

Curriculum Vitae
JOHN D. MERTENS

Department of Engineering
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EDUCATION:

- 1986-1990 **Stanford University**, Stanford, California
Ph.D. in Mechanical Engineering
Thesis: **"A Shock Tube Study of the Pyrolysis of HNCO and the Reactions of NH with NO, O₂, and O."** Advisors: Prof. Ronald K. Hanson, Prof. Tom Bowman.
Measured the reaction rate coefficients of gas phase chemical reactions using laser and infrared emission diagnostics in shock tube experiments. Performed theoretical calculations of collision efficiencies and threshold energies.
- 1985-1986 **Stanford University**, Stanford, California
M.S. in Mechanical Engineering
- 1980-1985 **California State University Chico**, Chico, California
B.S. in Mechanical Engineering
Minors in Mathematics and Physics
Summa Cum Laude

TEACHING EXPERIENCE:

- 2009-present **Professor**, Department of Engineering, Trinity College
Member of Environmental Science Program Coordinating Committee since 2000
- 2012-2018 **Chair**, Department of Engineering, Trinity College
- 1998-2009 **Associate Professor**, Department of Engineering, Trinity College
- 1992-1998 **Assistant Professor**, Department of Engineering, Trinity College
- 1990-1992 **Visiting Assistant Professor**, Dept. of Engineering & C. S., Trinity College
- Courses taught: Capstone Design I and II, Dynamics, Engineering Materials Laboratory, Experimental Design and Methods, Fluid Mechanics, Fluid Mechanics Laboratory, Gas Dynamics, Heat Transfer, Heat Transfer Laboratory, Measurement Instrumentation and Analysis, Mechanics of Materials Laboratory, Optical Diagnostics, Statics, Strength/Mechanics of Materials, Thermodynamics, Introductory Robotics, Introduction to Engineering, Everything You've Ever Wanted to Know About SECS But Were Afraid to Ask, The Present and Future Costs of Energy, What is Reality?, The Art of Engineering Design, An Engineering View of the Physical World, Reacting to the Past, Formal Organizations Internship Seminar, The Science and Policies of Energy and Sustainability.
- 1989 **Teaching Assistant**, Dept. of Mechanical Engineering, Stanford University
Developed, prepared, and supervised laboratory experiments.
Class: Optical Diagnostics and Spectroscopy Laboratory.
- 1988 **Teaching Assistant**, Dept. of Mechanical Engineering, Stanford University
Duties included lectures, grading, and preparing homework and exams.
Class: Non-Equilibrium Processes in High-Temperature Gases.
- 1985 **Laboratory Instructor**, Physics Dept., California State University, Chico
Taught and graded laboratory sections. Class: Light, Electricity, and Magnetism.

RESEARCH EXPERIENCE:

