

Adam B. Dempsey

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OBJECTIVES

Build a thorough understanding of the physical and chemical processes that take place in combustion and energy conversion systems through experimentation and simulation. Utilize this knowledge to research and develop the next generation of low emissions and high efficiency energy systems.

PROFILE

- Research focused on liquid sprays & atomization, turbulent reacting flows, combustion & chemical kinetics, and emissions formation
- Expertise in internal combustion engines with an emphasis on advanced combustion strategies
- Experimental expertise in engine combustion, optical measurements of sprays & combustion, and soot measurements & characterization
- Simulation expertise in both multi-dimensional turbulent combustion modeling and simplified phenomenological models of the combustion & emissions formation processes

EDUCATION

University of Wisconsin-Madison

Doctor of Philosophy in Mechanical Engineering (2013)

- Dissertation: “Dual-Fuel Reactivity Controlled Compression Ignition (RCCI) with Alternative Fuels”
- Advisor: Professor Rolf D. Reitz
- GPA: 4.00/4.00

Bradley University

Master of Science in Mechanical Engineering (2009)

- Thesis: “Autoignition Model for Diesel Sprays Using Reduced Chemical Kinetics and a Characteristic Scalar Dissipation Rate”
- Advisor: Professor Scott L. Post
- GPA: 4.00/4.00

Bachelor of Science in Mechanical Engineering (2007)

- Course work electives focused on Thermal Sciences
- GPA: 3.97/4.00

EXPERIENCE

Marquette University

2019 to Present

Department of Mechanical Engineering
Assistant Professor

- Teaching & developing courses in the thermal sciences
 - MEEN3340 Thermodynamics II
- Building a research program investigating advanced combustion strategies for IC engines that reduce pollutant emissions, increase fuel efficiency, and reduce the overall impact of combustion on the environment.

Caterpillar Inc.

2015 to 2019

Combustion & Air Systems Research
Sr. Research Engineer

- Use high fidelity computational fluid dynamics (CFD) simulations to study and develop combustion systems for high efficiency and low emissions.
- Conduct well controlled single-cylinder engine experiments to evaluate combustion system designs and provide data for model development and validation.
- Researched and developed improved methods for in-cylinder pressure measurements with an emphasis on data accuracy
- Development and characterization of next generation high pressure fuel injectors via spray momentum measurements, high speed spray and combustion visualization.
- Strong focus on soot emissions from spray combustion systems, both experimental measurements and reacting flow simulations.

Oak Ridge National Laboratory

2013 to 2015

Fuels, Engines, & Emissions Research Center
Postdoctoral Research Associate

- Evaluation and characterization of advanced compression ignition combustion concepts on a light-duty multi-cylinder engine.
- Focus on single-fuel and dual-fuel low temperature combustion strategies for low NO_x and soot emissions and high thermal efficiency.
- Conducting detailed characterization of the particulate matter produced by low temperature combustion strategies.
- Researching implications of using aftertreatment devices such as oxidation catalysts with low temperature combustion strategies.

University of Wisconsin-Madison

2009 to 2013

Engine Research Center

Graduate Research Assistant

Doctoral Candidate

- Utilized computational fluid dynamics (CFD) modeling to develop low temperature combustion strategies (LTC) with alternative fuels, namely gasoline and alcohols.
- Focused on in-cylinder fuel spray development, fuel/air mixing, and combustion processes to optimize the efficiency and emissions of advanced combustion.
- Used single-cylinder metal engine experiments to evaluate the optimum designs determined from the CFD modeling and understand how they compare to conventional combustion strategies (i.e., diesel combustion).
- Utilized single-cylinder experiments to compare piston designs for LTC strategies and evaluated alternative fuels for LTC operation (hydrated ethanol and methanol).
- Developed a data analysis code for calculating the emissions from engine experiments and quantifying the uncertainty in those measurements.

Caterpillar Inc.

Summer 2009

Global Engine Development

Associate Engineer (Internship)

- Created prototype and production engine operating maps that met customer requirements and emissions standards.

