

Christopher S. Combs

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EDUCATION

The University of Texas at Austin, Austin, TX August 2015
Ph.D. Aerospace Engineering

University of Evansville, Evansville, IN May 2010
B.S. Mechanical Engineering

RESEARCH EXPERIENCE

The University of Texas at San Antonio, San Antonio, TX August 2018-*Present*
Assistant Professor, Dee Howard Faculty Fellow

The University of Tennessee Space Institute, Tullahoma, TN August 2015-August 2018
Research Assistant Professor

The University of Texas at Austin, Austin, TX June 2010-August 2015
Graduate Research Assistant

NASA Langley Research Center, Hampton, VA June 2012-August 2015
Visiting NSTRF Fellow

NASA Ames Research Center, Moffett Field, CA May 2014-August 2015
Visiting NSTRF Fellow

TEACHING EXPERIENCE

The University of Texas at San Antonio, San Antonio, TX
Instructor, Measurements & Instrumentation Fall 2018
Instructor, Experimental Methods in Engineering Spring 2019
Instructor, Gas Dynamics Fall 2019

The University of Tennessee Space Institute, Tullahoma, TN Summer 2017
Instructor, Engineering Optics

The University of Texas at Austin, Austin, TX
Instructor, High-Speed Aerodynamics Laboratory January 2014-August 2015
Teaching Assistant, High-Speed Aerodynamics Laboratory August 2010-December 2013
Teaching Assistant, Compressible Flow January 2011-May 2011

HONORS & AWARDS

- Dee Howard Endowed Faculty Fellow, 2018 - *Present*
- Co-author on first place paper at AIAA International Student Conference, 2020
- Air Force Office of Scientific Research Young Investigator Program Awardee, 2019
- NASA Space Technology Research Fellowship, 2011 - 2015
- Temple Foundation Graduate Fellowship, 2014 - 2015
- AIAA Aerodynamic Measurement Technology Best Paper, January 2013
- John and Mary Wheeler Endowed Graduate Fellowship, 2011 - 2012
- Indiana Space Grant Consortium Scholarship, 2008 – 2010

PROFESSIONAL MEMBERSHIP

- Senior Member of the American Institute of Aeronautics and Astronautics (AIAA)
- Member of the AIAA Aerodynamic Measurement Technology Technical Committee
- Member of the American Physical Society (APS)
- Organizer of invited special sessions on High Enthalpy Optical Diagnostics for the 2018 AIAA AVIATION Conference
- Co-Chair of the AIAA AVIATION Aerodynamic Measurement Technology Conference 2019
- Chair of the AIAA SciTech Aerodynamic Measurement Technology Conference 2021
- Member of 2016 AIAA Ablation Workshop Organizational Committee
- Reviewer for several peer-reviewed publications including Journal of Fluid Mechanics, Experiments in Fluids, Applied Optics, AIAA Journal, Aerospace Science & Technology, and Experimental Thermal & Fluid Science

