SIMULATING VEHICLE DRIVELINES

How one supplier in Germany is realizing model-based design and development techniques for efficient vehicle architectures

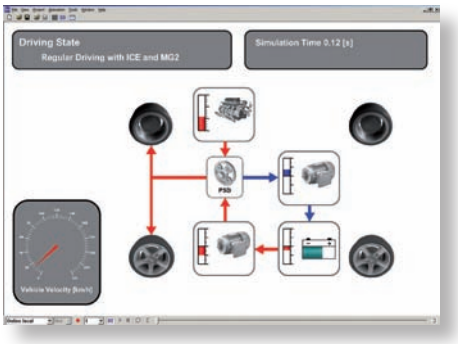
With tightening laws on emissions and CO_2 in automotive markets worldwide, OEMs are forced to keep close control of the fuel efficiency of their vehicles during the development process. Numerous influences on driveline designs are making it difficult for engineers to develop well-balanced systems for conventional drives and particularly for hybrids.

Tesis DYNAware's simulation framework, called DYNA4, enables model-based tests and development throughout the hybrid vehicle development process. Application areas of the simulation software range from design of control algorithms for hybrid control units (HCU) to the investigation and optimization of driving strategies and energy management functions to SiL and HiL tests.

Hybrid drivetrains can be very effective for the reduction of fuel consumption. But how does the hybrid drivetrain influence all the other important characteristics of a vehicle? Customers demand dynamics, drivability and comfort, and they are mostly unwilling to pay 50% more for a hybrid. So availability and costs do influence the choice of parts, as do the required installation space and weight, because hybrid drivetrains are usually integrated into existing vehicle concepts.

Safety issues are also key, with voltage levels of up to several hundred Volts. In addition, crash safety can become critical and this area has a lot to do with positioning of hybrid parts within the chassis and thus with the physical setup of the electrical power net. As a result, it is crucial to consider safety systems such as ABS and ESP. For example, with electric motors capable of applying an extra torque of several hundred Newton meters of torque, a closer look at braking stability controls is essential. On an electric systems level, not only the electric energy flows are to be taken into account, but also the thermal energy flows. Battery temperature has to remain in a relatively narrow range to ensure no damage is done to the battery. The cooling system needs a revision, and air and fluid circuits must often be completely redesigned to fulfil the needs of a vehicle lifespan of more than 10 years.

In all these fields of application, model-based design with DYNA4 can help the engineer find suitable architectures on a vehicle, system and component level. The dominating interdependencies between design targets can be revealed and analyzed, and the right measures for controlling them can be taken. The screen-shot in Figure 1



shows an example of the visualization of electric and mechanic energy flows for a driveline topology derived from the second-generation Toyota Prius.

After the design steps, function implementations on all levels are tested in environments integrating software models and hardware components. This means that throughout the vehicle development process, simulation models are needed that provide suitable levels of detail as well as suitable performance levels. For a detailed cooling system design, integration of specialized 3D simulation tools is necessary. This is an area in which, with today's technology, real-time capability is simply out of reach. For HiL tests, on the other hand, performance issues may override the demands for high accuracy of physical effects in the model.

Effective model-based design does not only imply accurate models and special tools for each field of application; instead it is also important to support simulation-related processes along the cycle. Simulation processes include management of simulation models, input data, and results. These processes are very similar in all phases of development. Experience in projects with OEMs has shown that a standardized working environment leads to better cooperation among the various departments engaged in the development process. A common working environment leads to interchangeability of models, data, results and also evaluation functionalities.

Tesis DYNAware's DYNA4 gives the user a in-depth working environment solution. Within this framework, Tesis offers a wide range of tested Simulink models for various simulation needs. All Simulink models provided by the user can easily be integrated into the framework via an import wizard. DYNA4 delivers a comfortable, easy-to-use framework for the management of all simulation-related during development **E&H**