high as that of the normal mode communication.

Another advantage of the daisy-chain method is its simplicity; only the basic LIN transceiver is used twice in the same node with a purely digital interconnection, while the current measurement requires the design of a relatively precise analog voltage measurement circuit intended to operate under harsh conditions. A dual-LIN node is therefore easier and faster to design.

The daisy-chain method also supports the use of other topologies besides a single linear bus with the master node on one extremity. Correct node-position detection is possible since each dual-LIN node is connected to the branching point of the tree with a different LIN port (LIN1 or LIN2). The auto-addressing can distinguish on which branch the node is connected. Examples of other allowed topologies include loops and nested loops.

In summary, the dual-LIN transceiver method for SNPD offers several advantages over the line-current measurement. It uses normal signal levels and is thus more robust; it increases fault tolerance by detecting the failing node; the bus topology is not limited to a linear bus; and SNPD requires less effort and less design risk, thus reducing LIN-based system design cost.

Information for this article was provided by **Pavel Drazdil** and **Geert Vandensande** of AMI Semiconductor.

Testing

Quiet on the inside, please

GFaI Tech's Acoustic Camera spherical array can measure in-vehicle noise.

The workday ends as the cell phone rings and the boss yells something just as the elevator doors clank shut. From inside the elevator, the outside world seems rather noiseless, and that quiet environment is highly sought after in other enclosed spaces, most notably vehicle interiors.

In order to rid a vehicle cabin of unwanted noise, it is necessary to know how the sound arrived at the interior destination, which is why many companies feature a variety of NVH detection tools. The following paragraphs provide a snapshot of what some suppliers are offering in their acoustic product portfolio as well as how some businesses are adjusting their technical sound strategies.

Acoustic mapping has long been an NVH testing staple, but the ability to do so in-vehicle is picking up momentum via beamforming technology. Germany-based **GFaI Tech**'s Acoustic Camera provides a method for noise field mapping. "This is a great device for finding a number of noise issues, like squeak and rattle," said Dennis Sulisz, Sales Engineer for **Sage Technologies**, the North American sales outlet for the device that is distributed in North America by **SenSound**. GFaI's Acoustic Camera is a carbon-fiber globe comprised of one USB camera and dozens of microphones, typically ranging between 32 and 1000. "Because the sphere is acoustically transparent, it doesn't affect the sound fields of the car interior that's being measured. We're also able to provide time-domain beamforming, which enables the capture and mapping of transient noises," said Sulisz. In early 2008, the device will incorporate rotating equipment analysis software. "That will enable users to analyze HVAC noise, powertrain noise, seat motors, *etc.* as those devices change operating speeds," Sulisz said.

Bruel & Kjaer's Spherical Beamformer is a solid globe that can be placed inside a vehicle for acoustic mapping. "The device is able to capture a 180° by 360° sound map. That information is then digitally stitched together and unwrapped into a 2-D presentation on a computer screen," said mechanical engineer Tony Frazer, Array Acoustics Solution Manager for Bruel & Kjaer in Canton, MI. The 19.5-cm (7.7-in) globe, about the size of a human head, contains 36 microphones and 11 USB cameras. "This device provides a very fast method of obtaining a contour map. In about five minutes, you can acquire the data and display the sound map," said Frazer. The Spherical Beamformer was market-launched in late 2006. "The second-generation product will have software updates, which will enable real-time monitoring as well as non-stationary measurements, such as an engine run-up or on-road testing—which, for example, can be done to determine where noise is entering a vehicle when other vehicles pass by," said Frazer.

Keeping vehicle drive-by noise at bay is one benefit of being inside a vehicle with properly set closure panels, and a wireless sensor from **Inora Technologies** can determine an incorrect seal margin. "Inora's WISEgap sensor is for measuring the hidden gaps around doors and other closure panels. The measurements can be done as a static test, such as verifying that the seal gaps match the specifica-

WISEgap sensors from Inora Technologies measure door-seal margins.

tions, or the measurements can be done as a dynamic test, like an on-road test to detect an inadequate closure panel seal, which could lead to water leakage, wind noise, or other problems," said Nate Enstrom, Sales Engineer with Inora in Michigan. In early 2008, the WISEgap 2.4 gets market-released. This sensor will be smaller—30 x 15 x 5 mm (1.2 x 0.6 x 0.2 in)—than the current 40 x 15 x 5-mm (1.6 x 0.6 x 0.2-in) sensor, "so it can be more easily located in hard-to-reach areas," said Enstrom, adding that the 2.4 sensor will have a 2.4 GHz frequency, unlike the present sensor's 916 MHz, so "the new sensor will match a worldwide standard for wireless communications."

Improving communications with customers was a contributing reason for **PCB Piezotronics** forming an automotive sensors division. The company, which designs and manufactures force, torque, load, strain, pressure, acoustic, and vibration sensors, recently launched the automotive unit with Jeff Case—former Chief Program Engineer at **Ricardo North America**—as the division's leader. "The goal is to grow the global market for automotive business across all PCB product lines, which is one reason PCB products will now be marketed by application areas—such as powertrain development, component and vehicle durability, sound, and vibration," said Case. With approximately 15% of overall business tied to NVH, sound and vibration "is PCB's most important application area, so we're definitely focused on how we can grow and evolve to match our customers' needs," Case said.

Polytec intends to make one testing job a quicker and easier task. "The traditional way to measure torsional vibration of a crankshaft is to use sensors in opposing directions in order to calculate the angular vibration, which means custom-machining an aluminum insert in order to mount the sensors. It's just a time-consuming setup process," said Mike Stone, Applications Engineer for Polytec in Michigan. Polytec's recently introduced RLV-5500 Rotational Laser Vibrometer—consisting of a sensor head with two lasers, a controller with BNC-outlet, and three BNC outputs (angular velocity, angular displacement, and rpm)—reduces the traditional setup time with no post-processing and no mass loading. "The RLV-5500 helps minimize torsional vibrations when developing a crankshaft, which

in turn means no noise transfer to the vehicle interior," said Stone.