PUBLICATIONS

1. Lindörfer, S. A., **C. S. Combs**, P. A. Kreth, R. B. Bond, and J. D. Schmisser, “Scaling of cylinder-generated shock-wave/turbulent boundary-layer interactions,” *Shock Waves*, *in press*, 2020.
2. **Combs, C. S.** and N. T. Clemens, “Simultaneous Measurements of Scalar and Velocity using Naphthalene Planar Laser-Induced Fluorescence,” *ALAA Journal*, Vol. 57, No. 11, 2019, pp. 5054-5060.
3. **Combs, C. S.**, J. D. Schmisser, B. F. Bathel, and S. B. Jones, “Unsteady Analysis of Shock-Wave/Boundary-Layer Interaction Experiments at Mach 4.2,” *ALAA Journal*, Vol. 57, No. 11, 2019, pp. 4715-4724.
4. **Combs, C. S.**, E. L. Lash, P. A. Kreth, and J. D. Schmisser, “Investigating the Unsteady Dynamics of Cylinder-Induced Shock-Wave/Transitional Boundary-Layer Interactions,” *ALAA Journal*, Vol. 56, No. 4, 2018, pp.1588-1599.
5. **Combs, C. S.**, P. A. Kreth, J. D. Schmisser, and E. L. Lash, “An Image-Based Analysis of Shock Wave-Boundary Layer Interaction Unsteadiness,” *ALAA Journal*, Vol. 56, No.3, 2018, pp. 1288-1293.
6. **Combs, C. S.**, N. T. Clemens, P. M. Danehy, and S. M. Murman, “Heat Shield Ablation Visualized using Naphthalene Planar Laser-Induced Fluorescence,” *Journal of Spacecraft and Rockets*, Vol. 54, No. 2, 2017, pp. 476-494.
7. **Combs, C. S.**, B. J. Lochman, and N. T. Clemens, “Technique for Studying Ablation-Products Transport in Supersonic Boundary Layers by using PLIF of Naphthalene,” *Experiments in Fluids*, Vol. 57, No. 89, 2016, pp. 1-14.
8. **Combs, C. S.** and N. T. Clemens, “Naphthalene Laser-Induced Fluorescence Measurements at Low Temperature and Pressure,” *Applied Optics*, Vol. 55, No. 13, 2016, pp. 3656-3669.
9. **Combs, C. S.**, N. T. Clemens, P. M. Danehy, B. Bathel, R. Parker, T. Wadhams, M. Holden, and B. Kirk, “Fluorescence Imaging of Reaction Control Jets and Backshell Aeroheating of Orion Capsule,” *Journal of Spacecraft and Rockets*, Vol. 52, 2015, pp. 243-252.
10. Guo, X., H. Zhao, H. Song, E. Zhang, **C. S. Combs**, N. T. Clemens, X. Chen, K. K. Li, Y. K. Zou, and Hua Jiang, “Upconverting Phosphor Thermometry for High Temperature Sensing Applications,” *Sensors & Transducers*, Vol. 13, 2011, pp. 124-130.

CONFERENCE PROCEEDINGS & PRESENTATIONS

1. Cottier, S. M., **C. S. Combs**, and L. Vanstone, “Spectral Proper Orthogonal Decomposition Analysis of Shock-Wave/Boundary-Layer Interactions,” AIAA SciTech 2020, Orlando, FL, Jan 6-10, 2020. (Invited)

