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Engineering & Scientific Consulting

Andreas Rauch, Ph.D.

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Professional Profile

Dr. Rauch has a background in combustion and fluid dynamics and specializes in thermal and fluid flow systems. He has broad expertise in reacting flows, thermodynamics, heat and mass transfer, and fluid dynamics.

At Exponent, Dr. Rauch has supported clients in the legal, insurance, medical device, and gas appliances industries across a range of matters. He has conducted fire and explosion investigations at residential, commercial, and industrial facilities and is a provisional Certified Fire and Explosion Investigator (p-CFEI). Dr. Rauch has experience investigating commercial and residential CO exposure incidents as they relate to gas fired systems (natural gas and propane) such as boilers and water heaters. He has evaluated commercial and consumer product applications for fire and explosion hazards, risks and safety concerns, and standard and regulatory requirements.

Dr. Rauch has broad experience in laboratory testing of gas fired appliances, including residential boiler systems, combustibility and explosibility of dust, and battery thermal runaway. He has also performed computational studies using the commercial Computational Fluid Dynamics (CFD) software Star-CCM+ for medical device and litigation applications.

Prior to joining Exponent, Dr. Rauch 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 while a researcher at the German Aerospace Center (DLR) and hypersonic, air-breathing aircraft propulsion engines while at the University of Michigan as a postdoctoral researcher and while at the University of Virginia during his Ph.D. These simulations included multi-physics effects such as heat transfer, turbulence, combustion, fuel injection, and flow compressibility. This design work included close coordination with partners for experimental validation and design optimization.

Dr. Rauch's academic work focused on the computational simulation and analysis of turbulent and reacting flows including the development of novel numerical methods to enable high-fidelity simulations of lab-scale power-generation and propulsion devices. Additionally, he has experience in machine learning (ML) models for accelerating simulations with data-driven physics-informed approaches.

Academic Credentials & Professional Honors

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

M.Eng., Aeronautical Engineering, Imperial College London, UK, 2015

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

Licenses and Certifications

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

Blasting Certificate of Competency (MA)

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

American Institute of Aeronautics and Astronautics, Member

National Association of Fire Investigators (NAFI), Member

Languages

German

Publications

Rauch AH, Sharma V, Raman V. 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.

Sharma V, Rauch AH, Raman V. 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.

Rauch AH, Ullman MJ, Sharma S, Bielawski R, Raman V, Dedic CE, Metro AJ, Rockwell RD. 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.

Sharma S, Bielawski R, Rauch AH, Raman V. 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.

Geipel CM, Rauch A, Chelliah HK, Cutler AD. 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 AH, Chelliah HK. 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.

Rauch AH, Konduri A, Chen J, Kolla H, Chelliah HK. 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 and Preprints

Sharma S, Bielawski R, Gibson O, Zhang S, Sharma V, Rauch AH, et al. An amrex-based compressible reacting flow solver for high-speed reacting flows relevant to hypersonic propulsion. arXiv preprint arXiv:2412.00900, 2024.

Rauch AH, Carreon A, Raman V. Turbulence fine-scale reconstruction using learning techniques. In: Proceedings of the International Conference on Numerical Combustion, Kyoto, Japan, May 2024.

Singh J, Sharma S, Rauch AH, Raman V. 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.

Geipel C, Rauch AH, Chelliah HK, Dedic C. 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, March 2020.

Rauch AH, Konduri A, Chen J, Kolla H, Chelliah HK. 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, March 2018.

Chen J, Konduri A, Kolla H, Rauch A, Chelliah H. Direct numerical simulation of a cavity-stabilized ethylene/air premixed flame. In: APS Division of Fluid Dynamics Meeting Abstracts, November 2016, A17-001.

Peer Reviews

Combustion Theory and Modeling