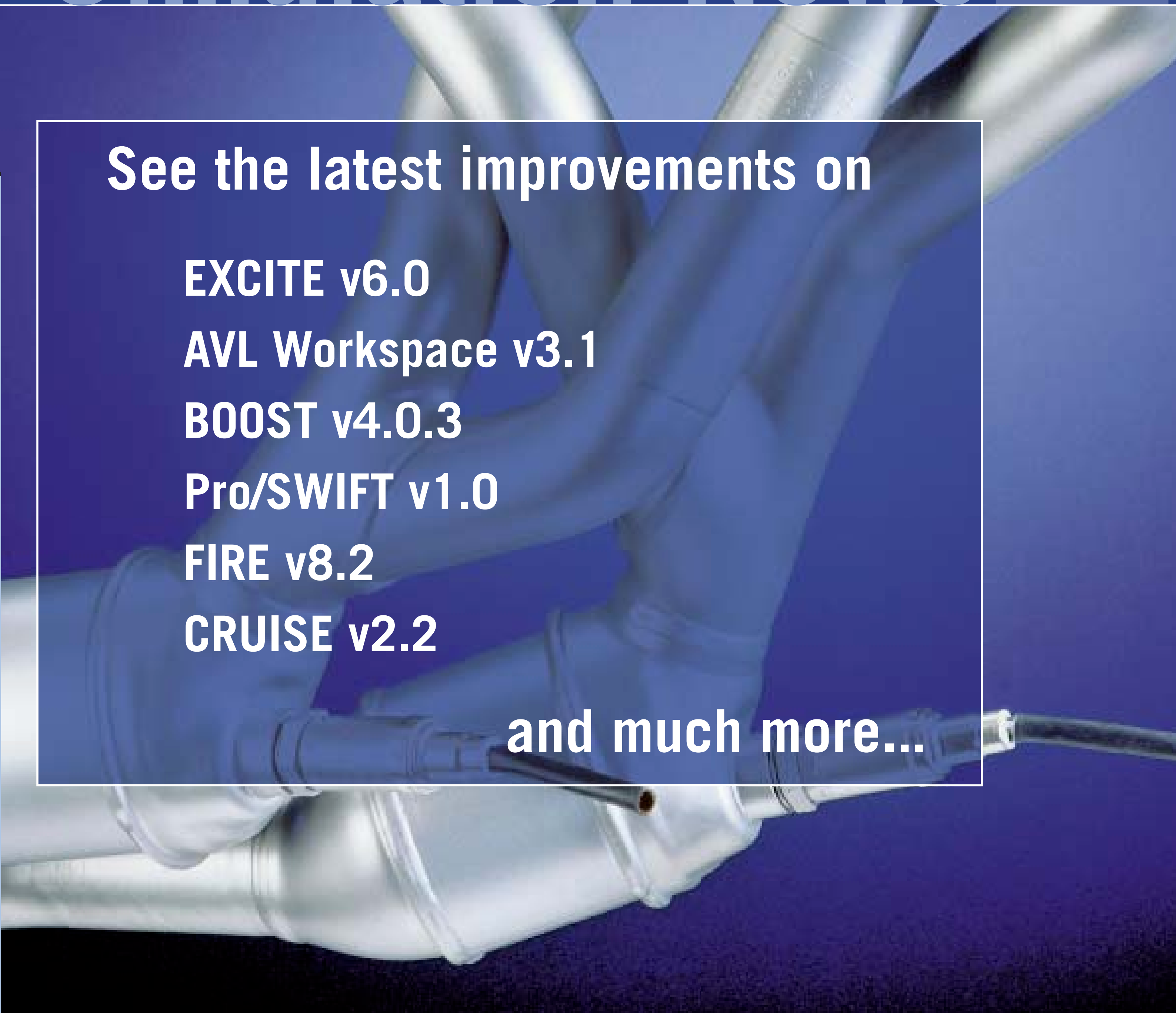
ADVANCED SIMULATION TECHNOLOGIES TRENDLETTER 2003

Simulation News 2



See the latest improvements on

- EXCITE v6.0
- AVL Workspace v3.1
- BOOST v4.0.3
- Pro/SWIFT v1.0
- FIRE v8.2
- CRUISE v2.2

and much more...

