Curriculum Vitae

Alan Robert Kerstein
72 Lomitas Road
Danville, CA 94526
phone: (925) 820-5063
email: alan.kerstein@gmail.com

Consultant:
Random Processes in Energy and Environmental Sciences and Engineering

Clients to date:
Brandenburg University of Technology, Cottbus, Germany
Chalmers University of Technology, Gothenburg, Sweden
Combustion Science and Engineering, Columbia, Maryland
Sandia National Laboratories, Albuquerque, New Mexico
SINTEF Energy Research, Trondheim, Norway

Graduate Education: Ph.D. in Applied Mathematics, Princeton University, 1976

National Science Foundation Fellowship
Woodrow Wilson Fellowship
IBM Research Fellowship

Past Employment: Sandia National Laboratories

Member of Technical Staff, 1976-1993
Distinguished Member of Technical Staff, 1993-2011

Affiliations: Fellow, American Physical Society
Adjunct Professor of Chemical Engineering, University of Utah
Adjunct Professor of Atmospheric Sciences, University of Utah

Professional Service: External reviewer for numerous journals and research sponsors
Editorial Board, Physical Review E, 2006 – 2011
American Physical Society Outstanding Referee, 2013
Advisory Board, SciDAC Computational Astrophysics Consortium, 2008 – 2010
Scientific Committee, Center for Environmentally Friendly Energy Research, 2010 – present

Significant Accomplishments:

1. Developed the Linear Eddy Model, a turbulent mixing model that provides new capabilities for turbulent reacting flow simulation.
2. Contributed to the development of the Chemical Percolation Model and the Flashchain Model for coal devolatilization. Both are currently used in research studies, and Flashchain has been incorporated into commercial software.
3. Developed a novel approach, based on percolation theory, for modeling the burning rate of heterogeneous solid propellants that is now used commercially for propellant design.
4. Formulated and proved a theorem in percolation theory that led to a new computational algorithm used in condensed matter simulations.

5. Pioneered the application of the G-equation level-set method to turbulent combustion simulations.
6. Discovered a new scaling law governing the weak-turbulence limit of premixed flame propagation.
7. Discovered a new scaling law governing differential diffusion in combustion that indicates its importance in highly turbulent non-premixed flames.
8. Proposed experiments that were subsequently performed: Liquid analog of turbulent premixed combustion; multiple-stream mixing in a turbulent jet; detection of a new regime of pipe-flow mixing.
9. Broadened the Linear Eddy approach to formulate One-Dimensional Turbulence, a turbulence model that provides new predictive capabilities for many turbulent flows and turbulence-microphysics interaction phenomena.
10. Mentored 9 postdoctoral associates.
11. Co-mentored numerous graduate students in partnership with university researchers.
12. Author or co-author of over 120 journal publications.

Recent publications:

1. S. Sannan, T. Weydahl, and A. R. Kerstein, "Stochastic Simulation of Scalar Mixing Capturing Unsteadiness and Small-Scale Structure Based on Mean-Flow Properties," Flow Turbul. Combust. **90**, 189 (2013).
2. H. Schmidt, A. R. Kerstein, S. Wunsch, R. Nedelec, and B. J. Sayler, "Analysis and Numerical Simulation of a Laboratory Analog of Radiatively Induced Cloud-Top Entrainment," Theor. Comput. Fluid Dyn. **27**, 377 (2013).
3. A. R. Kerstein, "Hierarchical Parcel-Swapping Representation of Turbulent Mixing. Part 1. Formulation and Scaling Properties," J. Stat. Phys. **153**, 142 (2013).
4. D. O. Lignell, A. R. Kerstein, G. Sun, and E. I. Monson, "Mesh Adaption for Efficient Multiscale Implementation of One-Dimensional Turbulence," Theor. Comput. Fluid Dyn. **27**, 273 (2013).
5. E. D. Gonzalez-Juez, A. R. Kerstein, and D. O. Lignell, "Reactive Rayleigh-Taylor Turbulent Mixing: A One-Dimensional-Turbulence Study," Geophys. Astrophys. Fluid Dyn. **107**, 506 (2013).
6. O. Chatakonda, E. R. Hawkes, A. J. Aspden, A. R. Kerstein, H. Kolla, and J. H. Chen, "On The Fractal Characteristics of Low Damk¨ohler Number Flames," Combust. Flame **160**, 2422 (2013).
7. F. T. Schulz, C. Glawe, H. Schmidt, and A. R. Kerstein, "Toward Modeling of CO2 Multi-phase Flow Patterns using a Stochastic Multi-scale Approach," Environ. Earth Sci. **70**, 3739 (2013).
8. A. R. Kerstein, "Hierarchical Parcel-Swapping Representation of Turbulent Mixing. Part 2. Application to Channel Flow," J. Fluid Mech. **750**, 421 (2014).
9. H. Kolla, E. R. Hawkes, A. R. Kerstein, N. Swaminathan, and J. H. Chen, "On Velocity and Reactive Scalar Spectra in Turbulent Premixed Flames," J. Fluid Mech. **754**, 456 (2014).
10. A. Gruber, A. R. Kerstein, D. Valiev, C. K. Law, H. Kolla, and J. H. Chen, "Modelling of Mean Flame Shape During Premixed Flame Flashback in Turbulent Boundary Layers," Proc. Combust. Inst. **35**, 1485 (2015).
11. E. I. Monson, D. O. Lignell, M. A. Finney, C. Werner, Z. Jozefik, A. R. Kerstein, and R. S. Hintze, "Simulation of an Ethylene Wall Fire Using the Spatially-Evolving One-Dimensional Turbulence Model," Fire Technol., in press (2015).
12. Z. Jozefik, A. R. Kerstein, H. Schmidt, S. Lyra, H. Kolla, J. H. Chen, "One-Dimensional Turbulence Simulation of a Turbulent Counterflow Flame with Comparison to DNS," Combust. Flame, in press (2015).
13. Z. Jozefik, A. R. Kerstein, H. Schmidt, S. Lyra, H. Kolla, J. H. Chen, "Simulation of shock-turbulence interaction in non-reactive flow and in turbulent deflagration and detonation regimes using one-dimensional turbulence," submitted to Combust. Flame (2015).

Recent Invited Presentations:

1. "Formulation and Application of a Sparse-Modes Method for Turbulence Simulation," Graduate Seminar, Brigham Young Univ., Jan. 2013.

2. "Turbulence Still Surprises: Explorations Using a 1D Model," Presidential Lecture, Univ. of Utah, Mar. 2013.
3. "Strategies for Economical Resolution of All Relevant Scales in Turbulent Combustion Models," Workshop on Interactions Between Small and Large Scales in Turbulent Combustion, San Antonio, TX, April 2013.
4. "Turbulence Still Surprises: Explorations Using a 1D Model," Chalmers Univ. of Technology, April 2013.
5. "Map-Based Advection, Low-Dimensional Simulation, and Superparameterization: Tools for Cost-Effective Simulation of Turbulent Atmospheric Phenomena," German Research Center for Geosciences, May 2013.
6. "Fundamental Analysis and Prediction of Turbulent Premixed Combustion: Status and Prospects," Topical Review, 9th Asia-Pacific Conference on Combustion, May 2013.
7. "Turbulence Still Surprises: Explorations Using a 1D Model," Pohang Univ. of Science and Technology, May 2013.
8. "Turbulence Still Surprises: Explorations Using a 1D Model," Technical University of Dresden, Oct. 2013.
9. "Hierarchical Parcel-Swapping (HiPS) Representation of Turbulent Flow and Mixing," Center for Turbulence Research, Stanford Univ., July 2014.
10. "Hierarchical Parcel-Swapping (HiPS) Representation of Turbulent Flow and Mixing," Institute for Pure and Applied Mathematics, UCLA, Nov. 2014.
11. "Hierarchical Parcel-Swapping (HiPS) Representation of Turbulent Flow and Mixing," Graduate Seminar, Brigham Young Univ., Mar. 2015.
12. "Coal Kinetics for CFD," Workshop on Coal and Biomass Conversion, Avignon, France, Apr. 2015.
13. "Turbulence Still Surprises: Explorations Using a 1D Model," North Carolina State University, May 2015.
14. "The ODTLES strategy for economical small-scale resolution in 3D turbulence simulations," International Conference on Model Integration across Disparate Scales in Complex Turbulent Flow Simulation, Penn State Univ., June 2015.
15. "Hierarchical Parcel-Swapping (HiPS) Representation of Turbulent Flow and Mixing," Meteorology Seminar, Penn State Univ., June 2015.
16. "Turbulence Still Surprises: Explorations Using a 1D Model," Engineering Seminar, Penn State Univ., June 2015.