- 2009- present **Professor**, Department of Engineering, Trinity College
- 1998- 2009 **Associate Professor**, Department of Engineering, Trinity College
- 1992-1998 **Assistant Professor**, Department of Engineering, Trinity College
- 1990-1992 **Visiting Assistant Professor**, Dept. of Engineering & C. S., Trinity College
Developed W.M. Keck Optical Diagnostics Laboratory.
Developed shock tube laboratory for studies of shock waves and combustion processes using visible and infrared emission optical diagnostics.
Performed computational studies of molecular-vibrational-relaxation processes in the flowfields of re-entry vehicles and other non-equilibrium processes.
- March 2010, **Visiting Scholar**, The Aerospace Corporation (an FFRDC), El Segundo, CA
- March, July '09 Worked on H₂O₂ laser diagnostic development for syngas studies.
- July 2006 **Visiting Scholar**, The Aerospace Corporation (an FFRDC), El Segundo, CA
Performed high-pressure shock tube studies of syngas ignition.
- July-Aug. 2004 **Visiting Scholar**, Department of Mechanical Engineering, Stanford University
Performed computational modeling of shock tube ignition studies.
- January 1996, **Visiting Scholar**, NASA Ames Research Center, Computational Chemistry
- May-June 1995 Group, Mountain View, CA. Performed computational study of nitrogen-electron collisions in high temperature flowfields.
- January 1994 **Visiting Scholar**, Department of Mechanical Engineering, Stanford University
Directed shock tube study of the thermal dissociation of C₂H₅I using narrow-line laser detection of OH.
- June-July 1993 **Visiting Scholar**, Department of Mechanical Engineering, Stanford University
Directed laser photolysis shock tube study of the reactions of CN and NCO with NO₂ and the products of CN reactions using narrow-line laser detection of CN and NCO.
- August 1992 **Visiting Scholar**, Department of Mechanical Engineering, Stanford University
Directed laser photolysis shock tube investigation of the reactions of CN with N₂O, NO, and O₂ using narrow-line laser detection of CN.
- Summer 1991 **Visiting Scholar**, Department of Mechanical Engineering, Stanford University
Directed shock tube investigation of narrow-line laser detection of HNO.
Performed laser photolysis shock tube study of the reaction of NH₃ with OH using narrow-line laser detection of OH.
- 1986-1990 **Research Assistant**, Stanford University (with advisor R. Hanson)
In addition to thesis work, assisted with assembly, maintenance, and performance testing of shock tubes. Designed and built infrared emission collection systems. Developed isocyanic acid manufacturing system.
Assisted in design of excimer laser photolysis system for shock tube studies.

RELATED EXPERIENCE:

- 1983-1985 U.S. Army Corps of Engineers, Hydrology Department, Sacramento, California. Worked during summers and winter breaks as engineering technician. Duties included computer modeling of river basins, statistical flood analysis, and field work.

RESEARCH INTERESTS:

Air Pollution, Chemical Kinetics, Combustion, Energy Conversion, Gas Dynamics, Heat Transfer, Non-Equilibrium Processes, Optical Diagnostics.

TEACHING INTERESTS:

Air Pollution, Combustion, Communication, Creative Thinking, Design, Energy Conversion, Environmental Science, Fluid Mechanics, Gas Dynamics, Heat Transfer, History of Science, Mechanics, Optical Diagnostics and Spectroscopy, Optics, Partial Differential Equations, Physical Gas Dynamics, Problem Solving, Public Policy, Sustainability, Thermodynamics.

SERVICE AND LEADERSHIP ACTIVITIES:

2020-2021 Member of Trinity College Employee Benefits Committee
2019-2021 Faculty Advisor of Trinity in Trinidad Program
2019 Connecticut Science Center 2019 STEM Achievement Award
2018-2021 Member of Trinity College Financial Affairs Committee (Chair 2020-2021) and Planning and Budget Committee
2018 Creator and Director of CT Next After School and Summer STEM program
2017-present Faculty Director of Trinity College Robotics Dream Camp
2014-present Faculty Director of Trinity College Robot Study Team
2014-present Director of Trinity College International Fire Fighting Robot Contest
'19,'14,'10,'03 Host of the Regional Meeting on Kinetics and Dynamics, Hartford, CT
2012-2021 Trinity College Campus Director of the NASA CT Space Grant Consortium
1992-2021 Director of Trinity College Engineering Summer Internship Program
1997-2021 Faculty Advisor of the Trinity College Student Chapter of the American Society of Mechanical Engineers (ASME)
2012-2018 Chair, Department of Engineering, Trinity College
1990-present Member of Trinity College Engineering Department. Duties include assisting in revision of engineering curriculum, allocation of capital equipment budget, chairing search committees, and preparing for ABET accreditation visits.
2014-2018 Faculty Advisor of the Trinity College Chapter of Engineers Without Borders
Led fundraising and implementation of sanitation system in Tanzania, 2015-2016
2012-2014 Trinity Portfolio Mellon Grant Project Founder and Director
2017 Author of Trinity College Engineering Department ABET self-study
2012 Chair of the ASME Energy Committee Colloquium II, Anaheim, CA
2008-2019 Director of Trinity College/Hartford Public Schools retention program funded by the Henkel Corporation
2002-2013 Member of the Energy Committee of the ASME National Council on Engineering
1995, 2011 Member of Trinity College Educational Policy Committee (spring '95, fall '11)
2007-2010 Member of Trinity College Curriculum Committee (Chair, spring '10)
2000-2019 Member of Trinity College Environmental Science Coordinating Committee
2008-2019 Faculty Advisor of the Trinity College Student Chapter of the Association of Energy Engineers (AEE)
2009-2010, and 1992-1994 Faculty Advisor of the Trinity College Student Chapter of the Society of Women Engineers (SWE)
1999-2007 Member of Trinity College Advisory Committee on Fraternities and Sororities (Chair, 2001-2006)
2004-2006 Faculty Advisor of Trinity College Chapter of Psi Upsilon
2004-2005 Member of Trinity College Mentors for Violence Prevention (MVP) program
1990-2004 Member of Trinity College Women's Center Coordinating Committee
1995-2003 Faculty Director of Trinity College Connecticut Pre-Engineering Program (CPEP). Member of CPEP Planning Committee 1994-2003. Also taught Friday and Saturday science courses for CPEP students from 1990-1999.