2. Schmisser, J. S., J. Coder, M. Gragston, R. Glasby, R. Bowersox, and **C. S. Combs**, “Low-Frequency Unsteadiness in Transitional Shock/Boundary Layer Interactions,” AIAA SciTech 2020, Orlando, FL, Jan 6-10, 2020. (Invited)
3. Cottier, S. M., **C. S. Combs**, and L. Vanstone, “Spectral Proper Orthogonal Decomposition Analysis of Shock-Wave/Boundary-Layer Interactions,” AIAA Paper 2019-3331, AIAA AVIATION 2019, Dallas, TX, Jun. 17-21, 2019.
4. Bashor, I. P., E. Hoffman, G. Gonzalez, and **C. S. Combs**, “Design and Preliminary Calibration of the UTSA Mach 7 Hypersonic Ludwig Tube,” AIAA Paper 2019-2859, AIAA AVIATION 2019, Dallas, TX, Jun. 17-21, 2019.
5. **Combs, C. S.**, John D. Schmisser, Brett F. Bathel, and Stephen B. Jones, “Analysis of Shock-Wave/Boundary-Layer Interaction Experiments at Mach 1.8 and Mach 4.2,” AIAA Paper 2019-0344, AIAA SciTech 2019, San Diego, CA, Jan. 7-11, 2019.
6. Ogg, D. R., B. E. Rice, S. J. Peltier, J. T. Staines, S. L. Claucherty, and **C. S. Combs**, “Simultaneous Stereo Digital Image Correlation and Pressure-Sensitive Paint Measurements of a Compliant Panel in a Mach 2 Wind Tunnel,” AIAA Paper 2018-3869, 2018 AIAA Fluid Dynamics Conference, Atlanta, GA, Jun. 25-29, 2018.
7. Kocher, B. D., **C. S. Combs**, P. A. Kreth, and J. D. Schmisser, “Investigation of the Streamwise Development of Distributed Surface Roughness Effects on Supersonic Flows,” AIAA Paper 2018-4047, 2018 AIAA Fluid Dynamics Conference, Atlanta, GA, Jun. 25-29, 2018.
8. Tester, B. W., J. G. Coder, **C. S. Combs**, and J. D. Schmisser, “Hybrid RANS/LES Simulation of Transitional Shockwave/Boundary-Layer Interaction,” AIAA Paper 2018-3224, 2018 AIAA Fluid Dynamics Conference, Atlanta, GA, Jun. 25-29, 2018.
9. Rice, B. E., J. A. McKenzie, S. J. Peltier, **C. S. Combs**, B. S. Thurow, C. J. Clifford, and K. Johnson, “Comparison of 4-camera Tomographic PIV and Single-camera Plenoptic PIV,” AIAA Paper 2018-2036, 56th AIAA Aerospace Sciences Meeting and Exhibit, Orlando, FL, Jan. 8-12, 2018.
10. Harris, A. J., P. A. Kreth, **C. S. Combs**, and J. D. Schmisser, “Laser Differential Interferometry and Schlieren as an Approach to Characterizing Freestream Disturbance Levels,” AIAA Paper 2018-1100, 56th AIAA Aerospace Sciences Meeting and Exhibit, Orlando, FL, Jan. 8-12, 2018.
11. Sweetland, K., **C. S. Combs**, J. D. Schmisser, R. Rhodes, F.-Y. Zhang, T. M. Moeller, D. H. Plemmons, “Development of MIR TLAS System with Applications to Reacting Hot Gas Flows,” AIAA Paper 2018-1023, 56th AIAA Aerospace Sciences Meeting and Exhibit, Orlando, FL, Jan. 8-12, 2018.
12. Lindörfer, S. A., **C. S. Combs**, R. B. Bond, and J. D. Schmisser, “The Role of Boundary-Layer Thickness on Cylinder-Generated Shock-Wave/Turbulent Boundary-Layer Interactions, Part I: Computations,” AIAA Paper 2018-0380, 56th AIAA Aerospace Sciences Meeting and Exhibit, Orlando, FL, Jan. 8-12, 2018.
13. **Combs, C. S.**, S. A. Lindörfer, P. A. Kreth, and J. D. Schmisser, “The Role of Boundary-Layer Thickness on Cylinder-Generated Shock-Wave/Turbulent Boundary-Layer Interactions, Part II: Experiments,” AIAA Paper 2018-0824, 56th AIAA Aerospace Sciences Meeting and Exhibit, Orlando, FL, Jan. 8-12, 2018.
14. Kocher, B. D., **C. S. Combs**, P. A. Kreth, J. D. Schmisser, and S. J. Peltier, “Investigation of the Effects of Distributed Surface Roughness on Supersonic Flows,” AIAA Paper 2017-4313, 32nd AIAA Aerodynamic Measurement Technology and Ground Testing Conference, Denver, CO, Jun. 5-9, 2017.

