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Engineering & Scientific Consulting

Andreas Rauch, Ph.D.

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Professional Profile

Dr. Rauch is a mechanical and aerospace engineer specializing in combustion, thermodynamics, heat transfer, and fluid dynamics. He has designed and analyzed combustion devices using computational simulations for both power-generation and propulsion applications. This included hydrogen-fueled gas turbines for greenhouse gas emission free power generation and hypersonic, air-breathing aircraft propulsion engines. These simulations included multi-physics effects such as turbulence, combustion, fuel injection, and flow compressibility. Throughout his work he has coordinated closely with partners for experimental validation and design optimization. Dr. Rauch has extensive experience with commercial computational fluid dynamics (CFD) software, such as Star-CCM+, as well as developing custom software to solve reacting flow and heat transfer problems.

Dr. Rauch is experienced in the simulation and analysis of turbulent and reacting flows with both model-based CFD (RANS and LES) and fully resolved CFD (DNS). He has developed numerical methods for CFD of turbulent, reacting flows for high-fidelity simulations of lab-scale devices. These numerical methods were applied to detailed studies of a novel propulsion engine for high-speed flight with simulation thermal boundary conditions informed from experiments. Additionally, he has experience in developing data-driven physics-informed surrogate models for accelerated simulation predictions.

Before joining Exponent, Dr. Rauch was a researcher at the German Aerospace Center (DLR) and at the University of Michigan. During his time at DLR he utilized CFD simulations to optimize a novel greenhouse gas emission free hydrogen combustor allowing for a test-stand ready design to be built by experimental collaborators. As a research fellow at the University of Michigan, Dr. Rauch held a joint appointment in the Department of Aerospace Engineering and the Michigan Institute for Data Science at the University of Michigan. In this position he developed numerical methods for simulating complex geometries in compressible, reacting flows and machine learning (ML) methods to accelerate simulation predictions.

Dr. Rauch is proficient in several coding languages including C++ and Python, chemical kinetic and combustion software packages such as Cantera, the PyTorch and TensorFlow ML libraries, as well as commercial CFD codes such as Siemens Star-CCM+.

Academic Credentials & Professional Honors

Ph.D., Mechanical and Aerospace Engineering, University of Virginia, 2020

M.Eng., Aeronautical Engineering, Imperial College London, UK, 2020

Schmidt AI in Science Postdoctoral Fellowship Program, a Schmidt Futures Program

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Licenses and Certifications

40-Hour Hazardous Waste Operation and Emergency Response Certification (HAZWOPER)

Academic Appointments

Research Fellow, Department of Aerospace Engineering, University of Michigan, August 2022 to November 2024

Research Fellow, Institute for Combustion Technology, German Aerospace Institute (DLR), July 2020 to July 2022

Prior Experience

Research Fellow, Department of Aerospace Engineering, University of Michigan, August 2022 to November 2024

Research Fellow, Institute for Combustion Technology, German Aerospace Institute (DLR), July 2020 to July 2022

Visiting Researcher, Combustion Research Facility, Sandia National Laboratories, June to December 2017

Professional Affiliations

Combustion Institute, Member

American Institute of Aeronautics and Astronautics, Member

Languages

German

Publications

Andreas H. Rauch, Vansh Sharma, and Venkatramanan Raman. “Super-Resolution Models for Turbulence Fine-Scale Reconstruction and Their Robustness to Noise”. In: AIAA SCITECH 2025 Forum. doi: 10.2514/6.2025-1281. eprint: https://arc.aiaa.org/doi/pdf/10.2514/6. 2025-1281. url: https://arc.aiaa.org/doi/abs/10.2514/6.2025-1281

Vansh Sharma, Andreas H. Rauch, and Venkatramanan Raman. “Accelerating CFD Simulations With Super-Resolution Feedback-Informed Adaptive Mesh Refinement”. In: AIAA SCITECH 2025 Forum. doi: 10.2514/6.2025-1467. eprint: https://arc.aiaa.org/doi/pdf/10.2514/ 6.2025-1467. url: https://arc.aiaa.org/doi/abs/10.2514/6.2025-1467