Bradley University

2007 to 2009

Graduate Research Assistant

Caterpillar Master's Fellowship Award Winner

- Developed multi-zone DI diesel spray and combustion model for use in one-dimensional engine simulation.
- Primary focus on improving the prediction of the autoignition delay of a diesel fuel spray in a multi-zone modeling framework.
- Studied the numerical simulation of the diesel fuel droplet breakup process in a multi-zone modeling framework.

Caterpillar Inc.

2008 to 2009

Virtual Product Development

Associate Engineer (Internship)

- Internship done in collaboration between Bradley University & Caterpillar on multi-zone diesel spray and combustion modeling.
- Developed and validated one-dimensional engine simulation tool for integrated systems simulations.

HONORS & AWARDS

ASME Internal Combustion Engine Division Best Paper Award (2018)

- Award for best paper at the 2018 ASME ICEF Conference in San Diego, CA
- Title: "Comparison of Cylinder Pressure Measurements on a Heavy Duty Diesel Engine Using a Switching Adapter"

SAE Engineering Meetings Board Outstanding Oral Presentation Award (2018)

- Award for outstanding oral presentation at the 2018 SAE World Congress
- Title: "A Comprehensive Evaluation of Diesel Engine CFD Modeling Predictions Using a Semi-Empirical Soot Model Over a Broad Range of Combustion Systems"

SAE Engineering Meetings Board Outstanding Oral Presentation Award (2015)

- Award for outstanding oral presentation at the 2015 SAE World Congress
- Title: "An Open Source Computer Program for Internal Combustion Engine Emissions Calculations and Uncertainty Analysis"

Oak Ridge National Laboratory Postdoctoral Research Symposium (2014)

- Awarded honorable mention for oral presentation at symposium.
- Title: "Particulate Matter from Reactivity Controlled Compression Ignition (RCCI)."

Princeton University (2010)

- Accepted to the inaugural Princeton Combustion Energy Frontier Research Center summer program on combustion.

ASME International Mechanical Engineering Congress & Exposition (2008)

- Youth engineering paper contest finalist (Fluids Engineering Division).
- Title: "Implementation and Use of a Secondary Droplet Break-Up Model under Diesel Engine Conditions."

Bradley University (2007)

- Awarded the Caterpillar Master's Fellowship for graduate research.

Bradley University (2007)

- Mechanical engineering faculty award for most outstanding undergraduate student.

INVITED TALKS

Purdue University (2018)

- Invited by mechanical engineering professor Greg Shaver to give a seminar
- Title: "Research & Development of Advanced Compression Ignition Combustion Strategies"

University of Wisconsin-Madison (2018)

- Invited by mechanical engineering department faculty to speak to students
- Title: “Cylinder Pressure Measurements on a Heavy-Duty Diesel Engine Using a Switching Adapter”

Illinois Institute of Technology (2018)

- Invited by mechanical engineering professor Carrie Hall to give a seminar
- Title: “Research & Development of Advanced Compression Ignition Combustion Strategies”

Missouri University of Science and Technology (2018)

- Invited by mechanical engineering department chair Jim Drallmeier to give seminar
- Title: “High Efficiency & Low Emissions Compression Ignition Combustion Strategies”

Clemson University (2015)

- Invited by automotive engineering department chair Zoran Filipi to speak to students.
- Title: “High Efficiency & Low Emissions Compression Ignition Combustion Strategies”

University of Wisconsin-Madison (2014)

- Invited by professor Sage Kokjohn to speak to undergraduate internal combustion engine class
- Title: “Understanding the Particulate Matter from Dual-Fuel Reactivity Controlled Compression Ignition (RCCI)”

SAE Powertrains, Fuels, and Lubricants Meeting, Malmo, Sweden (2012)

- Presented and participated in a panel discussion on gasoline compression ignition.
- Title: “Dual Fuel Reactivity Controlled Compression Ignition (RCCI) Research at the University of Wisconsin-Madison’s Engine Research Center”

