

BRYAN E. SCHMIDT

CURRICULUM VITAE (3/8/2023)

EDUCATION

Ph.D., Aeronautics (2016)

California Institute of Technology, Pasadena, CA

M.S., Aeronautics (2012)

California Institute of Technology, Pasadena, CA

B.S., *summa cum laude*, Aerospace and Mechanical Engineering (2011)

Case Western Reserve University, Cleveland, OH

PROFESSIONAL APPOINTMENTS

Assistant Professor (2020-present)

Mechanical and Aerospace Engineering

Case Western Reserve University, Cleveland, OH, USA

Summer Faculty Fellow (2022)

Naval Surface Warfare Center, Carderock Division, Bethesda, MD, USA

Summer Faculty Fellow (2020)

Optics and Photonics Branch

NASA Glenn Research Center, Cleveland, OH, USA

Postdoctoral Researcher (2016-2019)

Mechanical and Aerospace Engineering

Ohio State University, Columbus, OH, USA

PROFESSIONAL MEMBERSHIPS

- American Institute of Aeronautics and Astronautics (AIAA)
- American Physical Society (APS)

AWARDS AND HONORS

- IOP Publishing Outstanding Reviewer Award (2022)
- Case School of Engineering Undergraduate Teaching Award (nominated, 2022)
- John S. Diekhoff Award for Distinguished Graduate Student Teaching (nominated, 2022)
- John S. Diekhoff Award for Distinguished Graduate Student Mentoring (nominated, 2022)
- Invited Seminar: “Applications of Optical Flow: Velocimetry and Visualization,” Penn State University Fluid Dynamics Research Consortium (Feb. 3, 2022)
- Invited Lecture: “Computing high-resolution BOS images with optical flow,” AIAA Scitech Forum (2022)
- Srinivasa P. Gutti Memorial Teaching Award (nominated, 2021)
- Senior Member, AIAA (2020)

- 2019 AIAA Aerodynamic Measurement Technologies Best Paper Award from the 2019 AIAA SciTech Forum (2019)
- 2015 AIAA Ground Testing Best Paper Award from the 2015 AIAA Aviation Forum (2015)
- Foster and Coco Stanback STEM Fellowship, Caltech (2014-15)
- Engineering and Applied Science Division Discovery Fellowship, Caltech (2014-15)

PUBLICATIONS

1. N. S. Howard, A. Alrefaie, N. A. Mejia, T. Ugbeye, and **B. E. Schmidt**, “Characterizing Aerosol Generating Procedures with Background Oriented Schlieren,” *Journal of Biomechanical Engineering*, 2023. doi: 10.1115/1.4062191
2. J. P. Molnar, L. Venkatakrishnan, **B. E. Schmidt**, T. A. Sipkens and S. J. Grauer, “Estimating density, velocity, and pressure fields in supersonic flows using physics-informed BOS,” *Experiments in Fluids*, 2023, vol. 64, no. 14. doi: 10.1007/s00348-022-03554-y
3. N. A. Mejia and **B. E. Schmidt**, “Experimental Investigation of Flow Interaction Dynamics in Supersonic Retropropulsion,” *Journal of Spacecraft and Rockets*, 2022, vol. 59 no. 5, pp. 1753-1762. doi: 10.2514/1.A35228
4. T. S. Gevelber, **B. E. Schmidt**, M. A. Mustafa, D. Shekhtman, and N. J. Parziale, “Determining Velocity from Tagging Velocimetry Images Using Optical Flow,” *Experiments in Fluids*, 2022, vol. 63 no. 104. doi: 10.1007/s00348-022-03448-z
5. **B. E. Schmidt** and J. A. Sutton, “Evaluation of a wavelet-based optical flow method for planar velocimetry using scalar fields,” *Experiments in Fluids*, 2022, vol. 63 no. 58. doi: 10.1007/s00348-022-03403-y
6. **B. E. Schmidt**, W. E. Page, and J. A. Sutton, “On the application of the Abel transformation in statistically axisymmetric turbulent flows,” *AIAA Journal*, 2022, vol. 60, no.4, pp. 2169-2177. doi: 10.2514/1.J060819
7. E. Kucukal, Y. Man, U. A. Gurkan, and **B. E. Schmidt**, “Blood flow velocimetry in a microchannel during coagulation using PIV and wOFV,” *Journal of Biomechanical Engineering*, 2021, vol. 143 no. 9. doi 10.1115/1.4050647.
8. **B. E. Schmidt** and M. R. Woike, “Wavelet-based Optical Flow Analysis (wOFA) for Background Oriented Schlieren (BOS) Image Processing,” *AIAA Journal*, 2021. doi 10.2514/1.J060218.
9. **B. E. Schmidt** and J. A. Sutton, “A Physical Interpretation of Regularization for Optical Flow Methods in Fluids,” *Experiments in Fluids*, 2021, vol. 62 no. 34. doi 10.1007/s00348-021-03147-1.
10. **B. E. Schmidt**, A. W. Skiba, S. D. Hammack, C. D. Carter, and J. A. Sutton, “High-resolution velocity measurements in turbulent premixed flames using wavelet-based optical flow velocimetry (wOFV),” *Proceedings of the Combustion Institute*, 2021, doi 10.1016/j.proci.2020.07.028.
11. **B. E. Schmidt** and J. A. Sutton, “Evaluation of Gas- and Particle-Phase Separation Methods for Velocity Measurements in Multiphase Flows,” *Experiments in Fluids*, 2020, vol. 61 no. 12. doi 10.1007/s00348-020-03082-7.
12. **B. E. Schmidt** and J. A. Sutton, “Improvements in the accuracy of wavelet-based optical flow velocimetry (wOFV) using an efficient and physically based

