set Reinitialization". Annual Meeting of the Applied Physical Society Division of Fluid Dynamics, 2011.

27. Salac D. and Miksis M. "The Behavior of Lipid Vesicles in Finite Reynolds Number Flows: The Numerical Method and Results". International Council for Industrial and Applied Mathematics Meeting 2011.

28. Salac D. and Miksis M. "Reynolds Number Effects on the Behavior of Lipid Vesicles". Annual Meeting of the Applied Physical Society Division of Fluid Dynamics, 2010.

29. Salac D. and Miksis M. "Dynamic Behavior of Lipid Vesicles in Viscous Flows". AMS Spring Eastern Sectional Meeting, 2010.

30. Salac D. and Miksis M. "Level set modeling of lipid bilayer vesicles". Material Research Society Fall Meeting, 2009.

31. Salac D. and Miksis M. "A novel computational method to determine the dynamics of a lipid bilayer vesicle in a viscous flow". Annual Meeting of the Applied Physical Society Division of Fluid Dynamics, 2009.

32. Salac D. and Chopp D. "Fast marching method for adaptive non-graded Cartesian grids". Society of Industrial and Applied Mathematics Annual Meeting, 2008.

33. Salac D. "Fast marching methods: Time advancement and non-graded Cartesian grids". Applied Mathematics Colloquium, Engineering Sciences and Applied Mathematics, Northwestern University, 2008.

34. Salac D. and Lu W. "Simulation of directed nanocrack patterns for the fabrication of nanowires". Material Research Society Fall Meeting, 2006.

Conference Publications

1. Salac, D. and Lu W. "Self-assembly of metallic quantum dots". International Mechanical Engineering Congress and Exposition 2007 11, 1163-1167, 2008.

2. Salac, D. and Lu W. "Self-organized multilayers via a dipole interaction mechanism". Proceedings of the ASME Material Division 100, 285-290, 2005.

3. Salac, D. and Lu W. "Irradiation-induced defect self-organization". Proceedings of the ASME Applied Mechanics Division 256, 471-474, 2005.

4. Salac, D. and Lu W. "Instability induced by near-substrate electric field". Nanoscale Materials and Modeling-Relations among Processing, Microstructure and Mechanical Properties 821, 49-53, 2004.

Current Graduate Students

University at Buffalo, SUNY, Buffalo, NY

- Afsoun Rahnama Falavarjani **Sept. 2016 to Present**
  Ph.D Student.
- Paria Mir Hashemian **Sept. 2017 to Present**
  Ph.D Student.
- Shivam **May 2018 to Present**
  Masters student

Past Graduate Students

- Prerna Gera **Sept. 2010 to May 2017**
  Ph.D Student. Modeling of vesicles in three dimensions using the level set and immersed interface method.
- Ebrahim Mohammad Kolahdouz **Sept. 2010 to Feb. 2015**
  Ph.D. Student. Topic was the motion of lipids on vesicle membranes due to flow and electric fields.
- Saman Seifi **Sept. 2012 to Aug. 2014**
  Masters Student. Topic was electric field induced poration of lipid membranes.
- Mohammed Kazemi **Jan. 2014 to 2015**
  Masters Project Student. Topic is modeling of structuring of colloidal particles on droplet surfaces due to electric fields. Expected graduation: June 2015.
- Guhan Velmurugan **Sept. 2014 to 2015**
  Masters Thesis Student. Topic is advanced level set methods. Expected graduation: June 2015.
- Umang Narendrakumar Patel **Sept. 2017 to July 2018**
  Masters Student.

Undergraduate Students Supervised

Northwestern University, Evanston, IL

- Kai Hayashi **June 2009 to Aug. 2009**
  Solution of the linear systems arising in numerical solution of the full Navier-Stokes equations.
- Christine Nguyen **Sept. 2007 to May 2008**
  Aided in extension of fast-marching method to level-set time-advancement.

University of Michigan, Ann Arbor, MI

- Chen-Yue Zhang **May 2007 to Aug. 2007**
  Experiment investigation of temperature induced structure formation in thin polymer films.

High School Students Supervised

- Myers Weidner **July 2014**

  Part of the BEAM/SES Summer Research Program. Investigated vesicle dynamics.

- Liam Weidner **July 2013**

  Part of the BEAM/SES Summer Research Program. Investigated scientific computing technique using C.

