SAND2014-3048P

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SHORT BIO:

Jacqueline H. Chen is a Distinguished Member of Technical Staff at the Combustion Research Facility at Sandia National Laboratories. She has contributed broadly to research in petascale direct numerical simulations (DNS) of turbulent combustion focusing on fundamental turbulence-chemistry interactions. These benchmark simulations provide fundamental insight into combustion processes and are used by the combustion modeling community to develop and validate turbulent combustion models for engineering CFD simulations. In collaboration with computer scientists and applied mathematicians she is the founding Director of the Center for Exascale Simulation of Combustion in Turbulence (ExaCT). She leads an interdisciplinary team to co-design DNS algorithms, domain-specific programming environments, scientific data management and in situ uncertainty quantification and analytics, and architectural simulation and modeling with combustion proxy and production applications. She received the DOE

INCITE Award in 2005, 2007, 2008-2014, the Asian American Engineer of the Year Award in 2009, and the Sandia OE Adams Award in 2012. She is a member of the DOE Advanced Scientific Computing Research Advisory Committee (ASCAC) and Subcommittees on Exascale Computing, and Synergies of Big Data and Exascale. She is the editor of Flow, Turbulence and Combustion, the co-editor of the Proceedings of the Combustion Institute, volumes 29 and 30, and is a member of the Board of Directors of the Combustion Institute.

RESEARCH INTERESTS

My areas of research interests are in the development and application of massively parallel petascale direct numerical simulations (DNS) of turbulent combustion with complex chemistry. These DNS are used to understand fundamental chemistry-turbulence interactions in combustion, and to develop and validate predictive combustion models ultimately used to design efficient and clean engines reliably burning a diverse range of fuels, from bio-derived and synthesized fuels to fossil fuels from evolving feeds. I have used DNS to investigate phenomena including turbulent flame propagation, partially-premixed and triple flame structure, hydrodynamic and diffusive-thermal flame instabilities, lifted flame stabilization, autoignition, extinction and reignition, pollutant formation, soot production and differential transport, premixed flame boundary layer flashback in turbulent channel flow, reactive scalar mixing, and small scale energy transfer in turbulent premixed flames. Many of the fundamental DNS studies are relevant to the engineering design of fuel injection systems for staged gas turbine combustors that are intrinsically flashback safe and in developing strategies for controlling the pressure rise rate in fuel efficient premixed compression ignition engines. At the petascale, the DNS have been performed at conditions directly comparable to compact laboratory experiments and with sufficient chemical realism to differentiate fuel chemistry effects on critical finite-rate phenomena. The DNS benchmark data are increasingly used by the turbulent combustion modeling community for validation.

In the past ten years the increasing complexity of high performance computing hardware (currently, multi-core hybrid architectures constrained by power considerations) has driven my research in computational combustion to be more aligned with computer science research. In this regard, I am the founding Director of the Center for Exascale Simulation of Combustion in Turbulence (ExaCT), a multi-disciplinary, multi-institutional Center of computational scientists, applied mathematicians and computer scientists (http://www.exactcodesign.org). ExaCT is focused on the iterative co-design of the entire software stack–from combustion DNS, analytics and UQ algorithms to programming environments, runtimes and operating system to computer hardware–allowing effective combustion simulation on future exascale systems. I am also interested in the development and application of *in situ* topological analytics tools used to extract and track salient intermittent combustion and flow features, thereby vastly reducing the amount of data written to persistent storage.

EDUCATION

Ohio State University, Mechanical Engineering, B.S. 1981

University of California, Berkeley, Mechanical Engineering, M.S. 1982
Stanford University, Mechanical Engineering , Ph.D 1989

