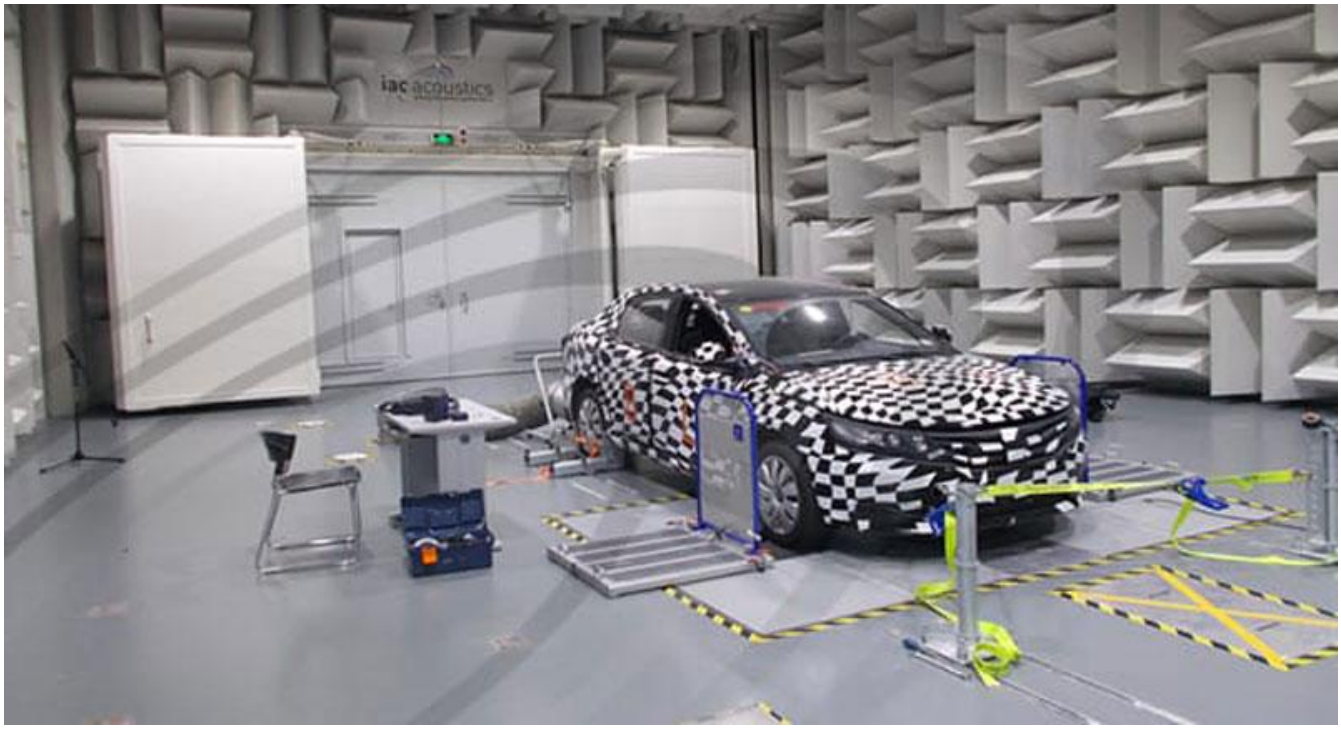
Thu, 9 June 2022
Weekly Newsletter

DVN-I
Automotive Interior

NEWSLETTER #115

Editorial

Acoustics: Crucial To Car Interior Experience



VSAC: VEHICLE SEMI-ANECHOIC CHAMBER (IAC ACOUSTICS IMAGE)

As far as the car interior experience goes, perception is everything. Acoustics is an important part of it, as spurious noises are annoying and distracting. The control of NVH (noise-vibration-harshness) and BSR (buzz-squeak-rattle) is increasingly paramount in car development. Brush up on the basics in this week's in-depth article, and learn about innovations in the field.

We also call your attention to a new DVN-I rubric, part of the Design Lounge, where we take a coffee break. It's called the Coffee Corner, where automotive culture is illuminated with stories; mythology; jokes; anecdotes, and unwritten history. It'll be linked to one of the newsletter articles—this week to NVH and BSR.

