

Technical Highlights for October 2012

ORNL Researchers Generate Significant Industry Interest in Ethanol Optimization

Jim Szybist has consolidated the results from ethanol optimization projects that he has contributed to over the past four years into a single talk and has presented it to industry partners on a number of occasions. The work summarizes the ethanol optimization potential for improving both thermodynamic efficiency and system-level efficiency in spark-ignition engines, as well as the challenges of doing so. Since August, Dr. Szybist has presented different versions of this talk to Ford, Chrysler, Department of Energy (DOE), Mercedes, and Corning. In addition, Dr. Szybist and Brian West authored a related talk at the Directions in Engine-Efficiency and Emissions Research (DEER) conference that spurred additional discussion with a representative from General Motors. Industry has a great deal of interest in the area as they are looking for improved fuel octane number as a way to enable higher efficiency engine technologies in order to comply with Corporate Average Fuel Economy (CAFE) regulations.

Results from a Recent FEERC Study of Vehicle Energy have been Incorporated into an International Energy Agency (IEA) Report

The results of researching and documenting the details of how energy is utilized and dissipated by light-duty vehicles were incorporated into the fueleconomy.gov website earlier this year. This effort has been valuable in correcting past misconceptions and making this information available to researchers, planners, policy makers, and the public. IEA directly incorporated this FEERC effort into their 2012 document "Technology Roadmap: Fuel Economy of Road Vehicles," even copying the ORNL artwork. ["Technology Roadmap: Fuel Economy of Road Vehicles," pg. 17 in *International Energy Agency*, Paris, France, 2012, available at <http://iea.org/publications/freepublications/publication/name,31269,en.html>.]

HIGH-LEVEL OR NOTEWORTHY VISITS

Nippon Soken Visits FEERC

Several researchers from Nippon Soken in Japan visited FEERC in October. Seminar topics included work in diesel fuel injection visualization and low-speed preignition. This visit was the second for one of the Japanese researchers, who also visited FEERC shortly after a DOE group visited several Japanese sites that same year to benchmark diesel engine and aftertreatment technology in 2001.

Southwest Research Institute (SwRI) Visits FEERC

Dr. Thomas Briggs from SwRI visited FEERC in October to discuss on-going combustion and emissions controls research at both institutions as well as potential future collaborations. SwRI has extensive transportation related research which is considerably different and complementary to the research at ORNL.

INVITED TALKS AND PRESENTATIONS

FEERC Researcher Presents Keynote Lecture at Global Powertrain Congress

Robert Wagner presented a keynote lecture at the 2012 Global Powertrain Congress in Troy, Michigan. His invited presentation was co-authored by Sreekanth Pannala and focused on the role of high performance computing to accelerate the development of high efficiency engines. This included a discussion on the challenges and opportunities of recent advances in engine technology as well as an

ever increasing parameter space. The presentation also highlighted the need to bridge basic sciences and engineering across very diverse research areas.

ORNL has Strong Showing at the 2012 DEER Conference

ORNL researchers authored a total of 7 oral presentations and 14 poster presentations and made technical contributions to nearly every topic area at the conference. The presented material covered a diverse range of topics, including neutron imaging of soot filters, aftertreatment and catalysis technologies, trends and opportunities in high engine efficiency technologies, low temperature combustion, and engine optimization for fuels. Additionally, ORNL was acknowledged as a collaborator in a number of additional presentations by industry, illustrating the impact of ORNL through the Supertruck program and various other industry projects

ORNL Researcher Presents at IEA Meeting in South Korea

Jim Szybist presented ORNL research on low temperature combustion (LTC) at the 34th Annual IEA Task Leader Meeting (TLM) on combustion at the meeting held on Jeju Island, South Korea. The invited talk focused on efficiency gains that could be realized using two different LTC techniques on a gasoline engine platform. Attendees to the conference included representatives from 10 of the 12 member countries of the IEA combustion tasks. This is the first time that a member of the ORNL/FEERC has attended this IEA meeting.

ORNL HPC Research on Accelerating High Efficiency Engine Development Featured in DEER Newsletter Article

Researchers at ORNL/FEERC are bridging engine and emissions controls expertise with computational expertise by utilizing Jaguar, a DOE flagship supercomputer and one of the most powerful HPC systems in the world. This research was recently featured in the newsletter for the 18th Annual DOE DEER Conference. The article included an ORNL perspective on the challenges and opportunities of using HPC for accelerating design as well as short descriptions of two collaborations with industry to leverage the ORNL expertise and resources for addressing real world engineering challenges.