AWARDS, HONORS AND MEMBERSHIPS

- Sandia Ph.D. Doctoral Study Program (DSP) Fellowship, 1986-1989
- University of California Distinguished Research Scientist Award, Irvine, 1996
- Sandia Employee Recognition Award for Technical Excellence, 1998
- Asian American Engineer of the Year Award, 2009
- O.E. Adams Award for Excellence in Combustion Science, 2012
- Member, Board of Directors of Combustion Institute, 2007-2018
- Co-Chair, Local Organizing Committee for 35th International Symposium on Combustion, San Francisco, 2014
- Member, DOE Office of Advanced Scientific Computing Advisory Committee, 2008-present
    - Subcommittee member on Exascale Computing
    - Subcommittee member on Big Data Synergies with Exascale Computing
    - Subcommittee member on ASCR Facilities
- National Academy of Science Committee on Cyberinfrastructure for Combustion Science Research, 2010
- Chair Executive Users Council National Center for Computational Sciences Oak Ridge National Lab 2009-2010
- Member, External Advisory Board, Oak Ridge National Laboratory, Computational and Computing Sciences Directorate 2012-present
- Member of Steering Committee for DOE Combustion Energy Frontier Research Center, 2009-present
- Editor of *Flow, Turbulence and Combustion*, 2011-present
- Co-Editor of *Proceedings of the Combustion Institute*, Volumes 29 and 30, 2008, 2010
- Editorial Board of Proceedings of Combustion Institute 2008-present
- Editorial Board of *Computational Science and Discovery* 2007-present
- Editorial Board of *Progress in Energy and Combustion* 2007-present
- Editorial Board of *Combustion and Flame,* 2004-2008
- DOE INCITE Awards 2005, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014
- DOE Advanced Leadership Computing Challenge (ALCC) Award 2012
- ORNL 250 Tflop and 1 Pflop Transition-to-Operations Awards
- ORNL CAARS Program for Application Readiness Award for 20 Pflop Titan 2012-2013.
- Plenary: 2014
- Keynote: Third International Conference on Turbulence Interactions, 2012
- Plenary: 33rd International Symposium on Combustion, Beijing, 2010
- Plenary: Sixth U.S. National Combustion Meeting, Ann Arbor, 2009
- Plenary: International Conference on High Performance Computing and Communications, 2009
- Plenary: Twelfth International Conference on Numerical Combustion, Monterey, 2008
- Masterworks Plenary: Supercomputing ‘06, 2006

SELECTED PUBLICATIONS & PATENTS

Refereed Combustion and Fluids Journal Articles

1. Krisman, A., Tang, J., Hawkes, E. R., Lignell, D., Chen, J. H. (2014) “A DNS evaluation of mixing models for transported PDF modelling of turbulent nonpremixed flames,” in press, *Combustion and Flame.*

2. Gruber, A., Chen, J. H., (2014) “Direct numerical simulation of laminar flame-wall interaction for a novel H2-selective membrane / injector configuration” in press, *International Journal of Hydrogen Energy.*

3. Bhagatwala, A., Lu, T., and Chen, J. H., (2014) "Direct numerical simulations of HCCI/SACI with ethanol," in press, *Combustion and Flame*, http://dx.doi.org/10.1016/j.combustflame.2013.12.027.

4. Chatakonda, O., Hawkes, E. R., Aspden, A., Kerstein, A. R., Kolla, H., Chen, J. H., (2013) “On the fractal characteristics of low Damkohler number flames,” *Combustion and Flame,* 160, 2422-2433.

5. Yang, Y., Wang, H., Pope, S. B., Chen, J. H., (2013) Large-eddy simulation/probability density function modeling of a non-premixed CO/H2 temporally evolving jet flame. *Proc. Comb. Inst.***,** *34*, 1241–1249.

6. Yang, Y., Pope, S. B., Chen, J. H., (2013) Empirical low-dimensional manifolds in composition space. *Combustion and Flame*, 160 (10), 1967-1980.

7. Kaul, C. M.; Raman, V.; Knudsen, E.; Richardson, E. S.; Chen, J. H., (2013) Large eddy simulation of a lifted ethylene flame using a dynamic nonequilibrium model for subfilter scalar variance and dissipation rate. *Proc. Comb. Inst.*, 1289–1297.

8. Valiev D.M., Zhu M., Bansal G., Kolla H., Law C.K., Chen J.H., (2013), Pulsating instability of externally forced premixed counterflow flame, *Combustion and Flame* 160(2), 285-294.