Teaching Experience

University at Buffalo, SUNY, Buffalo, NY **Aug. 2010 to Present**

- Thermodynamics

  Sophomore level course covering introductory topics in thermodynamics such as the First and Second Laws of Thermodynamics, thermodynamics properties, and physical applications such as internal combustion engines. An online verion of the course was developed in 2015 and will be offered yearly thereafter.

- Numerical Methods for Moving Interfaces

  Graduate level course covering numerical methods to model moving interfaces. Methods covered include marker particle, level set, volume of fluid, and phase field methods. Advance topics related to recent research is also covered.

- Intro To Numerical Mathematics For Data Scientists

  Graduate level course introducing linear algebra and numerical methods.

- Engineering Computations

  This is a course in Linear Algebra and a first course in programming using MATLAB. Upon completion of this course students should have a firm grasp of important topics in Linear Algebra and their application in engineering contexts as well as programming skills in MATLAB, including array manipulation, loop and branching structures, user-defined functions, and plotting.

Northwestern University, Evanston, IL **Sept. 2007 to Aug. 2010**

- Introductory Linear Algebra and Matlab

  Introduce freshman to linear algebra, including matrix inverse, solution sets, projections, and least squares. Also introduce students to programming using Matlab. Most students have no previous programming experience.

- Multi-variable Integration and Vector Calculus

  Integration techniques covered included double, triple and surface integrals in polar, cylindrical and spherical coordinates. Vector calculus topics included line integrals, Green's Theorem, Surface integrals, Divergence Theorem and Stokes' Theorem.

- Introduction to Ordinary Differential Equations

  Introduces methods to solve ordinary differential equations and first-order systems of ordinary differential equations. The methods are then used to solve engineering applications.

- Numerical Methods for Ordinary Differential Equations

  Introduces numerical methods to solve first-order ordinary differential equations and first-order systems of ordinary differential equations. The methods are then used to solve engineering applications.

- Honors Introduction to Ordinary Differential Equations

  Introduces methods to solve ordinary differential equations and first-order systems of ordinary differential equations. The methods are then used to solve engineering applications. This class is for students in the Honors sequence.

- Numerical Methods for Moving Interfaces

  Graduate level course covering numerical methods to model moving interfaces. Methods covered include marker particle, level set, volume of fluid, and phase field methods.

University of Michigan, Ann Arbor, MI **Sept. 2004 to May 2005**

- Junior Level Laboratory

  Weekly experiments designed to introduce students to the basics of experimentation, instrumentation, data collection, error analysis and reporting. Topics ranged from fluid mechanics to dynamical systems.

Service

University at Buffalo, SUNY, Buffalo, NY **Aug. 2010 to Present**

- Mechanical and Aerospace Engineering Director of Graduate Studies, 2015-Current.
- Undergraduate Mentor for University at Buffalo Engineering Class of 2017-2021.
- Mechanical and Aerospace Engineering Graduate Committee 2013-2015.
- Mechanical and Aerospace Engineering Faculty Search Committee, 2013-2018.
- Department of Mechanical and Aerospace Engineering Seminar Series co-chair, 2012-2013.
- Referee for Transactions on Biomedical Engineering, Journal of Computational Physics, Surface Science, Journal of Applied Physics, Computer Physics Communications, Journal of The Electrochemical Society, Journal of Fluid Mechanics, PLOS ONE, Langmuir, and SIAM Journal on Numerical Analysis.
- Reviewer for Western New York Prosperity Scholarship.
- NSF Panelist in 2012-2018.

Northwestern University, Evanston, IL **July 2008, July 2009**

- RTG Outreach

  Give short talks to underprivileged students from the Chicago area. These talks outline research currently being performed and how mathematics are used to perform the research.

University of Michigan, Ann Arbor, MI **Jan. 2005 to Aug. 2007**

- Graduate Student Mentor for Undergraduate Students

  Train and assist undergraduate students with individual research topics. Activities included fabrication of spin coating device, experimental investigation of self-assembly processes, and creation of an educational database.

- Engineering Graduate Symposium,

  Experimental Mechanics of Material Session Chair

Professional Membership	APS, SIAM, ACS
Awards	**University at Buffalo** • Early Career Teacher of the Year, 2015. **National Science Foundation** • Pan-American Advanced Studies Institute Fellow, 2006 • Graduate Research Fellowship Honorable Mention, 2004