SERVICE AND LEADERSHIP ACTIVITIES (cont'd):

- 1995-2003 Member of United Technologies/Trinity College Engineering Initiative (UTCEI) Planning Committee. Also member of UTCEI/Learning Corridor Advisory Committee in 1997.
- 1993-2002 Member of Trinity College Graduate Fellowship Committee
- 2000-2001 Member of Trinity College Priorities and Planning Council
- 1997-2001 Member of Trinity College Financial Affairs Committee. (Chair 2000-2001)
- 1995-2001 Member of Trinity College Chemical Hygiene Committee
- 1993-1994 Trinity College representative on the United Connecticut for Women in Science, Engineering, and Mathematics (SEM) NSF grant committee.
- 1991 Conceived and organized Trinity College Women in Science Month.
- 1990-1991 Represented department on campus-wide hazardous waste task force.

STUDENT AWARDS AND HONORS:

- 1985-1986 Stanford University Fellowship
- 1983-1985 Rotary Club Scholarship
- 1983-1984 Mechanical Engineering Student of the Year, CSU, Chico
- 1983-1984 Rawlins Scholarship
- 1984 Engineering Council of Sacramento Valley Scholarship
- 1984 Carroll Curtis Scholarship
- 1984 Sigma Pi Sigma, National Physics Honor Society
- 1980-1985 Dean's Honor List, California State University, Chico

PUBLICATIONS, PAPERS, AND CONFERENCE PRESENTATIONS:

Mertens, J. D., Zukowski, H. M., Rozaidi, F., Healy, A.: "Conclusions for the Ammonia Combustion Mechanism." **Presented at the 38th Regional Meeting on Kinetics and Dynamics**, Massachusetts Institute of Technology (2020).

Mertens, J. D., Rozaidi, F., Zukowski, H. M., Sinson, A. M., Palmer, D. R., Healy, A.: "Analysis, Comparison, and Improvement of Current NH₃ Combustion Mechanisms." **Presented at the 37th Regional Meeting on Kinetics and Dynamics**, Trinity College, Hartford (2019).

Mertens, J. D.: "Energy and Air Pollution in the United States since the 1990 Clean Air Act." **Invited Plenary Presentation at the 4th Congress on Sustainable Energy**, Bogota, Colombia (2018).

Mertens, J. D., Palmer, D. R., Rozaidi, F., Sinson, A. M., Mathieu, O., and Petersen, E.L.: "Analysis of DMMP Kinetics using OH* measurements in Shock Tube Experiments." **Presented at the 36th Regional Meeting on Kinetics and Dynamics**, Northeastern University (2018).

Mertens, J. D. and McInnis, J.: "Refining OH* Mechanism Using Emission Measurements in Nitromethane Shock Tube Experiments." **Presented at the 35th Regional Meeting on Kinetics and Dynamics**, New Jersey Institute of Technology (2017).

McInnis, J. and Mertens, J. D.: "A Novel Representation of Ignition Times to Evaluate Current Nitromethane Reaction Mechanism Using Methane Ignition Data." **Presented at the 35th Regional Meeting on Kinetics and Dynamics**, New Jersey Institute of Technology (2017).