15. Lash, E. L., **C. S. Combs**, P. A. Kreth, and J. D. Schmisser, "Study of the Dynamics of Transitional Shock Wave-Boundary Layer Interactions using Optical Diagnostics," AIAA Paper 2017-3123, 32nd AIAA Aerodynamic Measurement Technology and Ground Testing Conference, Denver, CO, Jun. 5-9, 2017.
16. Tester, B. W., J. G. Coder, **C. S. Combs**, and J. D. Schmisser, "Simulation of Transitional Shockwave/Boundary-Layer Interaction Using Advanced RANS-based Modeling," AIAA Paper 2017-4315, 32nd AIAA Aerodynamic Measurement Technology and Ground Testing Conference, Denver, CO, Jun. 5-9, 2017.
17. Lindörfer, S. A., **C. S. Combs**, P. A. Kreth, and J. D. Schmisser, "Limiting Cases for Cylinder-Induced Shock Wave/Boundary Layer Interactions," AIAA Paper 2017-4311, 32nd AIAA Aerodynamic Measurement Technology and Ground Testing Conference, Denver, CO, Jun. 5-9, 2017.
18. Lash, E. L., **C. S. Combs**, P. A. Kreth, and J. D. Schmisser, "Experimental Investigation of a Cylinder-Induced Transitional Shock Wave-Boundary Layer Interaction," AIAA Paper 2017-0760, 55th AIAA Aerospace Sciences Meeting and Exhibit, Grapevine, TX, Jan. 9-13, 2017.
19. Lindörfer, S. A., **C. S. Combs**, P. A. Kreth, and J. D. Schmisser, "Numerical Simulations of a Cylinder-Induced Shock Wave/Boundary Layer Interaction," AIAA Paper 2017-0534, 55th AIAA Aerospace Sciences Meeting and Exhibit, Grapevine, TX, Jan. 9-13, 2017.
20. **Combs, C. S.**, J. D. Schmisser, and J. C. Margiotta, "Update on DARPA's Materials Development for Platforms Program," 8th AIAA Ablation Workshop, Tucson, AZ, Oct. 5-6, 2016.
21. **Combs, C. S.**, E. L. Lash, and J. D. Schmisser, "Investigation of a Cylinder-Induced Transitional Shock Wave-Boundary Layer Interaction using Laser Diagnostics," AIAA Paper 2016-4321, 32nd AIAA Aerodynamic Measurement Technology and Ground Testing Conference, Washington, D.C., Jun. 13-17, 2016.
22. Lash, E. L., **C. S. Combs**, J. D. Schmisser, P. A. Kreth, and E. A. Beckman, "Developing an Image-Based Analysis of the Dynamics of Transitional Shock Wave-Boundary Layer Interactions," AIAA Paper 2016-4320, 32nd AIAA Aerodynamic Measurement Technology and Ground Testing Conference, Washington, D.C., Jun. 13-17, 2016.
23. Lindörfer, S. A., P. Anusonti-Inthra, J. D. Schmisser, and **C. S. Combs**, "An Investigation of the Role of an Upstream Burst Diaphragm on Flow Quality within a Ludwieg Tube using RANS," AIAA Paper 2016-3801, 46th AIAA Fluid Dynamics Conference, Washington, D.C., Jun. 13-17, 2016.
24. **Combs, C. S.** and N. T. Clemens, "Simultaneous Measurements of Scalar and Velocity in a Mach 5 Turbulent Boundary Layer using Naphthalene PLIF and PIV," AIAA Paper 2016- 1761, 54th AIAA Aerospace Sciences Meeting and Exhibit, San Diego, CA, Jan. 4-8, 2016.
25. **Combs, C. S.** and N. T. Clemens, "Quantitative Measurements of Ablation-Products Transport in a Mach 5 Boundary Layer using Naphthalene PLIF," 7th AIAA Ablation Workshop, Tullahoma, TN, Oct. 21-22, 2015.
26. **Combs, C. S.** and N. T. Clemens, "Quantitative Measurements of Ablation-Products Transport in a Supersonic Turbulent Boundary Layer using Simultaneous PIV and Naphthalene PLIF," Ninth International Symposium on Turbulence and Shear Flow Phenomena, Melbourne, Australia, June 30-July 3, 2015.
27. **Combs, C. S.** and N. T. Clemens, "Measurements of Ablation-Products Transport in a Mach 5 Turbulent Boundary Layer using Naphthalene PLIF," AIAA Paper 2015-1912, 53rd AIAA Aerospace Sciences Meeting and Exhibit, Kissimmee, FL, Jan. 5-9, 2015.

28. **Combs, C. S.** and N. T. Clemens, "Development of Naphthalene PLIF for Making Quantitative Measurements of Ablation Products Transport in Supersonic Flows," 67th Annual Meeting of the APS Division of Fluid Dynamics, San Francisco, CA, Nov. 23-25, 2014.
29. **Combs, C. S.**, N. T. Clemens, and P. M. Danehy, "Visualization of Capsule Reentry Vehicle Heat Shield Ablation using Naphthalene PLIF," 17th Int'l Symp. on Applications of Laser Techniques to Fluid Mechanics, Lisbon, Portugal, July 7-10, 2014.
30. **Combs, C. S.**, N. T. Clemens, and P. M. Danehy, "Development of Naphthalene PLIF for Visualizing Ablation Products from a Space Capsule Heat Shield," AIAA Paper 2014-1152, 52nd AIAA Aerospace Sciences Meeting and Exhibit, National Harbor, MD, Jan. 13-17, 2014.
31. **Combs, C. S.**, N. T. Clemens, and P. M. Danehy, "Naphthalene Planar Laser-Induced Fluorescence Imaging of Orion Multi-Purpose Crew Vehicle Heat Shield Ablation Products," 66th Annual Meeting of the APS Division of Fluid Dynamics, Pittsburgh, PA, Nov. 24-26, 2013.
32. Burns, R. J., **C. S. Combs**, and N. T. Clemens, "Development of Krypton Planar Laser-Induced Fluorescence for Supersonic Flow Environments," 66th Annual Meeting of the APS Division of Fluid Dynamics, Pittsburgh, PA, Nov. 24-26, 2013.
33. **Combs, C. S.**, N. T. Clemens, P. M. Danehy, B. Bathel, R. Parker, T. Wadhams, M. Holden, and B. Kirk, "NO PLIF Visualizations of the Orion Capsule in LENS-I" AIAA Paper 2013-0033, 51st AIAA Aerospace Sciences Meeting and Exhibit, Grapevine, TX, Jan. 7-10, 2013.
34. **Combs, C. S.**, N. T. Clemens, and P. M. Danehy, "Visualization of Capsule Reentry Vehicle Heat Shield Ablation using Naphthalene Planar Laser-Induced Fluorescence Imaging," 65th Annual Meeting of the APS Division of Fluid Dynamics, San Diego, CA, Nov. 18-20, 2012.
35. **Combs, C. S.**, N. T. Clemens, X. Guo, H. Song, H. Zhao, K. K. Li, Y. K. Zou, and H. Jiang, "High-Temperature Surface Thermometry Technique based on Upconversion Nano-Phosphors," 64th Annual Meeting of the APS Division of Fluid Dynamics, Baltimore, MD, Nov. 20-22, 2011.
36. Guo, X., H. Zhao, H. Song, Q. Chen, K.K. Li, Y.K. Zou, H. Jiang, **C. S. Combs**, V. Narayanaswamy, and N. T. Clemens, "Upconverting Nanophosphors for High Temperature Sensing Applications," Nanotech 2011, Vol. 1, 2011, pp. 429-433.