Editorial

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Simulation Models Becoming More Sophisticated within the Development Process

Applications of mathematical simulation for the design analysis of components, subsystems and systems of engines and vehicles have long been established in the development processes of automotive manufacturers. However, the models which are used for carrying out trend calculations in the concept phase are usually built on quite different foundations than the models that are used for accurate calculations during the prototype phase. Increasing demand for the various simulation tools used in the development process to deliver comparable results has caused us to concentrate on developing families of simulation models which consist on the one hand of complex, physically substantiated, highly accurate models and simplified models consistently derived from them on the other.
AVL has developed a platform concept to support all stages of the development process. It is based on multiphysical and scalable models: multiphysical models to represent complete systems, scalable models to enable simulations of differing complexity in terms of the modelling depth depending on the available information density and the optimization goal. This meets the demands not only for short run times allowing fast optimizations but also for high accuracies in the final design.
Examples of how this concept is implemented include the simulation models for catalysts and diesel particulate filters, and the calculation models for crank shaft simulation:
For exhaust gas aftertreatment, 1-dimensional models for the BOOST thermodynamics program were derived from the 3-dimensional models implemented in the CFD software FIRE. The advantage of this approach is that design analysis calculations can be carried out quickly with BOOST and then the most promising variants examined with consistent, highly accurate models in FIRE. The resultant reductions in development times are considerable.
The multi-stage design of crank shafts aims at much the same goal. A multi-body model of the crank shaft can be derived automatically from a CAD model. It can then be used both for a preliminary design analysis in EXCITE Designer and for an exact design assessment with EXCITE. The next step in further shortening crank shaft design times will be achieved by integrating components of the ABAQUS FEM software. This step is based on the strategic partnership set up between ABAQUS Inc. and AVL, announced in a press release on October 14, 2003.

Knowing from own experience that this is the best way to support the various phases of product development, AVL will continue to offer more and more simulation models which can „grow“ alongside the progress in the product development process.

Gotthard Ph. Rainer
Vice President
AVL Advanced Simulation Technologies

ADVISOR

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

ADVISOR has been developed by scientists at the U.S. Department of Energy's National Renewable Energy Laboratory (NREL), located in Golden, Colorado. ADVISOR 2003 is intended to help automakers, suppliers and the federal government to model the various fuel cell and hybrid powertrains, as well as optimizing vehicle performance, economy and emissions of these advanced vehicle concepts.

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.

A cooperative research and development agreement between NREL and AVL will enable further collaboration and enhancement of integrated advanced vehicle simulation tools.

PARTNER COLUMN: NATIONAL RENEWABLE ENERGY LABORATORY, USA

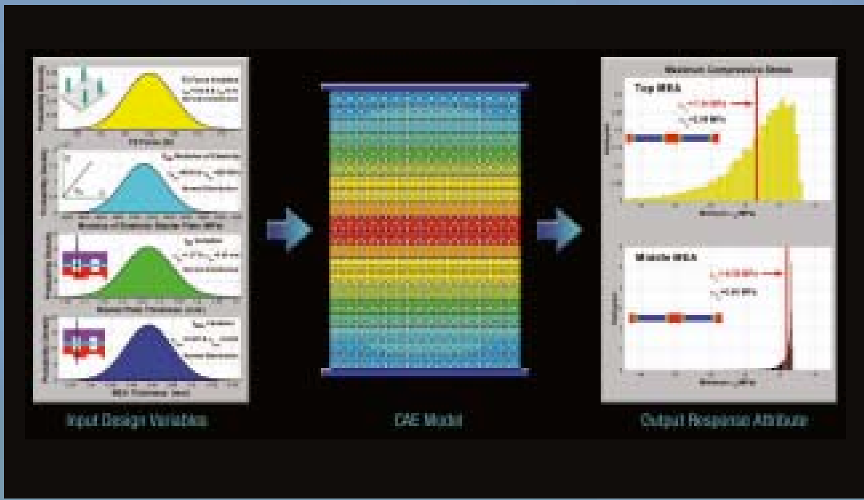
Leadership or Lipservice?

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 barriers. Increasingly, cross disciplinary engineering methods are not only desirable, but are considered to be mandatory. These methods are integrating teams within today's new knowledge-based and continuous-learning organization.

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.

Although we know that CAD, CAE, CFD all 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 handicapped by being 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.

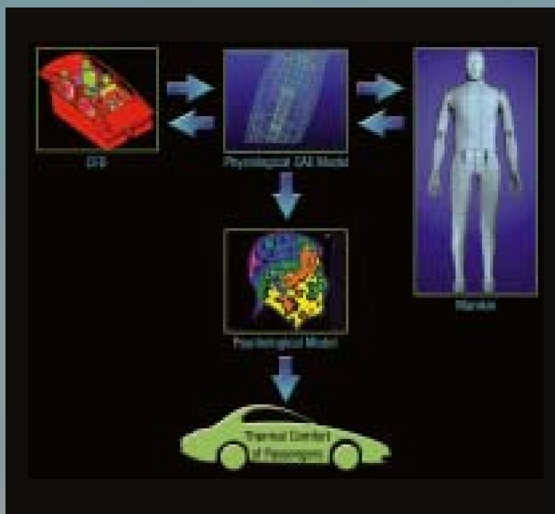


Our computer and experimental tools allow us to understand the effect of variations before prototypes are built. Designing quality into the product is imperative, especially when developing energy saving technologies for hybrid electric and fuel cell vehicles that must compete with mature technologies. 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.



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