Stanford



Christopher Edwards

Professor of Mechanical Engineering, Emeritus

CONTACT INFORMATION

- **Administrative Contact**

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Bio

BIO

The Edwards research group is focused on fundamental research for advanced energy technologies. The group performs theoretical and experimental studies of energy transformations such that the conversion process can be made cleaner, more efficient, and more controllable than has been possible with traditional technologies. Applications include advanced transportation engines (piston and turbine) and advanced electric power generation with carbon mitigation.

ACADEMIC APPOINTMENTS

- Emeritus Faculty, Acad Council, Mechanical Engineering

HONORS AND AWARDS

- PEP Award-Best Paper of 2009, International Journal of Engine Research (2009)
- Senior Fellow, Precourt Institute for Energy (2009)
- Walter J Gores Award, Stanford University (2008)
- John Henry Samter University Fellow in Undergraduate Education, Stanford University (2008-2012)
- The Rudolf Kalman Award, ASME Dynamic Systems and Control Division (2005)
- John Henry Samter University Fellow in Undergraduate Education, Stanford University (2002-2007)
- Professor of the Year, Stanford University Society of Women Engineers (2001-2002)
- Tau Beta Pi Undergraduate Teaching Award, Stanford University (2000)
- Phi Beta Kappa Undergraduate Teaching Prize, Stanford University (1999)
- Teacher of the Year, Stanford University Society of Women Engineers (1999)
- The Bing Fellowship, Stanford University (1998-2001)
- Tanasawa Award, International Conference on Liquid Atomization and Spray Systems (1994)
- Adams Award, Sandia National Laboratories (1994)
- W. Robert Marshall Award, Institute of Liquid Atomization and Spray Systems (1994)

- Starkman Memorial Award, University of California, Berkeley (1983)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Distinguished Member of Technical Staff, Sandia National Labs (1995 - 1995)

PROFESSIONAL EDUCATION

- PhD, UC Berkeley , Mechanical Engineering (1985)

Teaching

COURSES

2023-24

- Energy Systems II: Modeling and Advanced Concepts: ME 370B (Win)
- Intermediate Thermodynamics: ME 132 (Aut)

Publications

PUBLICATIONS

- **Maximum-efficiency architectures for heat- and work-regenerative gas turbine engines** *ENERGY*
  Ramakrishnan, S., Edwards, C. F.
  2016; 100: 115-128
- **Maximum-efficiency architectures for steady-flow combustion engines, I: Attractor trajectory optimization approach** *ENERGY*
  Ramakrishnan, S., Edwards, C. F.
  2014; 72: 44-57
- **Maximum-efficiency architectures for steady-flow combustion engines, II: Work-regenerative gas turbine engines** *ENERGY*
  Ramakrishnan, S., Edwards, C. F.
  2014; 72: 58-68
- **Unifying principles of irreversibility minimization for efficiency maximization in steady-flow chemically-reactive engines** *ENERGY*
  Ramakrishnan, S., Edwards, C. F.
  2014; 68: 844-853
- **Prospects for High-Temperature Combustion, Neat Alcohol-Fueled Diesel Engines** *SAE Int. J. Engines*
  Roberts, G., Johnson, B. J., Edwards, C. F.
  2014; 7 (1): 448-457
- **Thermodynamic benchmarking of CO2 capture systems: Exergy analysis methodology for adsorption processes** *12TH INTERNATIONAL CONFERENCE ON GREENHOUSE GAS CONTROL TECHNOLOGIES, GHGT-12*
  Calbry-Muzyka, A. S., Edwards, C. F.
  2014; 63: 1-17
- **Overcoming Pressure Waves to Achieve High Load HCCI Combustion** *SAE 2014 World Congress & Exhibition*
  Blumreiter, J., Edwards, C. F.
  2014
- **Homogeneous charge compression ignition with nondilute stoichiometric methane-air at extreme compression ratios** *INTERNATIONAL JOURNAL OF ENGINE RESEARCH*
  Svrcek, M. N., Edwards, C. F.
  2013; 14 (5): 479-495
- **The utility of environmental exergy analysis for decision making in energy** *ENERGY*
  Simpson, A. P., Edwards, C. F.
  2013; 55: 742-751