PUBLICATIONS

Refereed Journal Articles

1. **Dempsey, A. B.**, Seiler, P., and Johnson, S., “Comparison of Cylinder Pressure Measurements on a Heavy-Duty Diesel Engine Using a Switching Adapter,” *Journal of Engineering for Gas Turbines & Power*. 2019; 141(8):081014-081014-15.
2. **Dempsey, A. B.**, Seiler, P., Svensson, K., and Qi, Y., “A Comprehensive Evaluation of Diesel Engine CFD Modeling Predictions Using a Semi-Empirical Soot Model over a Broad Range of Combustion Systems,” *SAE International Journal of Engines* 11(6):2018.

3. **Dempsey, A. B.**, Fiveland, S., and Post, S., "Phenomenological Autoignition Model for Diesel Sprays Using Reduced Chemical Kinetics and a Characteristic Scalar Dissipation Rate," *SAE International Journal of Engines* 10(2):512-528, 2017.
4. Koci, C., **Dempsey, A. B.**, Nudd, J., and Knier, B., "Understanding Hydrocarbon Emissions in Heavy Duty Diesel Engines Combining Experimental and Computational Methods," *SAE International Journal of Engines* 10(3):1093-1109, 2017.
5. Wissink, M., Splitter, D. A., **Dempsey, A. B.**, Curran, S. J., Kaul, B., and Szybist, J. P., "An Assessment of Thermodynamic Merits for Current and Potential Future Engine Operating Strategies," *International Journal of Engine Research*, vol 18, Issue 1-2, pp. 155-169, 2017.
6. Storey, J. M., Curran, S., Lewis, S., Barone, T., **Dempsey, A. B.**, Moses-Debusk, M., Hanson, R., Prikhodko, V., and Northrop, W., "Evolution and current understanding of physicochemical characterization of particulate matter from reactivity controlled compression ignition combustion on a multicylinder light-duty engine," *International Journal of Engine Research*, vol 18, Issue 5-6, p. 505-519, 2017.
7. **Dempsey, A. B.**, Curran, S., and Wagner, R., "A perspective on the range of gasoline compression ignition combustion strategies for high efficiency and low NO_x and soot emissions: Effects of in-cylinder fuel stratification," *International Journal of Engine Research*, vol 17, Issue 8, p. 897-917, 2016.
8. **Dempsey, A. B.**, Curran, S., and Reitz, R., "Characterization of Reactivity Controlled Compression Ignition (RCCI) Using Premixed Gasoline and Direct-Injected Gasoline with a Cetane Improver on a Multi-Cylinder Engine," *SAE International Journal of Engines* 8(2):859-877, 2015.
9. **Dempsey, A. B.**, Curran, S., Wagner, R., and Cannella, W., "Effect of Premixed Fuel Preparation for Partially Premixed Combustion With a Low Octane Gasoline on a Light-Duty Multicylinder Compression Ignition Engine," *ASME Journal of Engineering for Gas Turbines and Power*, 2015, 137(11).
10. Bergin, M., Reitz, R., Rutland, C., **Dempsey, A. B.** et al., "Load Limit Extension in Pre-Mixed Compression Ignition Using a 2-Zone Combustion System," *SAE International Journal of Engines* 8(2):903-920, 2015.
11. Storey, J., Curran, S., **Dempsey, A. B.**, Reitz, R. D., Walker, N. R., Wright, C., "The Contribution of Lubricant to the Formation of Particulate Matter with Reactivity Controlled Compression Ignition in Light-Duty Diesel Engines," *Emission Control Science and Technology* (2015) 1:64-79.

