SHEAN HUFF

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I have been on staff at Oak Ridge National Laboratory since 2000 after working seven years at Chrysler Corporation. Both at Chrysler and ORNL, my areas of focus have been powertrain electronic controls, for which I hold nineteen US patents, and vehicle research, development and experimentation. My experience in the field of controls has contributed both to advanced production systems, as well as research in the areas of diesel lean NOx catalysis, advanced diesel combustion, improved engine efficiency, and the implementation of ethanol as a transportation fuel. Most recently, I have been involved in researching the fuel economy improvement potential of high-octane renewable fuels and Connected and Automated Vehicles (CAVs).

EDUCATION AND TRAINING

UNIVERSITY OF TENNESSEE KNOXVILLE **Knoxville, TN**

Master of Science, Mechanical Engineering, August 1993, GPA: 3.88/4.00
Thesis: "Investigation of the Fuel Economy Potential Associated with M85 Fueled Vehicles"

Bachelor of Science, Mechanical Engineering, May 1992, GPA: 3.88/4.00

Scholarships & Honors: Marjorie Roy Rothermel-American Society of Mechanical Engineers; American Association of Cost Engineers; Mr. And Mrs. Herman H. Morris Mechanical Engineering; Kodak Scholar-Tennessee Eastman Company; UT National Alumni Association Alumni Upperclass and Alumni Freshman. Tau Beta Pi Engineering Honor Society, President; Pi Tau Sigma National Honorary Mechanical Engineering Fraternity.

RESEARCH AND PERSONAL EXPERIENCE

OAK RIDGE NATIONAL LABORATORY **Oak Ridge, TN**
Research and Development Staff Oct 00–Present

■ Project Management

- Manage the Vehicle Research Laboratory including scheduling of projects, daily activity, experimental setup and execution, and equipment maintenance and repair. Managed the design of a new emission sampling system for an upgraded chassis dynamometer facility. The system is based on a critical flow venturi dilution tunnel design and includes measurements for particulate matter, ethanol, aldehydes, as well as criteria pollutants.
- Assist in the recruitment and management of both postgraduate and undergraduate research personnel.

■ Technical

- Responsible for research and testing to support the US Energy Independence and Security Act legislation. These responsibilities involve supporting the Office of Biomass Production's evaluation of intermediate ethanol blends on the US legacy vehicle fleet, evaluating aftermarket flex fuel conversion kits for production vehicles, and developing technology to improve fuel efficiency of vehicles operated on ethanol fuel.
- Led the development of the Fuels, Engines and Emissions Research Center's first rapid prototype engine controls system. This system has been used extensively in a broad range of research activities including lean NOx trap regeneration and desulfation, selective catalytic reduction, fuel oil dilution measurement, particulate matter measurement and characterization, diesel particulate filter regeneration, and novel exhaust chemistry analysis technique development. Rapid prototype controllers have since become universally used in the fuels and engines research test cells.
- Responsible for lean NOx trap regeneration and desulfation algorithm design and implementation. These algorithms include in-cylinder fuel control required to generate percent levels of hydrogen for lean NOx trap regeneration.
- Responsible for exhaust emissions characterization using advanced analytical tools.

■ Patents

- Awarded U.S. Patent for diesel engine control algorithms related to in-cylinder hydrogen formation.
- Awarded U.S. Patent for a system for determining biofuel concentration.

CHRYSLER CORPORATION **Chelsea, MI**
Engine Performance and Systems Development Engineer Oct 93–Oct 00

■ Management

- Lead engineer of the team that developed Chrysler's ethanol/gasoline flexible fueled engine control system. The control algorithms invented allowed the removal of the fuel composition sensor and the PCV interruption solenoid, as well as the avoidance of CAFE fines for an estimated corporate savings of 3-5 billion dollars over 20 years.