PUBLICATIONS, PAPERS, AND CONFERENCE PRESENTATIONS (cont'd):

Mathieu, O., Giri, B., Agard, A. R., Adams, T. N., Mertens, J. D., and Petersen, E.L.: "Nitromethane Ignition Behind Reflected Shock Waves: Experimental and Numerical Study." **Fuel**, **182**, 597 (2016).

Mertens, J. D., Agard, A. R., Adams, T. N., Mathieu, O., and Petersen, E.L.: "A Shock Tube Study of $\text{HCO} + \text{M} \rightarrow \text{H} + \text{CO} + \text{M}$ Using Nitromethane Ignition." **Presented at the 34th Regional Meeting on Kinetics and Dynamics**, Brown University (2016).

Mathieu, O., Giri, B., Mertens, J. D., and Petersen, E.L.: "Nitromethane Ignition Behind Reflected Shock Waves." **Proceedings of the 25th International Colloquium on the Dynamics of Explosions and Reactive Systems** (2015).

Giri, B., Mertens, J. D., Mathieu, O., and Petersen, E.L.: "Study of Nitromethane Combustion using a Shock Tube." **Presented at the 33rd Regional Meeting on Kinetics and Dynamics**, University of Massachusetts, Amherst (2015).

Giri, B., Firsching, C.T., and Mertens, J. D.: "Outdoor Testing of a Double-Diaphragm Shock Tube." **Presented at the 32nd Regional Meeting on Kinetics and Dynamics**, Trinity College, Hartford (2014).

Mertens, J. D. and Firsching, C.T.: "A Double-Diaphragm Shock Tube for Ignition Studies of Non-Premixed Supersonic Hydrocarbon Jets." **Presented at the 31st Regional Meeting on Kinetics and Dynamics**, Northeastern University (2013).

Mertens, J. D.: "A Computational Study of the NNH-NO_x Mechanism in High Hydrogen Content Fuels." **Presented at the 30th Regional Meeting on Kinetics and Dynamics**, University at Albany, SUNY (2012).

Aul, C. J., Petersen, E. L., Crofton, M. W., and Mertens, J. D.: "Measurement of H₂O₂ Broadening Parameters Near 7.8 μm Using a Shock Tube." **Proceedings of the 28th International Symposium on Shock Waves** (2011).

Aul, C. J., Crofton, M. W., Mertens, J. D., and Petersen, E. L.: "A Diagnostic for Measuring H₂O₂ Concentration in a Shock Tube Using Tunable Laser Absorption near 7.8 μm." **Proceedings of the Combustion Institute**, **33**, 709 (2011).

Aul, C. J., Petersen, E. L., Crofton, M. W., and Mertens, J. D.: "Measuring H₂O₂ Concentration in a Shock Tube Using Infrared Tunable Laser Absorption." **Proceedings of the 2010 Meeting of the Central States Section of the Combustion Institute**.

Aul, C. J., Crofton, M. W., Mertens, J. D., and Petersen, E. L.: "The Development of an H₂O₂ Laser Diagnostic for Shock Tube Kinetics Studies of Syngas Ignition." **Presented at the 28th Regional Meeting on Kinetics and Dynamics**, Trinity College, Hartford (2010).

Mertens, J. D., Kalitan, D. M., and Petersen, E. L.: "Determination of the Rate of $\text{H} + \text{O}_2 + \text{M} \rightarrow \text{HO}_2 + \text{M}$ (M = N₂, Ar, H₂O) from Ignition of Syngas at Practical Conditions." **Proceedings of the Combustion Institute**, **32**, 295 (2009).

PUBLICATIONS, PAPERS, AND CONFERENCE PRESENTATIONS (cont'd):

Mertens, J. D., Maliniak, D., and Mussmann, S. S.: "The Development of a Slow Compression Machine for Ignition Studies." **Presented at the 27th Regional Meeting on Kinetics and Dynamics**, University of Massachusetts, Amherst (2009).