9. Zhang, H., Hawkes, E.R., Chen, J.H., Kook, S., (2013), A numerical study of the autoignition of dimethyl ether with temperature inhomogeneities, *Proceedings of the Combustion Institute* 34(1), pp. 803-812.

10. Chakraborty, N., Kolla, H., Sankaran, R., Hawkes, E.R., Chen, J.H., (2013), Determination of three-dimensional quantities related to scalar dissipation rate and its transport from two-dimensional measurements: direct numerical simulation-based validation, *Proceedings of the Combustion Institute* 34(1), pp. 1151-1162.

11. Yoo C.S., Luo Z., Lu T., Kim H., Chen J.H., (2013), A DNS study of ignition characteristics of a lean iso-octane/air mixture under HCCI and SACI conditions, *Proceedings of the Combustion Institute* 34(2) pp. 2985-2993.

12. Kolla, H., Grout, R., Gruber, A., Chen, J. H., (2012) Mechanisms of flame stabilization and blowout in a reacting turbulent hydrogen jet in cross-flow. *Combust. Flame*, *159* (8), 2755-2766.

13. Gruber, A.; Chen, J. H.; Valiev, D.; Law, C. K., (2012) Direct numerical simulation of premixed flame boundary layer flashback in turbulent channel flow. *J. Fluid Mech.*, *709*, 516-542.

14. Shan R., Yoo C.S., Chen J.H., Lu T., (2012), Computational diagnostics for n-heptane flames with chemical explosive mode analysis, *Combustion and Flame* 159(10), pp. 3119-3127.

15. Grout R.W., Gruber A., Kolla H., Bremer P.-T., Bennett J.C., Gyulassy A., Chen J.H., (2012), A direct numerical simulation study of turbulence and flame structure in transverse jets analysed in jet-trajectory based coordinates, *Journal of Fluid Mechanics* 706(10), pp. 351-383.

16. Richardson E.S., Chen J.H., (2012), Application of PDF mixing models to premixed flames with differential diffusion, *Combustion and Flame* 159(7), pp. 2398-2414.

17. Knudsen E., Richardson E.S., Doran E.M., Pitsch H., Chen J.H., (2012), Modeling scalar dissipation and scalar variance in large eddy simulation: Algebraic and transport equation closures, *Physics of Fluids* 24(5), Art. No. 055103.

18. Wei J., Yu H., Grout R., Chen J. H., Ma K.-L., (2012), Visual analysis of particle behaviors to understand combustion simulations, *IEEE Computer Graphics and Applications* 32(1), pp. 22-33.

19. Luo Z., Yoo C.S., Richardson E.S., Chen J.H., Law C.K., Lu T., (2012), Chemical explosive mode analysis for a turbulent lifted ethylene jet flame in highly-heated coflow, *Combustion and Flame* 159(1), pp. 265-274.

20. Hawkes, E.R., Chatakonda, O., Kolla, H., Chen, J.H., (2012), A petascale direct numerical simulation study of the modelling of flame wrinkling for large-eddy simulations in intense turbulence, *Combustion and Flame* 159(8), pp. 2690–2703.

21. Bennett, J.C., Krishnamoorthy, V., Liu, S., Grout, R.W., Hawkes, E.R., Chen, J.H., Shepherd, J., Pascucci, V., Bremer, P.-T., (2011), Feature-based statistical analysis of combustion simulation data, *IEEE Transactions on Visualization and Computer Graphics* 17(12), pp. 1822-1831.

22. Yoo C.S., Lu T., Chen J.H., Law C.K., (2011), Direct numerical simulations of ignition of a lean n-heptane/air mixture with temperature inhomogeneities at constant volume: Parametric study, *Combustion and Flame* 158(9), pp. 1727-1741.

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25. Hawkes, E.R., Sankaran, R., Chen, J.H., (2011), Estimates of the three-dimensional flame surface density and every term in its transport equation from two-dimensional measurements, _Proceedings of the Combustion Institute_ 33(1), pp. 1447-1454.