Andreas H. Rauch, Michael J. Ullman, Shivank Sharma, Ral Bielawski, Venkatramanan Raman, Chloe E. Dedic, Andrew J. Metro, and Robert D. Rockwell. “High-Fidelity Numerical Simulations of a Scramjet Flowpath". In: AIAA SCITECH 2024 Forum. Jan 2024. doi: 10.2514/6.2024-2593. eprint: https://arc.aiaa.org/doi/pdf/10.2514/6.2024-2593. url: https://arc.aiaa.org/doi/abs/10.2514/6.2024-2593

Shivank Sharma, Ral Bielawski, Andreas H. Rauch, and Venkatramanan Raman. “High-fidelity Computational Study of High-speed Reacting Jets in Crossow". In: AIAA SCITECH 2024 Forum. Jan 2024. doi: 10.2514/6.2024-2596. eprint: https://arc.aiaa.org/doi/pdf/10.2514/6. 2024-2596. url: https://arc.aiaa.org/doi/abs/10.2514/6.2024-2596

Clayton M Geipel, Andreas Rauch, Harsha K Chelliah, and Andrew D Cutler. “Analysis of a Premixed Cavity-Stabilized Flame Using Simulated OH-PLIF Images From DNS". in: AIAA Scitech 2021 Forum. Jan 2021, p. 1465. doi: 0.2514/6.2021-1465. url: https://arc.aiaa.org/doi/abs/10.2514/6.2021-1465

Rauch, Andreas H., and Harsha K. Chelliah. "On the ambiguity of premixed flame thickness definition of highly pre-heated mixtures and its implication on turbulent combustion regimes." Combustion Theory and Modelling 24.4 (2020): 573-588. doi: 10.1080/13647830.2020.1722857. eprint: https://doi.org/10.1080/13647830.2020.1722857. url: https://doi.org/10.1080/13647830.2020.1722857

Andreas H. Rauch, Aditya Konduri, Jacqueline Chen, Hemanth Kolla, and Harsha K. Chelliah. DNS Investigation of Cavity Stabilized Premixed Turbulent Ethylene-Air Flame". In: AIAA SciTech Forum. Aerospace Sciences Meeting. American Institute of Aeronautics and Astronautics, Jan. 2018. doi: 10.2514/6.2018-1674. url: https://doi.org/10.2514/6.2018-1674

Presentations

Andreas H. Rauch, Anthony Carreon, and Venkat Raman. Turbulence Fine-scale Reconstruction Using Learning Techniques". In: Proceedings of the International Conference on Numerical Combustion. Kyoto, Japan, May 2024

Jagmohan Singh, Shivank Sharma, Andreas H. Rauch, and Venkat Raman. The Effect of Combustion-Induced Instabilities on Shock-trains in a Scramjet Isolator". In: Proceedings of the International Conference on Numerical Combustion. Kyoto, Japan, May 2024

Clayton Geipel, Andreas H. Rauch, Harsha K. Chelliah, and Chloe Dedic. “Hybrid fs/ps CARS system for counterflow flame investigation". In: Eastern States Section of the Combustion Institute. U.S. National Combustion Meeting. The Combustion Institute, Mar. 2020

Andreas H. Rauch, Aditya Konduri, Jacqueline Chen, Hemanth Kolla, and Harsha K. Chelliah. “DNS of Cavity Stabilized Premixed Turbulent Flame with a High-Order Immersed Boundary Method". In: Eastern States Section of the Combustion Institute. U.S. National Combustion Meeting. The Combustion Institute, Mar. 2018

Jacqueline Chen, Aditya Konduri, Hemanth Kolla, Andreas Rauch, and Harsha Chelliah. “Direct Numerical Simulation of a Cavity-Stabilized Ethylene/Air Premixed Flame". In: APS Division of Fluid Dynamics Meeting Abstracts. Nov 2016, A17-001

Peer Reviews

Combustion Theory and Modeling