- implementation of velocity regularization,” *Experiments in Fluids*, 2020, vol. 61 no. 2. doi 10.1007/s00348-019-2869-0.
13. **B. E. Schmidt** and J. E. Shepherd, “Stability of Supersonic Flow with Injection,” *AIAA Journal*, 2019, vol. 57 no. 12. doi 10.2514/1.J058080.
 14. **B. E. Schmidt** and J. A. Sutton, “High-resolution velocimetry from tracer particle fields using a wavelet-based optical flow method,” *Experiments in Fluids*, 2019, vol. 60 no. 37. doi 10.1007/s00348-019-2685-6.
 15. **B. E. Schmidt** and J. E. Shepherd, “Oscillations in cylinder wakes at Mach 4,” *Journal of Fluid Mechanics*, 2015, vol. 785. doi 10.1017/jfm.2015.668.
 16. **B. E. Schmidt** and J. E. Shepherd, “Analysis of focused laser differential interferometry,” *Applied Optics*, 2015, vol. 54 issue 28, pp. 8459-8472.
 17. **B. E. Schmidt**, N. P. Bitter, H. G. Hornung, and J. E. Shepherd, “Injection into supersonic boundary layers,” *AIAA Journal*, 2015. doi 10.2514/1.J054123.

CONFERENCE PAPERS AND PRESENTATIONS

1. G. R. Jassal and **B. E. Schmidt**, “Accurate Near Wall Measurements in Wall Bounded Flows with wOFV via an Explicit No-Slip Boundary Condition,” *Proceedings of the AIAA Scitech Conference*, National Harbor, MD, January 2023.
2. J. A. Dobrosotskaya, A. Alrefaie and **B. E. Schmidt**, “A Quantitative Comparison of Background Oriented and Conventional Schlieren Visualization,” *Proceedings of the AIAA Scitech Conference*, National Harbor, MD, January 2023.
3. N. A. Mejia and **B. E. Schmidt**, “ATLAS: Assistive Tool for seLf-Aligning Schlieren,” *Proceedings of the AIAA Scitech Conference*, National Harbor, MD, January 2023.
4. **B. E. Schmidt**, N. Sperlein, X. Deng, C. Hsiao, and G. Chahine, “Bubble collapse analysis and reentrant jet velocity measurements using wOFV,” *APS Division of Fluid Dynamics meeting*, Indianapolis, IN, November 2022.
5. G. R. Jassal, J. A. Dobrosotskaya, and **B. E. Schmidt**, “Optical Flow Velocimetry Using a Quasi-Optimal Basis with Implicit Regularization,” *Proceedings of the AIAA Aviation Forum*, Chicago, IL, June 2022.
6. A. Pandey, **B. E. Schmidt**, and K. M. Casper, “Demonstration of Internal-Digital Image Correlation (Internal-DIC) for Fluid-Structure Interaction Measurements in a Hypersonic Wind Tunnel,” *Proceedings of the AIAA Aviation Forum*, Chicago, IL, June 2022.
7. W. Huang, R. D. Quinn, **B. E. Schmidt**, and K. C. Moses, “Surrogate Modeling for Optimizing the Wing Design of a Hawk Moth Inspired Flapping-Wing Micro Air Vehicle,” *Proceedings of the Living Machines Conference*, July 2022.
8. N. A. Mejia, J. G. Smith, W. R. Stenta, B. McN. Maxwell, and **B. E. Schmidt**, “Numerical investigation of aerodynamic interference in supersonic retropropulsion,” *Proceedings of the AIAA Scitech Conference*, San Diego, CA, January 2022.
9. **B. E. Schmidt**, W. E. Page, I. Trueba-Monje, and J. A. Sutton, “Seedless velocimetry in reacting flows using OH PLIF imaging and a wavelet-based optical flow method,” *Proceedings of the AIAA Scitech Conference*, San Diego, CA, January 2022.