- Responsible for developing the engine control algorithm portion of a joint engine and transmission interactive shift control project. The project improved transmission shift quality, vehicle performance, and fuel economy.
- Coordinated the implementation of engine control algorithms with both prototype and production embedded-programming personnel.
- Guided the development of test equipment and procedures for certifying vehicles to the Environmental Protection Agency's Stricter Evaporative Emissions Regulation.

■ Technical

- Designed, tested, and released control strategies and algorithms for embedded engine controllers.
- Released to production engine control system calibrations that meet government emission standards and vehicle driveability requirements. This releasing included Chrysler's ethanol/gasoline flexible fueled engine control system that will be in production for a minimum of five years with annual sales volumes between 250,000 and 370,000 vehicles.
- Defined engine hardware specifications related to vehicle emissions, performance, durability, and driveability.
- Experienced with Motorola assembly language microprocessor programming.

■ Patents

- Awarded eighteen U.S. Patents for engine control algorithms (sixteen related to ethanol flex fuel control algorithms).
- Lead the team that received the 1999 Walter P Chrysler Award for the year's best invention.

UNIVERSITY OF TENNESSEE – DEPARTMENT OF MECHANICAL ENGINEERING **Knoxville, TN**
Graduate Research Assistant (under Dr. Jeffrey W. Hodgson) May 92–Oct 93

- Implemented hardware and embedded controller modifications to a methanol-fueled engine. The result was a 21% increase in gasoline equivalent fuel economy while maintaining comparable vehicle performance.
- Conducted engine dynamometer and in-vehicle track tests to verify fuel economy and performance results.
- Taught an undergraduate mechanical engineering course on instrumentation and measurements.

Undergraduate Research Assistant Aug 91-May 92

- Investigated fuel economy increases in a methanol-fueled engine (foundation for my graduate thesis work).

TENNESSEE EASTMAN COMPANY **Kingsport, TN**
Summer Intern'91: Improved the configuration of a steam boiler water testing station in an electric power plant.
BRISTOL COMPRESSORS **Bristol, VA**
Coop fall'89: Coordinated cost reducing material and tooling changes with a vendor yielding $20,000 annual savings.
NASA – JOHNSON SPACE CENTER **Houston, TX**
Coop winter'89: Designed and tested a containment tray for a blood sampling kit to be used in Space Shuttle missions.

PUBLICATIONS IMPACT

Publications from the list below:

(11) "Summary of High-Octane Mid-Level Ethanol Blends Study" – This publication, and the work that it contains has had a significant impact on our country's ability to comply with the Energy Independence and Security Act of 2007 (EISA). Because of this publication, it is now legal to distribute E15 nationwide, which has allowed us to surpass the blend wall previously determined by E10.

(26) "Effect of Intake Air Filter Condition on Vehicle Fuel Economy" – This publication has dispelled the false assertion that clean air filters can improve fuel efficiency by as much as 10% over that of dirty filters. This falsehood has been propagated since the late 1970s and had been untrue since the implementation of oxygen feedback fuel control.

(41) "Assessing Reductant Chemistry During In-Cylinder Regeneration of Diesel Lean NOx Traps" – This publication was the first of many which highlighted the importance of using in-cylinder reformation to generate significant levels of exhaust reductant species, most notable of which is molecular hydrogen.

PUBLICATIONS

1. Szybist, J., Pihl, J., Huff, S., and Kaul, B., "High Load Expansion of Catalytic EGR-Loop Reforming under Stoichiometric Conditions for Increased Efficiency in Spark Ignition Engines," SAE Int. J. Adv. & Curr. Prac. in Mobility 1(2):588-600, 2019, https://doi.org/10.4271/2019-01-0244.
2. Gao, Zhiming, Laclair, Tim, Ou, Shiqi, Huff, Shean, Wu, Guoyuan, Hao, Peng, Boriboonsomsin, Kanok, and Barth, Matthew, "Evaluation of electric vehicle component performance over eco-driving cycles," Energy, Volume 172, 2019, Pages 823-839, doi:10.1016/j.energy.2019.02.017.