- **SUPERCRITICAL AUTO-THERMAL RANKINE (SCATR) SYSTEM: HIGH EFFICIENCY FOSSIL FUEL BASED ELECTRICITY WITH INTRINSIC CARBON SEPARATION** *ASME International Mechanical Engineering Congress and Exposition*
  Calbry-Muzyka, A. S., Mobley, P. D., Edwards, C. F.
  AMER SOC MECHANICAL ENGINEERS.2013: 265–274
- **Exploring the Pathway to High Efficiency IC Engines through Exergy Analysis of Heat Transfer Reduction** *SAE Int. J. Engines*
  Johnson, B. J., Edwards, C. F.
  2013; 6 (1): 150-166
- **Understanding the Thermodynamic Possibilities and Limitations of the Solid-oxide Fuel Cell, Gas Turbine Double Cycle** *11th International Energy Conversion Engineering Conference*
  Pass, R. Z., Ramakrishnan, S., Edwards, C. F.
  2013
- **EXERGY ANALYSIS OF A SOLID-OXIDE FUEL CELL, GAS TURBINE, STEAM TURBINE TRIPLE-CYCLE POWER PLANT** *ASME International Mechanical Engineering Congress and Exposition*
  Pass, R. Z., Edwards, C. F.
  AMER SOC MECHANICAL ENGINEERS.2013: 255–263
- **Emissions from an extreme-compression, free-piston engine with diesel-style combustion** *INTERNATIONAL JOURNAL OF ENGINE RESEARCH*
  Svrcek, M. N., Edwards, C. F.
  2012; 13 (3): 238-252
- **EXERGY ANALYSIS OF COAL ENERGY CONVERSION WITH CARBON SEQUESTRATION VIA COMBUSTION IN SUPERCRITICAL SALINE AQUIFER WATER** *ASME 5th International Conference on Energy Sustainability*
  Mobley, P. D., Pass, R. Z., Edwards, C. F.
  AMER SOC MECHANICAL ENGINEERS.2012: 1987–1995
- **Optimal Architecture for Efficient Simple-Cycle Steady-Flow Combustion Engines** *JOURNAL OF PROPULSION AND POWER*
  Ramakrishnan, S., Teh, K., Miller, S. L., Edwards, C. F.
  2011; 27 (4): 873-883
- **Assessing the feasibility of increasing engine efficiency through extreme compression** *INTERNATIONAL JOURNAL OF ENGINE RESEARCH*
  Miller, S. L., Svrcek, M. N., Teh, K., Edwards, C. F.
  2011; 12 (3): 293-307
- **An exergy-based framework for evaluating environmental impact** *ENERGY*
  Simpson, A. P., Edwards, C. F.
  2011; 36 (3): 1442-1459
- **Requirements for designing chemical engines with reversible reactions** *ENERGY*
  Miller, S. L., Svrcek, M. N., Teh, K., Edwards, C. F.
  2011; 36 (1): 99-110
- **A Methodology for Determining Optimal Architectures for Heat-and-Work Regenerative Steady-Flow Combustion Engines** *42nd AIAA Thermophysics Conference*
  Ramakrishnan, S., Edwards, C. F.
  2011
- **DIESEL SPRAY BEHAVIOR AT COMPRESSION RATIOS UP TO 100:1** *ATOMIZATION AND SPRAYS*
  Svrcek, M. N., Miller, S. L., Edwards, C. F.
  2010; 20 (5): 453-465
- **IDENTIFICATION OF OPTIMAL ARCHITECTURE FOR EFFICIENT SIMPLE-CYCLE GAS TURBINE ENGINES** *ASME International Mechanical Engineering Congress and Exposition*
  Ramakrishnan, S., Teh, K., Edwards, C. F.
  AMER SOC MECHANICAL ENGINEERS.2010: 539–548