10. A. Alrefaie and **B. E. Schmidt**, “Visualization of the flow generated by human exhalation during jet ventilation using background-oriented schlieren (BOS),” *APS Division of Fluid Dynamics meeting*, Phoenix, AZ, November 2021.
11. K. Clancy, A. Alrefaie, **B. E. Schmidt**, N. Maronian, and N. S. Howard, “Background-Oriented Schlieren Imaging During Jet Ventilation Models Aerosolization During COVID-19,” *Laryngology/Broncho-Esophagology. Otolaryngology–Head and Neck Surgery*. Presented at the AAO-HNSF Annual Meeting, Los Angeles, CA, October 2021. doi 10.1177/01945998211030908e.
12. N. A. Mejia and **B. E. Schmidt**, “Experimental Investigation of Flow Interaction Dynamics in Supersonic Retropropulsion,” *Proceedings of the AIAA Scitech Conference*, Nashville, TN, January 2021. doi 10.2514/6.2021-0941.
13. T. S. Gevelber, **B. E. Schmidt**, M. A. Mustafa, D. Shekhtman, and N. J. Parziale, “Wavelet-based Optical Flow Velocimetry (wOFV) Applied to Tagging Velocimetry Data,” *Proceedings of the AIAA Scitech Conference*, Nashville, TN, January 2021. doi 10.2514/6.2021-0121.
14. **B. E. Schmidt**, W. E. Page, and J. A. Sutton, “Sensitivity of Wavelet-based Optical Flow (wOFV) to Sources of Error,” *Proceedings of the AIAA Scitech Conference*, Nashville, TN, January 2021. doi 10.2514/6.2021-0123.
15. E. Kucukal, Y. Man, U. A. Gurkan, and **B. E. Schmidt**, “Blood flow velocimetry in a microchannel during coagulation using PIV and wOFV,” *Proceedings of the ASME IMECE Conference*, Portland, OR, November 2020. doi 10.1115/IMECE2020-24173
16. W. E. Page, **B. E. Schmidt**, and J. A. Sutton, “Experimental Assessment of Wavelet-based Optical Flow Velocimetry (wOFV) as Applied to Tracer Particle Images from Free Shear Flows,” *Proceedings of the AIAA Scitech Conference*, Orlando, FL, January 2020. doi 10.2514/6.2020-1022.
17. **B. E. Schmidt**, W. E. Page, and J. A. Sutton, “Seedless Velocimetry in a Turbulent Jet using Schlieren Imaging and a Wavelet-based Optical Flow Method,” *Proceedings of the AIAA Scitech Conference*, Orlando, FL, January 2020. doi 10.2514/6.2020-2207.
18. **B. E. Schmidt**, A. W. Skiba, J. F. Driscoll, S. D. Hammack, C. D. Carter, and J. A. Sutton, “High-resolution velocimetry in turbulent premixed flames using a wavelet-based optical flow technique,” *Proceedings of the 11th U.S. National Combustion Meeting*, Pasadena, CA, March 2019.
19. **B. E. Schmidt**, C. A. Z. Towery, P. E. Hamlington, and J. A. Sutton, “Evaluation of Wavelet-Based Optical Flow Velocimetry from OH Scalar Fields in Reacting Turbulent Flows,” *Proceedings of the AIAA Scitech Conference*, San Diego, CA, January 2019. doi 10.2514/6.2019-0270.
20. C. A. Z. Towery, **B. E. Schmidt**, J. A. Sutton, and P. E. Hamlington, “Benchmark Direct Numerical Simulations with Lagrangian Tracers for Evaluating Combustion Diagnostics Algorithms,” *Proceedings of the AIAA Scitech Conference*, San Diego, CA, January 2019. doi 10.2514/6.2019-0836.
21. **B. E. Schmidt** and J. A. Sutton, “Performance Characteristics of a Wavelet-Based Optical Flow Method for Velocimetry from Tracer Particle Images,” *APS Division of Fluid Dynamics meeting*, Atlanta, GA, November 2018.