12. Jia, M., **Dempsey, A. B.**, Wang, H., Yaopeng, L., and Reitz, R. D., "Numerical Simulation of Cyclic Variability in Reactivity Controlled Compression Ignition (RCCI) Combustion with a Focus on the Initial Temperature at Intake Valve Closing," *International Journal of Engine Research*, vol 16, Issue 3, p. 441-460, 2015.
13. Wang, H., **Dempsey, A. B.**, Yao, M., Jia, M., and Reitz, R. D., "Kinetic and Numerical Study of the Effects of Di-tert-butyl Peroxide Additive on the Reactivity of Methanol and Ethanol," *Energy & Fuels*, 2014, 28(8), p. 5480-5488.
14. **Dempsey, A. B.**, Walker, N. R., Gingrich, E., and Reitz, R. D., "Comparison of Low Temperature Combustion Strategies for Advanced Compression Ignition Engines with a Focus on Controllability," *Combustion Science and Technology*, 186:2, 210-241, 2013.
15. **Dempsey, A. B.**, Walker, N., and Reitz, R., "Effect of Piston Bowl Geometry on Dual Fuel Reactivity Controlled Compression Ignition (RCCI) in a Light-Duty Engine Operated with Gasoline/Diesel and Methanol/Diesel," *SAE International Journal of Engines* 6(1):78-100, 2013.
16. **Dempsey, A. B.**, Walker, N., and Reitz, R., "Effect of Cetane Improvers on Gasoline, Ethanol, and Methanol Reactivity and the Implications for RCCI Combustion," *SAE International Journal of Fuels Lubricants* 6(1):170-187, 2013.
17. Walker, N., **Dempsey, A. B.**, Andrie, M., and Reitz, R., "Use of Low-Pressure Direct-Injection for Reactivity Controlled Compression Ignition (RCCI) Light-Duty Engine Operation," *SAE International Journal of Engines* 6(2):1222-1237, 2013.
18. **Dempsey, A. B.**, Das Adhikary, B., Viswanathan, S., and Reitz, R. D., "Reactivity Controlled Compression Ignition (RCCI) using Premixed Hydrated Ethanol and Direct Injection Diesel," *ASME Journal of Engineering for Gas Turbines and Power*, vol. 134(8), 2012.
19. Nieman, D., **Dempsey, A. B.**, and Reitz, R., "Heavy-Duty RCCI Operation Using Natural Gas and Diesel," *SAE International Journal of Engines* 5(2):270-285, 2012.
20. **Dempsey, A. B.**, Wang, B., Reitz, R., Petersen, B., Sahoo, D., and Miles, P., "Comparison of Quantitative In-Cylinder Equivalence Ratio Measurements with CFD Predictions for a Light Duty Low Temperature Combustion Diesel Engine," *SAE International Journal of Engines* 5(2):162-184, 2012.

21. **Dempsey, A. B.** and Reitz, R., "Computational Optimization of Reactivity Controlled Compression Ignition in a Heavy-Duty Engine with Ultra Low Compression Ratio," *SAE International Journal of Engines* 4(2):2222-2239, 2011.
22. **Dempsey, A. B.** and Reitz, R., "Computational Optimization of a Heavy-Duty Compression Ignition Engine Fueled with Conventional Gasoline," *SAE International Journal of Engines* 4(1):338-359, 2011.

