

David B. Rich, PhD

Reax Engineering, Inc.
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Current Positions

Principal Engineer, Reax Engineering Inc., Berkeley, CA
Post Doctoral Researcher, University of California, Berkeley, Combustion and Fire Processes Laboratories
Adjunct Professor, Santa Clara University, Santa Clara, CA

Education

PhD – Mechanical Engineering (major field: combustion), University of California, Berkeley, 2006
MS – Mechanical Engineering, University of California, Berkeley, 2002
BS – Mechanical Engineering, University of California, Berkeley, 2000

Overview

Dr. Rich brings a diverse background to the field of engineering with research and development experience in combustion, bioengineering and mechanical design in both the academic and private sector. Dr. Rich is an Adjunct Professor of thermal fluid sciences at Santa Clara University, conducts Post Doctoral research in the Combustion and Fire Processes Laboratory at the University of California, and provides engineering support to the private sector in support of product design, legal issues and infrastructure development. Dr. Rich has background as a Rescue Captain and Paramedic with the San Francisco Fire Department which brings a pragmatic and disciplined approach to his work. His work there included authorship of municipal disaster plans and training of top level city administrators in implementing them, which developed skills in leadership and project management.

Dr. Rich's primary area of expertise is development of experimental platforms for the study of fire and combustion phenomena including research into material flammability, internal combustion engine performance, building smoke control and studies of vehicle emissions. Methods include IR thermometry, particle image velocimetry, laser induced fluorescence, continuous mass loss measurement, high speed and IR videography, engine dynamometers, gas sampling, and a range of analog and computer measurement techniques. Work in engine performance, includes mini rotary engine research, piezo-ceramic spark ignition technology and emissions and alternative fuels research. This work includes development of alternative fuels and mitigation of engine pollutants and particulate emissions using a number of innovative methods like ammonia treatment, water injection, bio-fuels, particle traps, afterburning, and radio isotope tracing of particulates. NASA sponsored fire safety research investigated flame propagation rates of through porous media in microgravity and investigation of the mechanisms governing ignition delay and flame spread of materials, particularly composites, intended for use on spacecraft. Building studies include scale modeling and laser imaging of building smoke flows, particularly for innovative ventilation schemes. In bioengineering, projects include tumor ablation with combustion catalytic probes, heat transfer mechanisms and energetics of birds and measurements of the shear strength of post operative bone.

Experience

8/08 – present

Reax Engineering Inc. Berkeley, CA *Founding Partner and Principal Engineer*

- Development of experimental programs in support of product development, thermodynamics, fluid mechanics, heat transfer, instrumentation, control and data acquisition
- Fire litigation support – analysis, modeling, and theory, fire inspections/investigations
- Computer fire modeling: forensic fire reconstruction, prediction of heat release rate via fire growth modeling, fire timeline recreation, time to untenability/incapacitation by smoke or heat, calculation of smoke detector and sprinkler activation times, onset of flashover
- Ignition and flame spread of materials, evolved species, heat transfer and deformation

- 12/07 – present **University of California, Berkeley Post Doctoral Researcher**
- Development of carbon neutral fuels from cellulosic feedstock
 - Scale model and laser imaging of building smoke flows for innovative ventilation (under floor, natural) systems and validation of FDS models
 - Combustion testing and modeling to characterize fuels and measure energy efficiency of specially developed stoves for use in developing countries (<http://darfurstoves.org/>)
- 1/07 – 8/08 **Arup Fire San Francisco, CA Fire Protection Specialist**
- Worked in conjunction with engineering teams, architects, and approving authorities, to develop integrated fire safety strategies for buildings and transportation systems.
 - Applied current fire safety procedures including performance based design supported by analytical and numerical models.
 - Developed and currently manage a wind tunnel research program investigating smoke flow in large structures subject to wind pressures.
- 9/00 – 12/06 **University of California, Berkeley Graduate Student Researcher**
- Served as experimental lead on Forced Ignition and Flame Spread Test (FIST) project, a NASA funded research program to assess flammability of materials in terrestrial and reduced gravity conditions. This work included three tours on NASA’s microgravity research aircraft.
 - Responsibilities included experimental program development and management, cost control and collaboration with engineering groups at NASA’s Glenn Research Center, Cleveland.
- 9/00 – 8/08 **Independent technical consultant for fire-related litigation and research Berkeley, CA**
- Conducted laboratory experiments, numerical modeling, deposition review, and background research in support of fire related litigation, particularly cause and origin. Projects included vehicle, industrial and residential structure fires including the urban wildland interface. Fire causes included electrical failure, liquid fires, self-heating to ignition, and mechanical failure.
 - Developed exhaust emission mitigation technologies for several engine types including use of bio-diesel and water and ammonia injection technologies.
- 06/99 – 09/00 **Mide Technology Corporation Cambridge, MA Engineer**
- Developed and managed engineering projects for private and government clients applying “smart materials” (shape memory alloys, super absorbent gels, piezo ceramics).
- 07/91 – 06/99 **San Francisco Fire Department San Francisco, CA Paramedic/Rescue Captain**
- Provided 911 emergency services and community disaster training to the County of San Francisco with the San Francisco Department of Public Health and Fire Department.
 - Implemented a federally funded multi-agency program to manage casualties of nuclear, biological or chemical weapons and wrote the SFFD Prehospital Medical Disaster Plan.