- **REDUCING COMBUSTION IRREVERSIBILITY THROUGH EXTREME COMPRESSION: ANALYZING DEVICE PERFORMANCE** *ASME International Mechanical Engineering Congress and Exposition*
  Miller, S. L., Svrcek, M. N., Wilson, J. N., LaCroix, O., Edwards, C. F.
  AMER SOC MECHANICAL ENGINEERS.2010: 239–248

- **Coal energy conversion with carbon sequestration via combustion in supercritical saline aquifer water** *INTERNATIONAL JOURNAL OF GREENHOUSE GAS CONTROL*
  Heberle, J. R., Edwards, C. F.
  2009; 3 (5): 568-576

- **Understanding chemical effects in low-load-limit extension of homogeneous charge compression ignition engines via recompression reaction** *INTERNATIONAL JOURNAL OF ENGINE RESEARCH*
  Song, H. H., Edwards, C. F.
  2009; 10 (4): 231-250

- **Experimental study of recompression reaction for low-load operation in direct-injection homogeneous charge compression ignition engines with n-heptane and i-octane fuels** *INTERNATIONAL JOURNAL OF ENGINE RESEARCH*
  Song, H. H., Padmanabhan, A., Kaahaaina, N. B., Edwards, C. F.
  2009; 10 (4): 215-229

- **Coal energy conversion with carbon sequestration via combustion in supercritical saline aquifer water** *GREENHOUSE GAS CONTROL TECHNOLOGIES 9*
  Heberle, J. R., Edwards, C. F.
  2009; 1 (1): 4055-4062

- **Thermodynamic requirements for maximum internal combustion engine cycle efficiency. Part 2: work extraction and reactant preparation strategies** *INTERNATIONAL JOURNAL OF ENGINE RESEARCH*
  Teh, K., Miller, S. L., Edwards, C. F.
  2008; 9 (6): 467-481

- **Thermodynamic requirements for maximum internal combustion engine cycle efficiency. Part 1: optimal combustion strategy** *INTERNATIONAL JOURNAL OF ENGINE RESEARCH*
  Teh, K., Miller, S. L., Edwards, C. F.
  2008; 9 (6): 449-465

- **An optimal control approach to minimizing entropy generation in an adiabatic internal combustion engine** *JOURNAL OF DYNAMIC SYSTEMS MEASUREMENT AND CONTROL-TRANSACTIONS OF THE ASME*
  Teh, K., Edwards, C. F.
  2008; 130 (4)

- **Effects of pressure on performance of mesoscale burner arrays for gas-turbine applications** *JOURNAL OF PROPULSION AND POWER*
  Bardos, A., Walters, K. M., Boutross, M. G., Lee, S., Edwards, C. F., Bowman, C. T.
  2007; 23 (4): 884-886

- **Mesoscale burner Arrays for gas-turbine reheat applications** *JOURNAL OF PROPULSION AND POWER*
  Lee, S., Svrcek, M., Edwards, C. F., Bowman, C. T.
  2006; 22 (2): 417-424

- **Experimental study of confined, swirling, nonpremixed gas flame for validation of simulations** *JOURNAL OF PROPULSION AND POWER*
  Tribbett, E. J., Sipperley, C. M., Huh, J. Y., Edwards, C. F., Bowman, C. T.
  2006; 22 (1): 158-168

- **An optimal control approach to minimizing entropy generation in an adiabatic internal combustion engine** *45th IEEE Conference on Decision and Control*
  Teh, K., Edwards, C. F.
  IEEE.2006: 6648–6653

- **Dynamic modeling of residual-affected homogeneous charge compression ignition engines with variable valve actuation** *JOURNAL OF DYNAMIC SYSTEMS MEASUREMENT AND CONTROL-TRANSACTIONS OF THE ASME*
  Shaver, G. M., Gerdes, J. C., Roelle, M. J., Caton, P. A., Edwards, C. F.
  2005; 127 (3): 374-381