3. Storey, John Morse, Debusk, Melanie, Huff, Shean P., Thomas, John F., Eibl, Mary A., and Li, Fanfei, "Characterization of GDI PM during Vehicle Start-Stop Operation," SAE Technical Paper 2019-01-0050, 2019, https://doi.org/10.4271/2019-01-0050.
4. West, Brian H., Huff, Shean P., Moore, Larry G., DeBusk, Melanie Moses, and Sluder, Scott. “Effects Of High-Octane E25 On Two Vehicles Equipped With Turbocharged, Direct-Injection Engines,” ORNL/TM-2018/814, 2018, doi:10.2172/1470897.
5. Pihl, J., Thomas, J., Sinha Majumdar, S., Huff, S. et al., "Development of a Cold Start Fuel Penalty Metric for Evaluating the Impact of Fuel Composition Changes on SI Engine Emissions Control," SAE Technical Paper 2018-01-1264, 2018, https://doi.org/10.4271/2018-01-1264.
6. Taie, Z., West, B., Szybist, J., Edwards, D., Thomas, J., Huff, S., Vishwanathan, G., Hagen, C, “Detailed thermodynamic investigation of an ICE-driven, natural gas-fueled, 1 kWe micro-CHP generator,” Energy Conversion and Management, Volume 166, 15 June 2018, Pages 663-673. https://doi.org/10.1016/j.enconman.2018.04.077.
7. Reed Hanson; Scott Curran; Shawn Spannbauer; John Storey; Shean Huff; Christopher Gross; Rolf Reitz,”Fuel economy and emissions testing of an RCCI series hybrid vehicle,” International Journal of Powertrains (IJPT), Vol. 6, No. 3, 2017. http://doi.org/10.1504/ijpt.2017.10008722.
8. Thomas, J., Huff, S., West, B., and Chambon, P., "Fuel Consumption Sensitivity of Conventional and Hybrid Electric Light-Duty Gasoline Vehicles to Driving Style," *SAE Int. J. Fuels Lubr.* 10(3):2017, doi:10.4271/2017-01-9379.
9. Chambon, P., Curran, S., Huff, S., Love, L., Post, B., Wagner, R., Jackson, R., Green Jr., J., “Development of a range-extended electric vehicle powertrain for an integrated energy systems research printed utility vehicle,” Applied Energy, Volume 191, 2017, Pages 99-110, ISSN 0306-2619, doi: 10.1016/j.apenergy.2017.01.045.
10. Thomas, John F. et al., “Measurement of Vehicle Air Conditioning Pull-Down Period,” ORNL/TM-2016/275, 2016, doi:10.2172/1287033.
11. Theiss, T. et al., “Summary of High-Octane Mid-Level Ethanol Blends Study,” ORNL/TM-2016/42, July 2016, doi: 10.2172/1286966.
12. Hanson, R., Spannbauer, S., Gross, C., Reitz, R., Curran, S,. Storey, J., Huff, S., "Highway Fuel Economy Testing of an RCCI Series Hybrid Vehicle," SAE Technical Paper 2015-01-0837, 2015, doi:10.4271/2015-01-0837.
13. “Effects of High Octane Ethanol Blends on Four Legacy Flex-Fuel Vehicles, and a Turbocharged GDI Vehicle”, ORNL/TM-2015/116, March 2015, doi: 10.2172/1185964.