22. **B. E. Schmidt** and J. A. Sutton, “High-Resolution Velocimetry from Tracer Particle Fields Using Wavelet-based Optical Flow,” *Proceedings of the AIAA Scitech Conference*, Kissimmee, FL, January 2018. doi 10.2514/6.2018-1767.
23. **B. E. Schmidt** and J. A. Sutton, “Towards seedless velocimetry in reacting flows using a wavelet-based optical flow technique,” *Proceedings of the 10th U.S. National Combustion Meeting*, College Park, MD, April 2017.
24. **B. E. Schmidt** and J. E. Shepherd, “Measurements of instability in supersonic flow with injection by time-resolved flow visualization,” *Proceedings of the AIAA SciTech Conference*, San Diego, CA, January 2016. doi 10.2514/6.2016-0599.
25. **B. E. Schmidt** and J. E. Shepherd, “Analysis of focused laser differential interferometry,” *Proceedings of the AIAA Aviation Conference*, Dallas, TX, June 2015. doi 10.2514/6.2015-2246.
26. N. J. Parziale, **B. E. Schmidt**, J. S. Damazo, P. S. Wang, H. G. Hornung, and J. E. Shepherd, “Pulsed laser diode for use as a light source for short-exposure, high-frame-rate flow visualization,” *Proceedings of the AIAA SciTech Conference*, Kissimmee, FL, January 2015. doi 10.2514/6.2015-0530.
27. **B. E. Schmidt**, N. P. Bitter, H. G. Hornung, and J. E. Shepherd, “Experimental investigation of gas injection into the boundary layer on a slender body in supersonic flow,” *Proceedings of the AIAA Aviation Conference*, Atlanta, GA, June 2014. doi 10.2514/6.2014-2496.
28. **B. E. Schmidt**, B. D. Bobbitt, N. J. Parziale, and J. E. Shepherd, “Experiments in a combustion-driven shock tube with an area change,” *Proceedings of the 29th International Symposium on Shock Waves*, Madison, WI, July 2013. Paper 0044. doi 10.1007/978-3-319-16835-7_51.

RESEARCH SUPPORT

- **Awarded**
 - AFOSR, 2023-2025. Young Investigator Program (YIP): “Effect of Particulates and Nose Bluntness on Hypervelocity Boundary Layer Transition,” PI, 1 month summer. Total direct costs: \$298,521.
 - NSF, 2022-2024. “EAGER: Maximizing Spatial Resolution and Accuracy of PIV with Optical Flow Velocimetry,” PI, 0.5 months summer. Total direct costs: \$174,463
 - ONR, 2023-2025. Young Investigator Program (YIP): “Water Entry of Hypervelocity Projectiles,” PI, 1.5 months summer. Total direct costs: \$502,416.
 - AFOSR, 2022. Defense University Research Instrumentation Program (DURIP): “Two Stage Light Gas Gun for Research on Hypervelocity Base Flows,” PI, equipment only. Total direct costs: \$293,500.
 - NSF, 2022-2025. “Collaborative Research: Physics-Informed Background-Oriented Schlieren Tomography of Wildfire-Relevant Combustion,” co-PI, 0.25 months summer. Total direct costs: \$172,357.
 - AFOSR, 2022-2025. “Stagnation Point Injection in Hypersonic Flows,” PI, 1 month summer. Total direct costs: \$550,872.
 - CWRU, 2022. CAS Expanding Horizons Initiative: “Do Insects Sniff with their Wings?” co-PI, Total direct costs: \$30,000.