- **Strategies for Achieving Residual-Effected HCCI Using Variable Valve Actuation.** *SAE. Doc.*
  Caton, P. A., Song, H. H., Kaahaaina, N. B., Edwards, C. F.
  2005
- **A physics-based approach to the control of homogeneous charge compression ignition engines with variable valve actuation** *International Journal of Engine Research*
  Shaver, G. M., Roelle, M. J., Caton, P. A., Kaahaaina, N. B., Ravil, N., Hathout, J., Ahmed, J., Park, S., Edwards, C. F., Gerdes, J. C.
  2005; 6 (4): 361-375
- **Residual-Effected Homogeneous Charge Compression Ignition with Delayed Intake Valve Closing at Elevated Compression Ratio** *International Journal of Engine Research*
  Caton, P. A., Song, H. H., Kaahaaina, N. B., Edwards, C. F.
  2005; 6 (4): 399-419(21)
- **RP of Si3N4 burner arrays via assembly mould SDM** *RAPID PROTOTYPING JOURNAL*
  Liu, H. C., Lee, S., Kang, S., Edwards, C. F., Prinz, F. B.
  2004; 10 (4): 239-246
- **Computation of spray dynamics by moment transport equations I: Theory and development** *ATOMIZATION AND SPRAYS*
  Archambault, M. R., Edwards, C. F., MacCormack, R. W.
  2003; 13 (1): 63-87
- **Residual-effected homogeneous charge compression ignition at a low compression ratio using exhaust reinduction** *International Journal of Engine Research*
  Caton, P. A., Simon, A. J., Gerdes, J. C., Edwards, C. F.
  2003; 4 (3): 163-177
- **Computation of spray dynamics by moment transport equations II: Application to calculation of a quasi-one-dimensional spray** *ATOMIZATION AND SPRAYS*
  Archambault, M. R., Edwards, C. F., MacCormack, R. W.
  2003; 13 (1): 89-115
- **Development of a temporally modulated fuel injector with controlled spray dynamics** *46th International Gas Turbine and Aeroengine Congress and Exhibition*
  Chang, H., Nelson, D., Sipperley, C., Edwards, C.
  ASME-AMER SOC MECHANICAL ENG.2003: 284–91
- **Modeling for control of HCCI engines** *Annual American Control Conference (ACC 2003)*
  Shaver, G. M., Gerdes, J. C., Jain, P., Caton, P. A., Edwards, C. F.
  IEEE.2003: 749–754
- **Quasi-steady deformation and drag of uncontaminated liquid drops** *INTERNATIONAL JOURNAL OF MULTIPHASE FLOW*
  Helenbrook, B. T., Edwards, C. F.
  2002; 28 (10): 1631-1657
- **Toward a comprehensive theory of dense spray flows** *ATOMIZATION AND SPRAYS*
  Edwards, C. F.
  2000; 10 (3-5): 335-353
- **Computation of spray dynamics by direct solution of moment transport equations** *38th Aerospace Sciences Meeting and Exhibit*
  Archambault, M. R., Edwards, C. F.
  2000
- **The Point-Particle/Continuum-Field Theory of Spray Flows** *International Journal of Fluid Mechanics Research*
  Edwards, C. F.
  1997; 24 (1-3): 149-159
- **Single-point statistics of ideal sprays .1. Fundamental descriptions and derived quantities** *ATOMIZATION AND SPRAYS*
  Edwards, C. F., Marx, K. D.
  1996; 6 (5): 499-536