Refereed Conference Papers

1. **Dempsey, A. B.**, Seiler, P., and Johnson, S., "Comparison of Cylinder Pressure Measurements on a Heavy-Duty Diesel Engine Using a Switching Adapter," *Proceedings of the ASME 2018 Internal Combustion Engine Division Fall Technical Conference, ICEF2018-9776*.
2. Kodebyle Raju, N., **Dempsey, A. B.**, and Curran, S., "Analysis of Engine Air Handling Systems for Light-Duty Compression Ignition Engines Using 1-D Cycle Simulation: Achieving High Dilution Levels for Advanced Combustion," *Proceedings of the ASME 2016 Internal Combustion Engine Division Fall Technical Conference, ICEF2016-9459*.
3. Wissink, M., Splitter, D. A., **Dempsey, A. B.**, Curran, S. J., Kaul, B., and Szybist, J. P., "An Assessment of Thermodynamic Merits for Current and Potential Future Engine Operating Strategies," *Conference on Thermo and Fluid Dynamic Processes in Direct Injection Engines (THIESEL 2016)*.
4. **Dempsey, A. B.**, Curran, S., Wagner, R., and Cannella, W., "Effect of Premixed Fuel Preparation for Partially Premixed Combustion with a Low Octane Gasoline on a Light-Duty Multi-Cylinder Compression Ignition Engine," *Proceedings of the ASME 2014 Internal Combustion Engine Division Fall Technical Conference, ICEF2014-5561*.
5. **Dempsey, A. B.**, Curran, S., Storey, J., Eibl, M., Pihl, J., Prihodko, V., Wagner, R., and Parks, J., "Particulate Matter Characterization of Reactivity Controlled Compression Ignition (RCCI) on a Light Duty Engine," *SAE Technical Paper 2014-01-1596, 2014*.
6. Perini, F., **Dempsey, A. B.**, Reitz, R., Sahoo, D., Petersen, B., and Miles, P., "A Computational Investigation of the Effects of Swirl Ratio and Injection Pressure on Mixture Preparation and Wall Heat Transfer in a Light-Duty Diesel Engine," *SAE Technical Paper 2013-01-1105, 2013*.

7. **Dempsey, A. B.**, Walker, N., Splitter, D., Wissink, M., and Reitz, R. D., "Characterization of Reactivity Controlled Compression Ignition (RCCI) Using Premixed Hydrated Ethanol and Direct Injection Diesel in Heavy-Duty and Light-Duty Engines," *Conference on Thermo and Fluid Dynamic Processes in Direct Injection Engines (THIESEL 2012)*.
8. Walker, N., **Dempsey, A. B.**, Andrie, M., and Reitz, R., "Experimental Study of Low-Pressure Fueling Under RCCI Engine Operation," *ILASS-Americas 24th Annual Conference on Liquid Atomization and Spray Systems, San Antonio, Texas, May 2012*.
9. **Dempsey, A. B.** and Post, S., "Autoignition Model for Diesel Sprays," *Central States Section of the Combustion Institute Meeting, University of Illinois-Urbana Champaign, March 2010*.
10. **Dempsey, A. B.** and Fiveland, S., "Implementation and Use of a Secondary Droplet Break-Up Model Under Diesel Engine Conditions," *ASME International Mechanical Engineering Congress and Exposition Proceedings, vol. 10, p. 2019-2028, 2008*.

PRESENTATIONS & POSTERS

1. **Dempsey, A. B.**, Curran, S., and Wagner, R., "Computational Fluid Dynamics Modeling of Gasoline Compression Ignition (GCI) Combustion: Effect of Equivalence Ratio Stratification Level," *Oak Ridge National Laboratory 3rd Annual Postdoc Research Symposium, August, 2015*.
2. **Dempsey, A. B.**, Curran, S., and Wagner, R., "Computational Fluid Dynamics Modeling of Gasoline Compression Ignition (GCI) Combustion: Effect of Equivalence Ratio Stratification Level," *DOE Advanced Engine Combustion (AEC/HCCI) Working Group Meeting, Southfield, Michigan, August, 2015*.
3. **Dempsey, A. B.** and Ghandhi, J., "An Open Source Computer Program for Internal Combustion Engine Emissions Calculations and Uncertainty Analysis," *SAE 2015 World Congress, Oral Only Presentation, Emissions Measurement and Testing Session*.
4. **Dempsey, A. B.**, Curran, S., and Reitz, R. D., "Characterization of RCCI using Premixed Gasoline and Direct-Injected Gasoline with Various Levels of Ignition Improver," *DOE Advanced Engine Combustion (AEC/MOU) Working Group Meeting, Sandia National Laboratory, Livermore, California, February, 2015*.
5. **Dempsey, A. B.**, Curran, S., Wagner, R., and Cannella, W., "Effect of First Injection Timing on LTC Gasoline Compression Ignition Using a Low Octane Fuel," *DOE Advanced Engine Combustion (AEC/HCCI) Working Group Meeting, Southfield, Michigan, August, 2014*.