Selected Publications

1. Bar-Ilan, A., Rich, D., Rein, G., & Fernandez-Pello, A.C., “Flow-Assisted Flame Propagation through a Porous Combustible in Microgravity,” *Western States Section/The Combustion Institute*, San Diego, CA, 2002.
2. Cheng, E.S., Rich, D., Dibble R.W., & Buckholz, B.A., “Quantifying the Contribution of Lubrication Oil to Particulate Emissions from a Diesel Engine,” *Journal of the Society of Automotive Engineers*, 2003.
3. Lautenberger, C., Stevanovic, A., Rich, D., & Torero, J., “Effect of Material Composition on Ignition Delay of Composites,” *Composites 2003*, Anaheim CA, October 2003.
4. Lautenberger, C., Stevanovic, A., Rich, D., Torero, J. & Fernandez-Pello, A.C., “An Experimental and Theoretical Study on the Ignition Delay Time of Composite Materials,” *Western States Section/The Combustion Institute*, Los Angeles CA, October 2003.
5. Rich, D., Lautenberger, C., Stevanovic, A., Mehta, S., Torero, J., Yuan, Z., Ross, H., Fernandez-Pello, C., “Piloted Ignition of Polypropylene/Glass Composites in a Forced Air Flow,” *7th International Workshop on Microgravity Combustion and Chemically Reacting Systems*, Cleveland, OH, 2003.
6. Lautenberger, C., Rich, D., Yuan, Z., & Fernandez-Pello, C., “Modeling Ignition of Solid Combustibles in Normal and Micro Gravity,” Work in progress poster presented at the *30th International Symposium on Combustion*. Chicago, IL, 2004.

7. Rich, D., Lautenberger, C., Hernandez, J., & Fernandez-Pello, A.C. "Effect of Environmental Variables on Critical Pyrolysate Mass Flux for Piloted Ignition of PMMA and PP/GL Composite," *Proceedings of the 4th Mediterranean Combustion Symposium*, Lisbon, Portugal, 2005.
8. Rich, D., Lautenberger, C., McAllister, S. & Fernandez-Pello, A.C., "Microgravity Flame Spread Rates Over Samples of Polymer and Polymer/Glass Composites," *Western States Section/The Combustion Institute*, Boise ID, March 2006.
9. Lautenberger, C., McAllister, S., Rich, D., & Fernandez-Pello, C., "Modeling the Effect of Environmental Variables on Opposed-Flow Flame Spread Rates with FDS," *International Congress on Fire Safety in Tall Buildings*, Santander, Spain, October 2006.
10. Rich, D., Lautenberger, C., Torero, J.L., Quintiere, J.G. & Fernandez-Pello, C., "Mass Flux of Combustible Solids at Piloted Ignition," *Proceedings of the Combustion Institute* **31** 2653-2660 (2007).
11. McAllister, S., Rich, D., Lautenberger, C., & Fernandez-Pello, C., "Modeling Microgravity and Normal Gravity Opposed Flame Spread over Polymer/Glass Composites," *45th AIAA Aerospace Sciences Meeting and Exhibit*, Reno, NV, January 2007, AIAA Paper 2007-740.
12. Lautenberger, C., McAllister, S., Rich, D., & Fernandez-Pello, C., "Effect of Environmental Variables on Flame Spread Rates in Microgravity," *45th AIAA Aerospace Sciences Meeting*, Reno, NV, Jan. 2007, AIAA 2007-383.
13. McAllister, S., Rich, D., Lautenberger, C., Fernandez-Pello, C. & Yuan, Z.G., "Modeling Microgravity and Normal Gravity Flame Spread Rates over Samples of Polymer and Polymer/Glass Composites," *Fifth International Seminar on Fire and Explosion Hazards*, Edinburgh, UK, April 2007.

Other Publications and Projects

- San Francisco Public Utilities Commission, Emergency Operations Plan and Field Operations Guide, 2008.
- San Francisco Fire Department PreHospital Emergency Operations Plan and Field Operations Guide, 2000.
- Darfur Stoves Project, Director of combustion testing to characterize fuels and measure energy efficiency of specially developed stoves for use in developing countries.

Journal Referee / Peer Review

- *Fire Safety Journal*
- *Fire Science and Technology*
- *Fire Technology*
- *Mediterranean Combustion Symposia*
- *Proceedings of the Combustion Institute*

Professional Societies

- Society of Fire Protection Engineers (SFPE)
- National Fire Protection Association (NFPA)
- American Society for Testing and Materials (ASTM)