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Distinguished Member of Technical Staff
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Reacting Flows

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Jonathan Frank

SHORT BIO:

Jonathan Frank is the Principal Investigator for the Advanced Imaging Laboratory (add link to Adv. Imaging Lab), which is funded by the US Department of Energy Basic Energy Sciences Combustion Research Program. His research focuses on the development and application of laser-based imaging diagnostics for studying reacting flows. Jonathan is also a Visiting Scholar at the University of Cambridge, where he conducts experimental research on combustion as well as the development of optical diagnostic techniques for microscopy. Prior to becoming a Sandia staff member in 1999, Jonathan served as a Postdoctoral Fellow at Sandia and The University of Sydney. He has authored or co-authored over 50 journal articles. In 2013, he was promoted to Distinguished Member of Technical Staff.

RESEARCH INTERESTS

Jonathan's research focuses on the development and application of imaging diagnostics to investigate the coupling between fluid dynamics and combustion chemistry in turbulent flames. Imaging diagnostics provide temporally and spatially resolved measurements of species, temperature, and velocity distributions over a wide range of length scales. Multi-dimensional measurements are necessary to determine spatial correlations, scalar and velocity gradients, flame orientation, curvature, and connectivity. The diagnostic capabilities in the Advanced Imaging Laboratory enable multi-laser and multi-camera imaging experiments that provide new insights into the interaction between turbulent flows and combustion chemistry. These capabilities have recently expanded to enable studies of the dynamics of turbulent flames using high-repetition rate imaging techniques. Experimental results are coupled with numerical simulations to advance understanding of the interplay between fluid dynamics and chemistry as well as to expand predictive capabilities. A detailed understanding of turbulence-chemistry interactions is critical for the development of advanced combustion technologies.

EDUCATION

Ph.D. Mechanical Engineering - Yale University

M.S. Mechanical Engineering - Yale University

B.S. Physics - Wesleyan University

AWARDS, HONORS, AND MEMBERSHIPS

Associate Editor of the Proceedings of the Combustion Institute

Invited Visiting Scholar, University of Cambridge, Cambridge, UK

Colloquium Co-Chair for Turbulent Combustion, 34th and 35th International Symposia on Combustion

Distinguished Paper Award, 33rd International Symposium on Combustion

Becton Engineering Prize for Ph.D. Thesis, Yale University

Silver Combustion Medal, The Combustion Institute

Bertman Physics Prize, Wesleyan University

Professional Memberships: Optical Society of America, American Physical Society, The Combustion Institute

SELECTED PUBLICATIONS & PATENTS

B. Coriton, J. H. Frank, A. Gomez, Effects of strain rate, turbulence, reactant stoichiometry and heat losses on the interaction of turbulent premixed flames with stoichiometric counterflowing combustion products. *Combust. Flame* **160**, 2442 (2013).

J. H. Frank, S. A. Kaiser, J. C. Oefelein, Analysis of scalar mixing dynamics in LES using high-resolution imaging of laser Rayleigh scattering in turbulent non-reacting jets and non-premixed jet flames. *Proc. Combust. Inst.* **33**, 1373 (2011).

B. Coriton, J. H. Frank, A. G. Hsu, M. D. Smooke, A. Gomez, Effect of quenching of the oxidation layer in highly turbulent counterflow premixed flames. *Proc. Combust. Inst.* **33**, 1647 (2011).

A. G. Hsu, V. Narayanaswamy, N. T. Clemens, J. H. Frank, Mixture fraction imaging in turbulent non-premixed flames with two-photon LIF of krypton. *Proc. Combust. Inst.* **33**, 759 (2011).

S. A. Kaiser, J. H. Frank, The effects of laser-sheet thickness on dissipation measurements in turbulent non-reacting jets and jet flames. *Meas. Sci. Technol.* **22**, 045403 (2011).

A. M. Steinberg, I. Boxx, C. M. Arndt, J. H. Frank, W. Meier, Experimental study of flame-hole reignition mechanisms in a turbulent non-premixed jet flame using sustained multi-kHz PIV and crossed-plane OH PLIF. *Proc. Combust. Inst.* **33**, 1663 (2011).

B. Böhm, J. H. Frank, A. Dreizler, Temperature and mixing field measurements in stratified lean premixed turbulent flames. *Proc. Combust. Inst.* **33**, 1583 (2011).

J. H. Frank, S. A. Kaiser, High-resolution imaging of turbulence structures in jet flames and non-reacting jets with laser Rayleigh scattering. *Exp. Fluids* **49**, 823 (2010).

U. D. Lee, C. S. Yoo, J. H. Chen, J. H. Frank, Effect of NO on extinction and re-ignition of vortex-perturbed hydrogen flames. *Combust. Flame* **157**, 217 (2010).

J. H. Frank, R. S. Barlow, in *Combustion Phenomena: Selected Mechanisms of Flame Formation, Propagation, and Extinction,* J. Jarosinski, B. Veyssiere, Eds. (CRC Press, 2009), pp. 153-162.

S. A. Kaiser, J. H. Frank, Spatial scales of extinction and dissipation in the near field of non-premixed turbulent jet flames. *Proc. Combust. Inst.* **32**, 1639 (2009).

W. D. Kulatilaka, J. H. Frank, T. B. Settersten, Interference-free two-photon LIF imaging of atomic hydrogen in flames using picosecond excitation. *Proc. Combust. Inst.* **32**, 955 (2009).

E. R. Hawkes, R. Sankaran, J. H. Chen, S. A. Kaiser, J. H. Frank, An analysis of lower-dimensional approximations to the scalar dissipation rate using direct numerical simulations of plane jet flames. *Proc. Combust. Inst.* **32**, 1455 (2009).

W. Kulatilaka, J. Frank, B. Patterson, T. Settersten, Analysis of 205-nm photolytic production of atomic hydrogen in methane flames. *Applied Physics B: Lasers and Optics* **97**, 227 (2009).

A. D. Elder, C. F. Kaminski, J. H. Frank, ϕ^2FLIM: a technique for alias-free frequency domain fluorescence lifetime imaging. *Opt. Express* **17**, 23181 (2009).

C. S. Yoo, J. H. Chen, J. H. Frank, A numerical study of transient ignition and flame characteristics of diluted hydrogen versus heated air in counterflow. *Combust. Flame* **156**, 140 (2009).

C. F. Kaminski, R. S. Watt, A. D. Elder, J. H. Frank, J. Hult, Supercontinuum radiation for applications in chemical sensing and microscopy. *Applied Physics B: Lasers and Optics* **92**, 367 (2008).

S. Schlachter, A. D. Elder, J. H. Frank, A. Grudinin, C. F. Kaminski, Spectrally resolved confocal fluorescence microscopy with a supercontinuum laser. *Microscopy and Analysis* **22**, 11 (2008).

W. D. Kulatilaka, B. D. Patterson, J. H. Frank, T. B. Settersten, Comparison of nanosecond and picosecond excitation for interference-free two-photon laser-induced fluorescence detection of atomic hydrogen in flames. *Appl. Opt.* **47**, 4672 (2008).

J. H. Frank, S. A. Kaiser, High-resolution imaging of dissipative structures in a turbulent jet flame with Rayleigh scattering. *Exp. Fluids* **44**, 221 (2008).