FEERC Research Featured in *Green Car Congress*

(<http://www.greencarcongress.com/2012/10/malikopoulos-20121003.html>)

Recent research conducted by Andreas Malikopoulos and his student, Juan Aguilar, was featured in *Green Car Congress*. In this research, they investigated the key driving factors that have a major impact on fuel economy and developed an optimization framework that can aim to optimize the driver's driving style with respect to these driving factors. In this context, they developed a driver feedback system that can provide visual instructions to the driver to alter his/her driving behavior and make it eco-friendly. A feature that distinguishes this technology from other similar ones is that the driver can customize how he/she prefers to have his/her driving style optimized, e.g., the optimized driving style should not exceed the original destination arrival time by X%, or the optimized driving style should not yield vehicle speed profiles less than Y mph from the original driving style, etc. The results of this research were reported in the paper entitled "Optimization of Driving Styles for Fuel Economy Improvement," which was presented in the 2012 15th International IEEE Conference on Intelligent Transportation Systems.

ORNL High Performance Computing (HPC) Research Featured in Online Article

ORNL research was recently featured on *Digital Manufacturing Report*. The article "A New Era in Automotive Engine Development Driven by HPC," included interviews with Robert Wagner and Sreekanth Pannala. Dr. Wagner provided a perspective on the state and future of engine technology

and Dr. Pannala described the significance of an ongoing activity with Ford Motor Company to further the understanding and design considerations of cyclic dispersion in internal combustion engines. The article also features recent performance in collaboration with General Motors on injector design optimization. The full article is here: http://www.digitalmanufacturingreport.com/dmr/2012-10-25/a_new_era_in_automotive_engine_development_driven_by_hpc.html?featured=top

ORNL Research Presented at the 2012 Biodiesel Technical Workshop

FEERC researchers Todd Toops and Scott Curran presented the results of recent research involving biodiesel at the 2012 Biodiesel Technical Workshop in Kansas City, Missouri. Todd Toops' presentation "Materials Characterization to Investigate Location of Fuel-borne Metals" highlighted the materials characterization efforts ongoing at University of Tennessee-Knoxville (UTK) and ORNL and is part of a collaborative effort between ORNL/UTK, National Renewable Energy Laboratory (NREL), and Ford. Scott Curran's presentation, "Background on RCCI and B20 RCCI Results with Both Gasoline and Ethanol Blends" gave the biodiesel community an overview of the advanced combustion mode known as reactivity controlled compression ignition (RCCI) and showed results of how biofuels including biodiesel blends can improve the performance of these modes as compared to their operation using conventional fuels.

AWARDS

ORNL, NREL, and Ford Team Recognized as "Researchers of the Year" at 2012 Biodiesel Technical Workshop

Todd J. Toops (ORNL), Aaron Williams (NREL), and Giovanni Cavataio (Ford) were recognized for their collaborative effort to investigate the impact of trace metal impurities (Na, K, and Ca) on the end-of-life functionality and mechanical properties of emissions control devices. This effort focused on the light duty application and employed the Ford aftertreatment system that includes a diesel oxidation catalyst (DOC)/selective catalytic reduction (SCR)/diesel particulate filter (DPF) arrangement. The long-term introduction of the metal impurities as well as the evaluation of the entire aftertreatment system on an Federal Test Procedure (FTP) drive cycle was performed at NREL, the evaluation of the performance of the individual devices and sections were performed at Ford, and the characterization of the metals location and chemical nature were performed at ORNL and the UTK. The team was able to show that the aftertreatment system was durable and able to meet the 2010 emissions standards at 150,000 miles (based on equivalent metal exposure and thermal cycling), but that some deactivation of both the DOC and the front of the SCR relative to the base case did occur, such that more strict emissions regulations or further exposure may result in failed emissions standards.

FEERC Researchers West and Wagner Elected Fellows of SAE

Robert Wagner and Brian West have been elected to Fellow status within the Society of Automotive Engineers. Letters received from the SAE Fellows Committee note that Robert's selection is based on his distinctive contributions in combustion stability fundamentals and the scaling and harmonization of low temperature combustion processes to multi-cylinder engines, while Brian's selection is attributed to outstanding research accomplishments that have impacted multiple national fuel policies and sustained, unique contributions to technology and data supporting improved vehicle fuel economy. The two will be honored during the SAE World Congress and Exhibition in Detroit in April.

FEERC Researcher was appointed secretary at the American Society of Mechanical Engineers (ASME) Model Identification and Intelligent Systems (MIIS) Technical Committee

Andreas Malikopoulos was nominated and will be serving as a secretary at the MIIS technical committee of the ASME Dynamic Systems & Control Division (DSCD). The committee's interests include modeling, identification, design of control systems, intelligent systems, physical system modeling, and simulation. Application areas include but are not limited to automotive/transportation systems, energy systems, industrial/manufacturing systems, bio systems, large-scale systems, micro/nanosystems, electro-mechanical systems, and aerospace systems.