A new technical center gives passenger vehicle makers, Class 5 through 8 engine manufacturers, as well as suppliers a place to conduct an array of powertrain tests. "The facility design group was comprised entirely of people with NVH experience, so there's a level of noise suppression in the test cells—even the heavy-duty test cells—that allow for sound localization," said Michael Pierz, Laboratory Director for the **Meiden Technical Center North America** in Northville, MI. Unique dynamometers underscore the attention to NVH inside the 88,000-ft² (8175-m²) building. "Because of Meiden's liquid-cooled dynamometers, we can test the entire driveline dynamics in one cell, and that means you can get the load and the inertia to be the same as it would with an on-the-road vehicle but without a noise influence," said Pierz.

Noise influencers can be pinpointed with the aid of new software from **National Instruments**. The Sound and Vibration Assistant, a stand-alone program, enables the user to acquire signals, generate signals, obtain frequency response measurements, as well as perform other acoustic and vibration analysis functions. "A test engineer could use the Sound and Vibration Assistant along with National Instruments' data acquisition hardware in order to have a portable, flexible, easy-to-use system for in-vehicle NVH testing," said Chris Fronda, Product Marketing Engineer for Sound and Vibration at National Instruments.

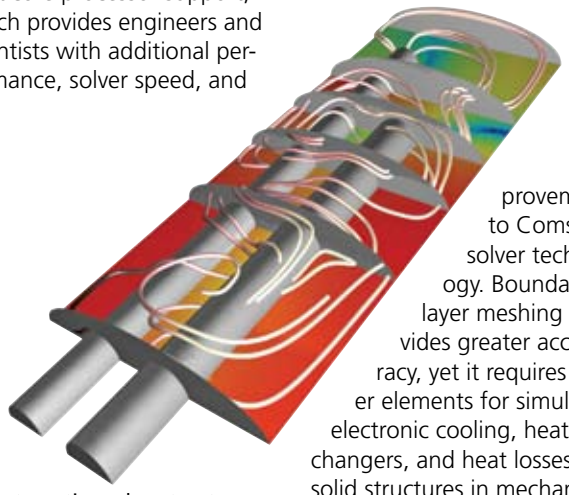
Kami Buchholz

Simulation

Comsol 3.4 speeds simulations

In October at its annual conference in Boston, **Comsol** released the latest version of its engineering and scientific software environment for modeling and simulating physics-based systems, Comsol Multiphysics 3.4.

Perhaps the most notable new feature of version 3.4 is multicore processor support, which provides engineers and scientists with additional performance, solver speed, and accuracy when performing multiphysics simulations. By leveraging multicore processors and shared-memory parallelism, each step of the simulation workflow—meshing, assembly, and solving—can now be executed in parallel.



An automotive exhaust system is constructed of a combination of reflective and dissipative muffler elements. In the Comsol Multiphysics 3.4 Acoustics Module, a streamline plot of acoustics intensity is shown, together with a slice plot of the sound pressure level.

The software uses the maximum number of cores available on a system and allows users to have complete control over the number of processors dedicated to their simulations.

Thermal boundary layers, charged double-layers in ac/dc applications, and viscous boundary layers in fluid-flow applications are now able to be meshed more efficiently, with greater accuracy, and with less memory consumption thanks to a new boundary layer meshing feature.

Comsol's Heat Transfer Module benefitted from the introduction of boundary layer meshing and through improvements to Comsol's solver technology. Boundary layer meshing provides greater accuracy, yet it requires fewer elements for simulating electronic cooling, heat exchangers, and heat losses to solid structures in mechanical design. This module includes the ability to model 3-D surface-to-surface radiation using a 2-D axisymmetric modeling domain.

Solver performance for fluid dynamics also received an upgrade in Version 3.4 with the addition of new iterative methods. Galerkin Least Squares stabilization techniques now complement Comsol's iterative solvers, allowing large fluid-flow problems with millions of degrees of freedom to be computed.

A new segregated solver reduces memory consumption when computing large problems such as fluid-structure interaction or wave propagation in thermally deformed structures. Fluid-flow problems are now solved up to five times faster when compared with previous versions, according to Comsol.

Post-processing tools for computing geometric properties such as volume, area, center of gravity, and moment of inertia have also been added.

Users of Comsol's Chemical Engineering and Heat Transfer Modules can now include variable-density flow and free convection in their simulations. These capabilities will be helpful when solving coupled flow and conjugate heat transfer problems often encountered in electronic cooling and heat exchanger analyses.

For applications such as microfluidics, multispecies convection, and reacting flows, Comsol has been enhanced with additional multiphysics modeling interfaces for turbulent and laminar flow with variable densities due to variations in composition.

A new interface has been added to the Comsol Reaction Engineering Lab for running nonlinear parameter estimations on multiple sets of experimental data, making it possible to select which parameters to estimate and which to keep constant in each estimation run.

The ac/dc Module's new SPICE user interface makes it easy to build and run Comsol models as part of SPICE-based circuit simulations. Electronics, electrical components, geophysics, and electrochemistry applications also benefit from small-signal analysis for ac impendance studies. Users can model electric motors and generators through a new interface supporting periodic boundary conditions and sector symmetry.

Comsol Multiphysics 3.4 runs on Windows, Linux, Solaris, and Apple workstations with a minimum of 1 GB of memory.

Matt Monaghan