- NIH, 2022-2024. R21 Trailblazer: “Background Oriented Schlieren for Evaluation of Aerosol Generating Procedures,” PI, 2.2% AY plus 1.5 months summer. Total direct costs: \$388,681.
- Sandia National Laboratories, 2021. “Panel Deformation Measurements in Hypersonic Flight,” PI, 3.5% AY plus 1 month summer. Total direct costs awarded: \$18,541.
- **Pending Review**
 - NIH, 2022-2025. “STTR: Assessing the Performance of Modular, Multi-Functional Anesthesia Oxygen Mask in Reducing Respiratory Particle Transmission Across a Range of Aerosol Generating Procedures (AGPs),” co-PI, 1.5 months summer. Total direct costs: \$656,412.
 - NIH, 2022-2023. “Predicating the optimal treatment of patient specific aneurysms with living bioprinted constructs,” co-PI, 0.66 months summer. Total direct costs: \$40,968.
- **Not Awarded**
 - NSF, 2023-2027. “CAREER: Characterizing Turbulent Flow Separation with High Resolution Velocimetry,” PI, 1 month summer. Total direct costs: \$328,402.
 - ONR, 2023. Defense University Research Instrumentation Program (DURIP): “Two stage light gas gun for hypersonic aerodynamics and hypervelocity water impacts research,” PI, equipment only. Total direct costs: \$306,400.
 - ONR, 2022. Defense University Research Instrumentation Program (DURIP): “Two Stage Light Gas Gun for Research on Hypervelocity Water Impacts,” PI, equipment only. Total direct costs: \$293,500.
 - ONR, 2022-2025. Young Investigator Program (YIP): “Water Entry of Hypervelocity Projectiles,” PI, 1.5 months summer. Total direct costs: \$358,214. (submitted twice, once for 2021 and once for 2022)
 - NIH, 2022-2025. STTR: “Assessing the Performance of Modular, Multi-Functional Anesthesia Oxygen Mask in Reducing Respiratory Particle Transmission Across a Range of Aerosol Generating Procedures (AGPs),” co-PI, 1.5 months summer. Total direct costs: \$620,687.
 - NASA, 2022-2025. Early Stage Innovations (ESI): “Analysis of Flow Dynamics in Supersonic Retropropulsion,” PI, 1 month summer. Total direct costs: \$381,709.
 - AFOSR, 2022-2024. Young Investigator Program (YIP): “Effect of Aerothermochemistry on Turbulence in Hypervelocity Base Flows,” PI, 1 month summer. Total direct costs: \$329,270.
 - DARPA, 2021-2024. Young Faculty Award (YFA): “Three-dimensional Force Measurements in a High Enthalpy Shock Tunnel using Optical Flow,” PI, 1 month summer (Years 1-2), 1.5 months summer (Year 3). Total direct costs: \$557,647.
 - NSF, 2021-2024. “Microscale flow dynamics in hemostasis and blood coagulation,” PI, 0.4 months summer. Total direct costs: \$285,966.
 - NASA, 2020-2023. Early Career Faculty (ECF): “Three-dimensional, High Resolution Flow Visualization and Velocimetry in High Enthalpy

Hypersonic Facilities using Two-Camera Plentoptic Background Oriented Schlieren (BOS),” PI, 1 month summer. Total direct costs: \$440,774.

TEACHING

- **Case Western Reserve University**
 - o EMAE 251: Thermodynamics (Spring 2020, Spring 2021, Spring 2022)
 - o EMAE 359: Aero/Gas Dynamics (Spring 2023)
 - o EMAE 453: Advanced Fluid Dynamics (Fall 2020, Fall 2021, Fall 2022)
 - o EMAE 554: Turbulent Fluid Motion (Spring 2023)

ADVISING

- **PhD students**
 - o Nicholas Mejia. PhD candidate. Expected degree date: 2025.
 - o Abdulaziz Alrefaie. Pre-candidacy. Expected degree date: 2025.
 - o Gauresh Raj Jassal. PhD candidate. Expected degree date: 2026.
 - o Joshua Smith. PhD candidate. Expected degree date: 2025.
 - o Abbeigh Schroeder. Pre-candidacy. Expected degree date: 2027.
- **MS students**
 - o Chloe Kenet. Expected degree date: 2023.
 - o Alexander Savadelis. Expected degree date: 2023.
 - o Vincent Russo. Expected degree date: 2023.
 - o David Walker. Expected degree date: 2024.
 - o Zhuoqing Song. Expected degree date: 2024.

PROFESSIONAL SERVICE

- **Technical Committee Member**
 - o Aerodynamic Measurement Technology technical committee, AIAA (2021 – present).
- **Peer reviewer**
 - o *AIAA Journal, Journal of Fluid Mechanics, Journal of Spacecraft and Rockets, Combustion and Flame, Journal of Measurement, Experiments in Fluids, Applied Optics, Journal of Visualization, Optics Letters, Experimental Thermal and Fluid Science, Journal of Thermophysics and Heat Transfer, IEEE Sensors Journal, Measurement Science and Technology, Frontiers Bioengineering, Review of Scientific Instruments*
- **Conference session chair**
 - o US National Combustion Meeting (2019), AIAA Scitech (2023)

UNIVERSITY SERVICE

- Member of CSE Undergraduate Studies committee (Fall 2020 – Fall 2022)
- Member of EMAE department Graduate Studies committee (Fall 2022 – present)
- Member of EMAE department Undergraduate Studies committee (Fall 2020 – Fall 2022)
- Thesis committee member:
 - o Masters Degree:
 - Scott Karn (2021)

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- Grace Floring (2022)
- Enna van den Akker (2022)
- Arland Zatania-Lojo (2022)
- PhD:
 - Utku Goerke (2022)
 - Mohnish Peswani (2023)