14. Thomas, J., Huff, S., and West, B., "Fuel Economy and Emissions Effects of Low Tire Pressure, Open Windows, Roof Top and Hitch-Mounted Cargo, and Trailer," SAE Int. J. Passeng. Cars - Mech. Syst. 7(2):862-872, 2014, doi:10.4271/2014-01-1614.
15. Huff, S., West, B., and Thomas, J., "Effects of Air Conditioner Use on Real-World Fuel Economy," SAE Technical Paper 2013-01-0551, 2013, doi:10.4271/2013-01-0551.
16. J.F. Thomas, H-L. Hwang, B. West, S. Huff, “Predicting Light-Duty Vehicle Fuel Economy as a Function of Highway Speed,” SAE Int. J. Passeng. Cars - Mech. Syst. 6(2): 859-875, 2013, doi:10.4271/2013-01-1113.
17. J.F. Thomas, B. West, S. Huff, “Effect of Intake Air Filter Condition on Diesel Vehicles,” SAE Technical Paper 2013-01-0311, 2013, doi:10.4271/2013-01-0311.
18. John F. Thomas, Brian H. West, Shean P. Huff, “ORNL Researchers Quantify The Effect Of Increasing Highway Speed On Fuel Economy,” Green Car Congress, January 18, 2013, available at: http://www.greencarcongress.com/2013/01/thomas-20130117.html
19. Thomas, John F., Huff, Shean P., West, Brian H., Norman, Kevin M., “Effect of Intake Air Filter Condition on Light-Duty Gasoline Vehicles,” SAE 2012-01-1717, September 2012, doi:10.4271/2012-01-1717.
20. Storey, J., Barone, T., Thomas, J., and Huff, S., "Exhaust Particle Characterization for Lean and Stoichiometric DI Vehicles Operating on Ethanol-Gasoline Blends," SAE Technical Paper 2012-01-0437, 2012, doi:10.4271/2012-01-0437.
21. Thomas, John F., Huff, Shean P., West, Brian H., “Fuel Economy and Emissions of a Vehicle Equipped with an Aftermarket Flexible-Fuel Conversion Kit,” ORNL T/M-2011/483, April 2012.
22. Chambon, Paul H, Shean P Huff, Kevin Dean Edwards, Kevin M Norman, Vitaly Y Prikhodko, John F Thomas, “European Lean Gasoline Direct Injection Vehicle Benchmark,” SAE Technical Paper 2011-01-1218, April 2011, doi:10.4271/2011-01-1218.
23. Parks, Jim, Vitaly Prikhodko, Bill Partridge, Jae-Soon Choi, Kevin Norman, Paul Chambon, John Thomas, Shean Huff, “Lean Gasoline Engine Reductant Chemistry During Lean NOx Trap Regeneration,” SAE Int. J. Fuels Lubr. 3(2):956-962, 2010, doi:10.4271/2010-01-2267.
24. Parks, II, James E., Kass, Michael D., Huff, Shean P., Barone, Teresa L., Lewis Sr, Samuel Arthur, Prikhodko, Vitaly Y., Storey, John Morse, “Emissions from premixed charge compression ignition (PCCI) combustion and affect on emission control devices,” Catalysis Today, April 2010, pp 278-284, doi:10.1016/j.cattod.2010.02.053.