Mertens, J. D., Mussmann, S. S., Kalitan, D. M., and Petersen, E. L.: "A Chemical Kinetics Model for the Fast Ignition of Syngas at Lower Temperatures and Higher Pressures." **Proceedings of the 2008 Meeting of the Western States Section of the Combustion Institute.**

Mertens, J. D.: "Experimental and Computational Studies of the Third-Explosion-Limit Kinetics of H₂/CO Ignition." **Presented at the 26th Regional Meeting on Kinetics and Dynamics**, University at Albany, SUNY (2008).

Kalitan, D. M., Mertens, J. D., Crofton, M. W., and Petersen, E. L.: "Ignition and Oxidation of Lean CO/H₂ Fuel Blends in Air." **Journal of Propulsion and Power**, **23**, 1291 (2007).

Petersen, E. L., Kalitan, D. M., Barrett, A., Reehal, S. C., Mertens, J. D., Beerer, D. J., Hack, R. L., and McDonnell, V. G.: "New Syngas/Air Ignition Data at Lower Temperature and Elevated Pressure and Comparison to Current Kinetics Models." **Combustion and Flame**, **149**, 244 (2007).

Bockus, T. A. and Mertens, J. D.: "A Study of Emissions from Diesel and Vegetable-Oil Fueled Vehicles." **Proceedings of the 2007 Meeting of the Eastern States Section of the Combustion Institute.**

Kalitan, D. M., Reehal, S. C., Mertens, J. D., Crofton, M. W., and Petersen, E. L.: "Oxidation of Hydrogen/CO-based Mixtures at High Pressures." **Work-in-Progress Poster, 31st International Symposium on Combustion** (2006).

Kalitan, D. M., Petersen, E. L., Mertens, J. D., and Crofton, M. W.: "Ignition of Lean CO/H₂/Air Mixtures at Elevated Pressures." **Proceedings of GT2006, ASME Turbo Expo** (2006).

Kalitan, D. M., Petersen, E. L., and Mertens, J. D.: "A Shock-Tube Study of the Ignition and Oxidation Characteristics of Syngas at Elevated Pressures." **Proceedings of the 2005 Meeting of the Eastern States Section of the Combustion Institute.**

Mertens, J. D.: "Computational Modeling of High Pressure Shock Tube Iso-Octane Ignition." **Presented at the 23rd Regional Meeting on Kinetics and Dynamics**, University of Massachusetts, Amherst (2005).

Mertens, J. D.: "The Potential Benefits of Storing and Distributing Wind Energy Using Hydrogen." **Presented at the 2004 New England Technology Awareness Conference: The Hydrogen Economy, Fuel Cells, and the Environment.**

Mertens, J. D.: "Wave Dynamics in Shock Tube Design." **Presented at the 21st Regional Meeting on Kinetics and Dynamics**, Trinity College, Hartford, CT (2003).

PUBLICATIONS, PAPERS, AND CONFERENCE PRESENTATIONS (cont'd):

Mertens, J. D.: "Strategies for Isolating and Studying Combustion Reactions in Shock Tube Experiments." **Presented at the 20th Regional Meeting on Kinetics and Dynamics**, Schenectady, NY (2002).

Mertens, J. D.: "Adding Teamwork, Design, and Creative Thinking to Traditional Engineering Courses." **Presented at the 2001 ASEE Annual Conference.**

Stoane, D. L., Mertens, J. D., and Ahlgren, D. J.: "A Proven Recruitment and Retention Model: United Technologies/Trinity College Engineering Initiative (UTCEI)." **Presented at the 2001 ASEE Annual Conference.**

Mertens, J. D.: "Shock Tube Studies of Chemical Kinetics Using Emission Diagnostics." **Presented at the 19th Regional Meeting on Kinetics and Dynamics**, Troy, NY (2001).

Mertens, J. D.: "Computational Model of Nitrogen Vibrational Relaxation by Electron Collisions." **Journal of Thermophysics and Heat Transfer**, **13**, 204 (1999).