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27. Wang, L., Hawkes, E.R., Chen, J.H., (2011), Flame edge statistics in turbulent combustion, _Proceedings of the Combustion Institute_ 33(1), pp. 1439-1446.

28. Yoo C.S., Richardson E.S., Sankaran R., Chen J.H., (2011), A DNS study on the stabilization mechanism of a turbulent lifted ethylene jet flame in highly-heated coflow, _Proceedings of the Combustion Institute_ 33(1), pp. 1619-1627.

29. Chen J.H., (2011), Petascale direct numerical simulation of turbulent combustion - Fundamental insights towards predictive models, _Proceedings of the Combustion Institute_ 33(1), pp. 99-123. (Plenary Paper)

30. Richardson E.S., Granet V.E., Eyssartier A., Chen J.H. (2010), Effects of equivalence ratio variation on lean, stratified methane-air laminar counterflow flames, _Combustion Theory and Modelling_ 14(6), pp. 775-792.

31. Yu H., Wang C., Grout R.W., Chen J.H., Ma K.-L., (2010), In situ visualization for large-scale combustion simulations, _IEEE Computer Graphics and Applications_ 30(3), pp. 45-57.

32. Gruber, A., Sankaran, R., Hawkes, E.R., Chen, J.H., (2010), Turbulent flame–wall interaction: a direct numerical simulation study, _Journal of Fluid Mechanics_ 658, pp. 5-32. [**Featured in Focus on Fluids**]

33. Lu T, Yoo, C.S., Chen, J.H., Law, C.K., (2010), Three-dimensional direct numerical simulation of a turbulent lifted hydrogen/air jet flame in heated coflow: explosive mode analysis, _Journal of Fluid Mechanics_ 652, pp. 453-481.

34. Richardson, E.S., Sankaran, R., Grout, R.W., Chen, J.H., (2010), Numerical analysis of reaction-diffusion effects in turbulent premixed methane-air combustion, *Combustion and Flame* 157, pp. 506-515.

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36. Yoo, C.S., Sankaran, R., Chen, J.H., (2009), Three-dimensional direct numerical simulation of a turbulent lifted hydrogen/air jet flame in heated coflow: stabilization and structure, *Journal of Fluid Mechanics* 460, pp. 453-48.

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38. Bisetti, F., Chen, J.Y., Chen, J.H., Hawkes, E.R., (2009), Differential diffusion effects during the ignition of a thermally stratified premixed hydrogen-air mixture subject to turbulence, *Proceedings of the Combustion Institute* 32(1), pp. 1465-1472.

39. Richardson, E.S., Yoo, C.S., and Chen, J.H., (2009), Analysis of second-order conditional moment closure applied to an autoignitive lifted hydrogen jet flame, *Proceedings of the Combustion Institute* 32(2) pp. 1695-1703.

40. Lee, U.D., Yoo, C.S., Chen, J.H., and Frank, J.H., (2009), Effects of H_2O and NO on extinction and reignition of vortex-perturbed hydrogen counterflow flames, *Proceedings of the Combustion Institute* 32(1) pp. 1059-1066.

41. Lignell, D., Hewson, J.C. and Chen, J.H., (2009), A priori analysis of conditional moment closure modeling of a temporal ethylene jet flame with soot formation using DNS, *Proceedings of the Combustion Institute* 32(1):1491-1498.

42. Yoo, C.S., Chen, J.H., Frank, J.H., (2009), A numerical study of transient ignition and flame characteristics of diluted hydrogen versus heated air in counterflow, *Combustion and Flame* 156(1) 140-151.

43. Lu, T., Law, C.K., Yoo, C.S., and Chen, J.H., (2009), Dynamic stiffness removal for direct numerical simulation, *Combustion and Flame* 156(8), pp. 1542-1551.

44. Chen, J.H., Choudhary, A., de Supinski, B., DeVries, M., Hawkes, E.R., Klasky, S., Liao, W.K., Ma, K.L., Mellor-Crummey, J., Podhorski, N., Sankaran, R., Shende, S., Yoo, C.S., (2009), Terascale direct numerical simulations of turbulent combustion using s3d, *Computational Science and Discovery* 2.