6. **Dempsey, A. B.**, "Particulate Matter from Reactivity Controlled Compression Ignition (RCCI)," *Oak Ridge National Laboratory 2nd Annual Postdoc Research Symposium, July, 2014.*
7. **Dempsey, A. B.**, "Overview of Dual-Fuel Reactivity Controlled Compression Ignition Combustion," *Presentation to Daimler Truck Corporation, Oak Ridge National Laboratory, April, 2014.*
8. **Dempsey, A. B.**, and Gandhi, J., "Experimental Uncertainty Quantification Applied to Internal Combustion Engines," *University of Wisconsin-Madison's Engine Research Center Summer Lecture Series, July, 2013.*
9. **Dempsey, A. B.**, and Reitz, R. D., "Modeling of LTC Strategies for Advanced Compression Ignition Engines," *Direct-Injection Engine Research Consortium (DERC) Annual Meeting, University of Wisconsin-Madison, June, 2013.*
10. **Dempsey, A. B.**, Walker, N., Gingrich, E., and Reitz, R. D., "Comparison of Low Temperature Combustion Strategies for Advanced Compression Ignition Engines with a Focus on Controllability," *Direct-Injection Engine Research Consortium (DERC) Annual Meeting, University of Wisconsin-Madison, June, 2013.*
11. **Dempsey, A. B.**, and Reitz, R. D., "Investigation of Reactivity Controlled Compression Ignition (RCCI) in a Light-Duty Engine using Methanol," *Advanced Engine Combustion (AEC/HCCI) Working Group Meeting, Sandia National Laboratory, February, 2013.*
12. **Dempsey, A. B.**, Kokjohn, S., Splitter, D., Hanson, R., and Reitz, R. D., "Dual Fuel Reactivity Controlled Compression Ignition (RCCI) Research at the University of Wisconsin-Madison's Engine Research Center," *Society of Automotive Engineers (SAE) Powertrains, Fuels, and Lubricants Meeting, Malmo, Sweden, 2012.*
13. **Dempsey, A. B.**, and Reitz, R. D., "Dual-Fuel Reactivity Controlled Compression Ignition with Alternative Fuels," *University of Wisconsin-Madison's Engine Research Center Student Seminar Series, November, 2012.*
14. **Dempsey, A. B.**, Das Adhikary, B., Viswanathan, S., and Reitz, R. D., "Characterization of Dual-Fuel Reactivity Controlled Compression Ignition (RCCI) Using Hydrated Ethanol and Diesel Fuel," Poster, *Directions in Engine-Efficiency and Emissions Research (DEER), Detroit, Michigan, 2011.*

15. **Dempsey, A. B.**, and Reitz, R. D., “Computational Optimization of a Heavy-Duty Compression Ignition Engine Fueled with Conventional Gasoline,” *University of Wisconsin-Madison’s Engine Research Center Student Seminar Series, March, 2011.*

PROFESSIONAL SERVICE

- Organizer of “Achieving High Efficiency in Heavy-Duty Engines” panel discussion at the SAE Powertrain Fuels and Lubricants meeting, January 2018, San Antonio, TX.
- Created an open source computer program for analyzing the emissions and uncertainty from internal combustion engine experiments. Established a forum for users to communicate and collaborate on engine experimental data analysis:
https://groups.google.com/forum/#!forum/engine_emissions_code
- Co-Organizer of the Partially Premixed Compression Ignition Session at the Society of Automotive Engineers (SAE) Annual World Congress (2014 to Present).
- Co-Organizer of the Compression Ignition Session for the Society of Automotive Engineers (SAE) Annual Powertrain Fuels and Lubricants Conference (2014 to Present).
- Active member on the Society of Automotive Engineers (SAE) Engine Combustion Committee (2014 to Present).
- Review Editor for the Frontiers in Mechanical Engineering Open Access Journal: Engine and Automotive Engineering.
- Member of the Bradley University Mechanical Engineering Alumni Advisory Council
- Serve as an annual judge for Bradley University Mechanical Engineering senior design competition.