INVITED PRESENTATIONS

1. The University of Texas at Austin, Austin, TX, "Investigations of Cylinder-Generated Shock-Wave/Boundary-Layer Interactions," Dec. 2019.
2. SpaceATX Forum, Austin, TX, "Hypersonics and the New Space Race," Nov. 2019.
3. Texas A&M University, College Station, TX, "Design considerations and analysis of Ludwig tube wind tunnels," Feb. 2019.
4. Air Force Institute of Technology, Wright-Patterson AFB, OH, "Investigations of Cylinder-Generated Shock-Wave/Boundary-Layer Interactions," Apr. 2018.
5. Arizona State University, Tempe, AZ, "Investigations of Cylinder-Generated Shock-Wave/Boundary-Layer Interactions," Mar. 2018.

6. University of Colorado Boulder, Boulder, CO, "Investigations of Cylinder-Generated Shock-Wave/Boundary-Layer Interactions," Mar. 2018.
7. The University of Texas at San Antonio, San Antonio, TX, "Investigations of Cylinder-Generated Shock-Wave/Boundary-Layer Interactions," Jan. 2018.
8. AIAA Aerodynamic Measurement Technology Technical Committee Meeting, Kissimmee, FL, "UTSI HORIZON Group Diagnostics Expertise," Jan. 2018.
9. University of Southern California, Los Angeles, CA, "Advancement of Non-Intrusive Optical Diagnostics for the Study of Supersonic Aerothermodynamics," Feb. 2017.
10. University of Central Florida, Orlando, FL, "Advancement of Non-Intrusive Optical Diagnostics for the Study of Supersonic Aerothermodynamics," Nov. 2016.
11. Aerospace Corp., El Segundo, CA, "Quantitative Measurements of Ablation-Products Transport in Supersonic Turbulent Flows Using Planar Laser-Induced Fluorescence," May 2015.
12. The University of Tennessee Space Institute, Tullahoma, TN, "Quantitative Measurements of Ablation-Products Transport in Supersonic Turbulent Flows Using Planar Laser-Induced Fluorescence," Apr. 2015.
13. NASA Ames Research Center, Moffett Field, CA, "Development of Naphthalene PLIF for Visualizing Ablation Products from a Space Capsule Heat Shield," May 2014.
14. NASA Langley Research Center, Hampton, VA, "Quantitative Measurements of Ablation-Products Transport for Turbulence Model Validation," Jul. 2013.
15. The University of Texas at Austin, Austin, TX, "NO PLIF Visualization of the Orion capsule in LENS-I," Apr. 2013.
16. NASA Langley Research Center, Hampton, VA, "Quantitative Measurements of Ablation-Products Transport for Turbulence Model Validation," Jul. 2012.
17. The University of Texas at Austin, Austin, TX, "High Temperature Surface Thermometry Technique based on Upconversion Nano-Phosphors," Feb. 2012.