- **Effect of fuel gas composition and excess air on VOC emissions from a small-scale, industrial-style burner** *4th International Congress on Toxic Combustion Byproducts*
  Edwards, C. F., Goix, P. J.
  TAYLOR & FRANCIS INC.1996: 375–97
- **MULTIPOINT STATISTICAL STRUCTURE OF THE IDEAL SPRAY, PART I: FUNDAMENTAL CONCEPTS AND THE REALIZATION DENSITY** *Atomization and Sprays*
  Edwards, C. F., Marx, K. D.
  1995; 5 (4 & 5): 435-455
- **MULTIPOINT STATISTICAL STRUCTURE OF THE IDEAL SPRAY, PART II: EVALUATING STEADINESS USING THE INTERPARTICLE TIME DISTRIBUTION** *Atomization and Sprays*
  Edwards, C. F., Marx, K. D.
  1995; 5 (4 & 5): 457-505
- **STRUCTURE OF A METHANOL AIR COAXIAL REACTING SPRAY NEAR THE STABILIZATION REGION** *COMBUSTION AND FLAME*
  Goix, P. J., Edwards, C. F., Cessou, A., DUNSKY, C. M., Stepowski, D.
  1994; 98 (3): 205-219
- **LIMITATIONS OF THE IDEAL PHASE-DOPPLER SYSTEM - EXTENSION TO SPATIALLY AND TEMPORALLY INHOMOGENEOUS PARTICLE FLOWS** *ATOMIZATION AND SPRAYS*
  Marx, K. D., Edwards, C. F., Chin, W. K.
  1994; 4 (1): 1-40
- **LIMITATIONS OF THE IDEAL PHASE-DOPPLER SYSTEM: EXTENSION TO SPATIALLY AND TEMPORALLY INHOMOGENEOUS PARTICLE FLOWS** *Atomization and Sprays*
  Marx, K. D., Edwards, C. F., Chin, W. K.
  1994; 4 (1): 1-40
- **SPATIAL STRUCTURE OF A CONFINED SWIRLING FLOW USING PLANAR ELASTIC SCATTER IMAGING AND LASER-DOPPLER VELOCIMETRY** *FUEL*
  Edwards, C. F., FORNACIARI, N. R., DUNSKY, C. M., Marx, K. D., Ashurst, W. T.
  1993; 72 (8): 1151-1159
- **ANALYSIS OF THE IDEAL PHASE-DOPPLER SYSTEM: LIMITATIONS IMPOSED BY THE SINGLE-PARTICLE CONSTRAINT** *Atomization and Sprays*
  Edwards, C. F., Marx, K. D.
  1992; 2 (3): 319-366
- **Autoignition of Methane and Natural Gas in a Simulated Diesel Environment** *1991 SAE International Congress & Exposition*
  Fraser, R., Siebers, D., Edwards, C. F.
  1991
- **Ignition Delay Performance Versus Composition of Model Fuels** *1992 SAE International Congress & Exposition*
  Hoskin, D., Edwards, C. F., Siebers, D.
  1992
- **Structure of a swirl-stabilized spray flame by imaging, laser doppler velocimetry, and phase doppler anemometry** *Twenty-Third Symposium (International) on Combustion*
  Edwards, C. F.
  1991: 1353–59
- **A Photographic Study of Plasma Ignition Systems** *1985 SAE International Congress and Exposition*
  Edwards, C. F., Stewart, H., Oppenheim, A.
  1985
- **A Study of the Autoignition Process of a Diesel Spray via High Speed Visualization** *1992 SAE International Congress & Exposition*
  Edwards, C. F., Siebers, D., Hoskin, D.
  1992
- **Use of Dynamic Valving to Achieve Residual-Affected Combustion** *SAE 2001 World Congress*

Kaahaaina, N., Simon, A., Caton, P., Edwards, C. F.
2001

- **Emission Characteristics of Methanol Fueled Vehicles Using Feedback Carburetion and Three Way Catalysts** *1981 SAE International Fall Fuels and Lubricants Meeting and Exhibition*
  Edwards, C. F., Baisley, W.
  1981
- **Wear Characteristics of Fleet Vehicles Operating on Methyl Alcohol** *1981 SAE International Fall Fuels and Lubricants Meeting and Exhibition*
  Baisley, W., Edwards, C. F.
  1981
- **A Comparative Study of Plasma Ignition Systems** *1983 SAE International Congress and Exposition*
  Edwards, C. F., Oppenheim, A., Dale, J.
  1983
- **Optimization of Recompression Reaction for Low-Load Operation of Residual-Effected HCCI** *2008 SAE World Congress & Exhibition*
  Song, H., Edwards, C. F.
  2008
- **Effects of nozzle geometry and ambient pressure on the characteristics of a modulated spray** *37th Aerospace Sciences Meeting and Exhibit*
  Wang, D., Ganji, A., Sipperley, C., Edwards, C. F.
  1999
- **Autoignition of Methanol and Ethanol Sprays under Diesel Engine Conditions** *1987 SAE International Congress and Exposition*
  Siebers, D., Edwards, C. F.
  1987