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Publications

FIRE
Von Berg, E., Edelbauer, W., Tatschl, R., Alajbegovic, A., Volmajer, M., Kegl, B. (Univ. of Maribor); Ganippa, L. (Chalmers Univ. of Technolog-}

y); “Validation of a CFD Model for Coupled Simulation of Nozzle Flow, Primary Fuel Jet Break-up and Spray Formation”, ICE503, Salzburg,}

Austria, May 11-14, 2003

Turbulent Combustion – A Validation Study”, 2nd M.I.T. Conf. on Computational Fluid and Solid Mechanics, June 17-20, 2003

SWIFT

Yugoslavia, May 26-28, 2003

EXCITE

for Analysis of Crankshaft and Engine Dynamics”, 30th Leeds-Lyon Symposium on Tribology, 02.-05.09.2003, Lyon/France

BOOST
Peters, B.: „Numerical Simulation of a Diesel Particulate Filter During Loading and Regeneration”, ASME 2003, 

11-14.05.2003, Schloss Hellbrunn/Salzburg
Wurzenberger, J., Peters, B.: „Design and Optimization of Catalytic Converters taking into Account 3D and Transient Phenomena as an Inte-

gral Part in Engine Cycle Simulations”, ASME 2003, 11-14.05.2003, Schloss Hellbrunn/Salzburg

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AVL Selected to Commercialize, Refine FreedomCAR Vehicle Simulation Software - ADVISOR

Under the agreement between AVL and NREL, AVL will develop and market ADVISOR 2003 which will grow AVL’s already extensive vehicle simulation software portfolio. AVL will market and sell ADVISOR 2003 worldwide through its affiliates and provide technical support for its global user base.

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Our computer and experimental tools allow us to understand the effect of variations before prototypes are built. Designing quality into the product is imperative, especially when developing energy saving technologies for hybrid electric and fuel cell vehicles that must compete with mature technologies. The only way to reduce a product’s variability and incorporate quality into its design is to account for variation using advanced computational and probabilistic tools. We can account for variation in materials, dimensions, and loading using CAE analysis and evaluating the performance in terms of sigma quality levels (the distance from the mean to the target in standard deviation units).

Figure 1 shows a workflow for robust fuel cell design. Advanced computational tools can be used as virtual prototypes, thereby reducing the need for computational prototypes; however, we still need advanced experimental tools to validate models and verify performance. We have been working on reducing vehicle ancillary loads, such as air conditioning, using one such tool—a life-size thermal manikin. The manikin helps us assess the thermal comfort of the vehicle occupants by simulating human responses to temperature and humidity.

The manikin is controlled by a three-dimensional finite-element CAE model of the human thermal physiological and thermoregulatory systems. The physiological model consists of bone, muscle, fat, and skin layers, as well as blood circulation. The thermoregulatory system physiological responses of sweating, shivering, vasodilatation/ constriction, and variable metabolic or cardiac rates are simulated. The physiological model determines skin temperatures and sweat rate, and transmits this information, as well as the breathing rate, to the manikin. These CAE simulations provide in real time the necessary information to the manikin’s control system which then adjusts the manikin’s heating and sweating systems accordingly. Next the body temperatures are transmitted to a psychological comfort model that provides a real time transient thermal comfort level, where the ultimate question—is the vehicle occupant comfortable—is answered. See Figure 2.

It’s the rare company that has both detailed knowledge of all the cutting edge products/software and hardware and the available capital to invest in training and deployment for the future. We have found that when companies cooperate and leverage their talents and products across disciplines, each adds value. By working together, companies can develop credible, experimentally validated software tools that can help predict the next evolution in vehicle technology. This understanding of the future is critical to remaining on the cutting edge of both technology and company profitability. We have carefully evaluated and competitively selected partners like AVL to work with us to achieve this vision. By combining the talent and power of motivated people working to seamlessly integrate advanced computational and experimental tools—we will move beyond “lipservice” and into reality.

References:

Today, more than ever, the automotive industry is being challenged to meet more complex design requirements such as cost, performance, safety, quality, time to market, short life cycle, environmental impacts, aesthetics, and major changes in industries’ business models. Although engineers talk of “seamless integration” and breaking down internal “silos,” it takes a special breed of leadership to respond to these needs. As a national lab, our mission is to overcome long range barriers. And our transportation focus has been on integrating tools and techniques to effectively evaluate and advance energy saving technologies while accommodating the constraints faced by the OEMs and their suppliers.

Although we know that CAD, CAE, and CFD provide valuable information, they are not being used early enough in the product development process. The number one bottleneck in automotive product development process is a lack of data interoperability. For example, CAD may provide information about form and fit, while CAE and CFD provide information about functional performance. The vehicle development process is hand-crafted by combining CAD-centric instead of requirement driven. The ultimate question is, “How do we design a vehicle system that meets all the performance targets the first time?”

Our engineers are working to integrate computational tools with statistical and optimization algorithms with the goals of rapid functional performance engineering and compressed time-to-quality. For example, engineers rely on “deterministic” computer-aided engineering methods, which typically do not account for variations in dimensions, material properties, and loading. This build-it and test-it approach is too costly and too time consuming.

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Leadership or Lipservice?

PARTNER COLUMN: NATIONAL RENEWABLE ENERGY LABORATORY, USA

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To overcome these challenges to the automotive industry, engineers at the National Renewable Energy Laboratory have strategically implemented advanced computational and experimental tools, such as CAD, CAE, and CFD, with probabilistic and optimization techniques. These tools allow us to more effectively assess a product’s design while freeing up greater portions of engineers’ time for fundamental engineering to better meet customer needs. As a national lab, our mission is to overcome long range barriers. And our transportation focus has been on integrating tools and techniques to effectively evaluate and advance energy saving technologies while accommodating the constraints faced by the OEMs and their suppliers.

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