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46. Chakraborty, N., Hawkes, E.R., Chen, J.H., Cant, R.S., (2008), The effects of strain rate and curvature on surface density function transport in turbulent premixed methane-air and hydrogen-air flames: a comparative study, _Combustion and Flame_ 154, pp. 259-280.

47. Lignell, D., Chen, J.H., and Smith, P.J., (2008), Three-dimensional DNS of soot formation and transport in a temporally-evolving non-premixed ethylene jet flame, _Combustion and Flame_ 155, pp. 316-333.

48. Hawkes, E.R., Sankaran, R., Sutherland, J.C., Chen, J.H., (2007), Scalar mixing in direct numerical simulation of temporally evolving plane jet flames with skeletal CO/H_2 kinetics, _Proceedings of the Combustion Institute_ 31, pp. 1633-1640.

49. Sankaran, R., Hawkes, E.R., Chen, J.H., Lu, T., Law, C.K., (2007), Structure of a spatially developing lean methane-air Bunsen flame, _Proceedings of the Combustion Institute_ 31, pp. 1291-1298.

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51. Lignell, D.O., Chen, J.H., Smith, P.J., Lu, T., Law, C.K., (2007), The effect of flame structure on soot formation and transport in turbulent nonpremixed flames using direct numerical simulation, _Combustion and Flame_ 151, pp. 2-28.

52. Sutherland, J.C., Smith, P.J., Chen, J.H. (2007), A quantitative method for a priori evaluation of combustion reaction models, _Combustion Theory and Modelling_ 11(2), pp. 287-303.

53. Akiba, H., Ma, K.-L., Chen, J.H., Hawkes, E.R., (2007), Visualizing multivariate volume data from turbulent combustion simulations, _Computing in Science and Engineering_ 9(2), pp. 76-83.

54. Liu, S., Hewson, J.C., Chen, J.H., (2006), Nonpremixed n-heptane autoignition in unsteady counterflow, _Combustion and Flame_ 145, pp. 730-739.

55. Chen, J.H., Hawkes, E.R., Sankaran, R., Im, H.G., (2006), Direct Numerical Simulation of ignition front propagation in a constant volume with temperature inhomogeneities, Part I: Fundamental analysis, _Combustion and Flame_ 145, pp. 128-144.

56. Hawkes, E.R., Sankaran, R., Pébay, P.P., Chen, J.H., (2006), Direct numerical simulation of ignition front propagation in a constant volume with temperature inhomogeneities, Part II: Parametric study and multi-zone model predictions, _Combustion and Flame_ 145, pp. 145-159.

57. Hawkes, E.R., Chen, J.H., (2005), Comparison of direct numerical simulation of lean premixed methane-air flames with strained laminar flame calculations, *Combustion and Flame* 144, pp. 112-125.

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63. Liu S., Hewson J.C., Chen J.H., Pitsch H., (2004), Effects of strain rate on high-pressure nonpremixed n-heptane autoignition in counterflow, *Combustion and Flame* 137(3).

64. Echekki T., Chen J.H., (2004), Direct numerical simulation of autoignition in non-homogeneous hydrogen-air mixtures, *Combustion and Flame* 134(3).

65. Echekki, T. and Chen, J.H., (2003), Direct numerical simulation of autoignition in non-homogeneous hydrogen-air mixtures, *Combustion and Flame*, **134**:169-191.

66. Echekki, T. and Chen, J.H., (2002) High-temperature combustion in autoigniting non-homogeneous hydrogen-air mixtures, *Proceedings of the Combustion Institute,* **29**: 2061-2068.

67. Im, H.G. and Chen, J.H., (2002) Direct numerical simulation of turbulent premixed flame interaction, *Combustion and Flame*, **131**:246-258.

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74. Im, H.G., Chen, J.H and Chen, J.Y., (1999) Chemical Response of Methane/Air Diffusion Flames to Unsteady Strain Rate, *Combustion and Flame,* **118**, 204.

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Refereed Computer Science Articles

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