Mertens, J. D.: "A Shock Tube Study of CH* Reaction Kinetics in C₂H₂ and CH₄ Oxidation." **Proceedings of the 22nd International Symposium on Shock Waves** (1999).

Mertens, J. D.: "Teaching Invention and Design to First Year Students." **Presented at the 3rd Annual NCIIA Conference**, Washington DC (1999).

Mertens, J. D.: "Shock Tube Studies of Hydrocarbon Reaction Kinetics Using Emission and Absorption Diagnostics." **Presented at the 17th Regional Meeting on Kinetics and Dynamics**, Albany, NY (1999).

Mertens, J. D., and Garypie, E. J.: "Measurements of Reaction Kinetics Test Times and Shock Wave/Contact Surface Interactions in Shock Tube Experiments." **Proceedings of the 1998 Meeting of the Central States Section of the Combustion Institute.**

Mertens, J. D. and Hanson, R. K.: "A Shock Tube Study of $H + \text{HNCO} \rightarrow H_2 + \text{NCO}$ and the Thermal Decomposition of NCO." **Proceedings of the Combustion Institute**, **26**, 551, (1996).

Mertens, J. D., Caragianis-Broadbridge, C., and Bronzino, J. D.: "Engineering Design: A Team Approach for Freshmen." **Presented at the 1995 New England ASEE Meeting.**

Mertens, J. D., Wooldridge, M. S., and Hanson, R. K.: "A Shock Tube Study of the Pyrolysis of C₂H₅I." **Proceedings of the 1994 Meeting of the Eastern States Section of the Combustion Institute.**

Bronzino, J. D., Ahlgren, D. J., Chung, C. L., Mertens, J. D., and Palladino, J. L.: "Design and Teamwork: A Must for Freshmen." **IEEE Trans. on Educ.**, **37**, 182 (1994).

PUBLICATIONS, PAPERS, AND CONFERENCE PRESENTATIONS (cont'd):

Wooldridge, S. T., Mertens, J. D., Hanson, R. K. and Bowman, C. T.: "A Shock Tube Study of the Reactions of CN and NCO with NO₂." **Proceedings of the Combustion Institute**, **25**, 983 (1994). Also **Proceedings of the 1993 Meeting of the Western States Section of the Combustion Institute**.

Mertens, J. D., Wooldridge, M. S., and Hanson, R. K.: "A Laser Photolysis Shock Tube Study of the Reaction of OH with NH₃." **Proceedings of the 19th International Symposium on Shock Waves**, Vol. II, p. 37, Springer (1993).

Mertens, J. D., Dean, A. J., Hanson, R. K. and Bowman, C. T.: "A Shock Tube Study of Reactions of NCO with O and NO Using NCO Laser Absorption." **Proceedings of the Combustion Institute**, **24**, 701 (1992).

Mertens, J. D., Dean, A. J., Hanson, R. K. and Bowman, C. T.: "A Shock Tube Study of Reactions of Atomic Oxygen with Isocyanic Acid." **Int. J. Chem. Kinetics**, **24**, 279 (1992).

Mertens, J. D., Kohse-Höinghaus, K., Hanson, R. K. and Bowman, C. T.: "A Shock Tube Study of $H + HNCO \rightarrow NH_2 + CO$." **Int. J. Chem. Kinetics**, **23**, 655 (1991).

Mertens, J. D., Chang, A. Y., Hanson, R. K. and Bowman, C. T.: "A Shock Tube Study of the Reactions of NH with NO, O₂, and O." **Int. J. Chem. Kinetics**, **23**, 173 (1991). Also **Proceedings of the 1989 Meeting of the Western States Section of the Combustion Institute**.

Mertens, J. D., Chang, A. Y., Hanson, R. K. and Bowman, C. T.: "Reaction Kinetics of NH in the Shock Tube Pyrolysis of HNCO." **Int. J. Chem. Kinetics**, **21**, 1049 (1989).

Mertens, J. D., Chang, A. Y., Hanson, R. K. and Bowman, C. T.: "Decomposition Kinetics of HNCO at High Temperatures." **Proceedings of the 1988 Meeting of the Western States Section of the Combustion Institute**.