25. Knoll, Keith, Brian West, Shean Huff, John Thomas, John Orban, Cynthia Cooper “Effects of Mid-Level Ethanol Blends on Conventional Vehicle Emissions,” SAE Technical Paper 2009-01-2723, November 2009, doi:10.4271/2009-01-2723.
26. Norman, Kevin, Shean Huff, and Brian West, “Effect of Intake Air Filter Condition on Vehicle Fuel Economy,” ORNL/TM-2009/021, February 2009, doi: 10.2172/948545.
27. Kass, Michael D., et al. "UTILIZING WATER EMULSIFICATION TO REDUCE NOX AND PARTICULATE EMISSIONS ASSOCIATED WITH BIODIESEL." Transactions of the ASAE (American Society of Agricultural Engineers) 52, no. 1, 5—13, (2009).
28. Parks, James E., Vitaly Prikhodko, Mike Kass, and Shean Huff, “Synergies of PCCI-Type Combustion and Lean NOx Trap Catalysis for Diesel Engines,” SAE Technical Paper 2008-01-2493, October 2008, doi:10.4271/2008-01-2493.
29. Parks, Jim, Brian West, Matt Swartz, and Shean Huff, “Characterization of Lean NOx Trap Catalysts with In-Cylinder Regeneration Strategies,” SAE Technical Paper 2008-01-0448, April 2008, doi:10.4271/2008-01-0448.
30. Parks, J., Huff, S., Kass, M., and Storey, J., "Characterization of In-Cylinder Techniques for Thermal Management of Diesel Aftertreatment," SAE Technical Paper 2007-01-3997, 2007, doi:10.4271/2007-01-3997.
31. Bechtold, R., J. F. Thomas, S. P. Huff, J. P. Szybist, T. J. Theiss, B. H. West, M. Goodman, T. A. Timbario, “Technical Issues Associated with the Use of Intermediate Ethanol Blends (>E10) in the U.S. Legacy Fleet: Assessment of Prior Studies,” ORNL/TM-2007/37, August 2007, doi: 10.2172/936789.
32. Swartz, Matthew M., Shean Huff, James Parks, and Brian West, “Intra-Catalyst Reductant Chemistry and NOx Conversion of Diesel Lean NOx Traps at Various Stages of Sulfur Loading,” SAE Technical Paper 2006-01-3423, October 2006, doi:10.4271/2006-01-3423.
33. Kass, M., Swartz, M., Huff, S., Lewis Sr, S., Lee, D., Storey, J., Wagner, R., “Lowering NOx and PM Emissions in a Light-Duty Diesel Engine with Biodiesel-Water Emulsions,” American Society of Agricultural and Biological Engineers, 2006 ASABE Annual International Meeting (066137), 2006.
34. West, Brian H., Shean Huff, James E. Parks, Matt Swartz, and Ronald L. Graves, “In-Cylinder Production of Hydrogen During Net-Lean Diesel Operation,” Society of Automotive Engineers Paper 2006-01-0212, April 2006, doi:10.4271/2006-01-0212.
35. Wang, J., Storey, J., Domingo, N., Huff, S., Thomas, J., West, B., (2006) "Studies of Diesel Engine Particle Emissions During Transient Operations Using an Engine Exhaust Particle Sizer," Aerosol Science and Technology, 40:11, 1002-1015, DOI: 10.1080/02786820600919408.
36. Huff, Shean, Brian West, James E. Parks, Matt Swartz, Johney Green, and Ronald Graves, “In-Cylinder Regeneration of Lean NOx Trap Catalysts Using Low Temperature Combustion,” Society of Automotive Engineers Paper 2006-01-1416, April 2006, doi:10.4271/2006-01-1416.
37. West, B., Huff, S., Parks, J., “Efficient Emissions Control for Multi-Mode Lean DI Engines,” ORNL/TM-2006/560, January 2006.
38. Storey, J., Lewis, S., West, B., Huff, S., Sluder, C., Wagner, R., Domingo, N., Thomas, J., and Kass, M., 2005, "Hydrocarbon species in the exhaust of diesel engines equipped with advanced emissions control devices," CRC project no. AVFL-10b-2.
39. Parks, James E., Shean Huff, Josh Pihl, Jae-Soon Choi, and Brian H. West, “Nitrogen Selectivity in Lean NOx Trap Catalysis With Diesel Engine In-Cylinder Regeneration,” SAE Technical Paper 2005-01-3876, October 2005, doi:10.4271/2005-01-3876.
40. Witze, Peter O., Shean P. Huff, John M. Storey, Brian H. West, “Time-Resolved, Laser Induced Incandescence Measurements of Particulate Emissions During Enrichment for Diesel Lean NOx Trap Regeneration,” Society SAE Technical Paper 2005-01-0186, April 2005, doi:10.4271/2005-01-0186.
41. West, Brian H., Shean P. Huff, James E. Parks, Jae-Soon Choi, William P. Partridge, Sam A. Lewis, John M. Storey, “Assessing Reductant Chemistry During In-Cylinder Regeneration of Diesel Lean NOx Traps,” SAE Technical Paper 2004-01-3023, 2004, doi:10.4271/2004-01-3023.