Speaking of three-letter initialisms, DMS is still a hot topic, with interior news from Magna; Seeing Machines; Mitsubishi Electric; Toyota, and Osram, all coming up with new developments to enhance traffic safety.

As always, we're hard at work to ensure a steady supply of enjoyable, informative reading in the DVN Interior Newsletter. We're glad you're here, and we thank you for your support. Enjoy!

Philippe Aumont
General Editor, DVN-Interior

In Depth Interior Technology

Squelching NVH, BSR For Perfect Interior Acoustics

WORDLESSTECH IMAGE

In last week's in-depth report, we explained why voice technology is getting to technical maturity within a favorable context of electrification; development of active noise cancellation, and the reduction of BSR (buzz, squeak, and rattle) inside vehicles.

BSR level reflects the loudness, roughness, sharpness, tonality and fluctuation strength of a sound. Consumer demand for improved quality has prompted automobile manufacturers to perform comprehensive BSR testing to find and squash the causes of annoying noises. BSR testing ensures that automotive components and interiors remain durable and free from noise, for passenger comfort and freedom from distraction.

Then there's NVH—noise, vibration, and harshness within a vehicle. While noise and vibration can be readily measured, harshness is a subjective quality measured either via jury evaluations, or with analytical tools that can provide results reflecting human subjective impressions. The latter tools belong to the field called psychoacoustics.

NVH control is one of the major design objectives in today's automobiles, since NVH affects ride quality, driveability, perceived quality, and occupant safety and comfort. Among the sources of noise and vibration are engine and powertrain vibrations; exhaust noise; high speed wind flowing over and around the vehicle; wheel imbalance, and tires rolling on the road surface.

ECKEL NOISE CONTROL TECHNOLOGIES IMAGE

Just like aerodynamics, NVH needs specialized testing facilities. Automakers and specialized suppliers use special semi-anechoic chambers and extremely sophisticated, sensitive listening devices to analyze and tune the sound characteristics of new vehicles.

There are three principal means of improving NVH:

- Reducing the source strength, as in making a noise source quieter with a muffler, or improving the balance of a rotating mechanism. Switching from a combustion engine to electric motive power is obviously an excellent way to reduce powertrain noise by deleting the source of it.
- Interrupting the noise or vibration path with barriers (for noise) or isolators (for vibration)
- Absorption of the noise or vibration energy, as for example with foam noise absorbers, or tuned vibration dampers

The industry's toolbox for improving NVH includes tuned-mass dampers and subframes; balancing or modifying the stiffness or mass of structures; modifying the characteristics of elastomeric isolators; adding sound-deadening or -absorbing materials; tuning exhausts and intakes, and ANC (active noise control).

Improving NVH is the task of the automaker's acoustics department, supported by acoustic material suppliers such as Adler Pelzer; Autoneum; Auria, and many others.

Adler Pelzer Group

The Adam Pelzer Group is a worldwide expert in the design, engineering and manufacturing of automotive acoustic and thermal components and systems. Headquartered in Hagen, Germany, the company has 11,000 employees in 22 countries worldwide. Last year Pelzer acquired Faurecia Acoustics and Soft Trims, representing eight plants with about 1,800 employees and €270m worth of sales in 2020.

autoneum

Autoneum is an automotive supplier headquartered in Winterthur, Switzerland. They're one of the leading manufacturers in vehicle acoustic and thermal insulation, and they supply the majority of global automobile manufacturers. Autoneum was founded in 2011 as a spinoff of Rieter Holding. As of 2019, Autoneum operated 55 production facilities and employed around 13,000 people worldwide.

AURIA™

Auria is the world's second largest supplier of automotive acoustic and other fiber-based products. They have 24 manufacturing facilities; 10 commercial, engineering, and testing and tooling facilities, with approximately 5,000 employees globally, as well as interest in three joint ventures.

Car interior acoustic performance is also highly dependent of the overhead/headliner acoustic performance, where main suppliers are, among others:

Grupo Antolin is a Burgos, Spain based multinational company in the development, design and manufacture of interior components: roof systems; doors; lighting, and cockpits and consoles. They've got presence in 26 countries, and over 25,000 employees.

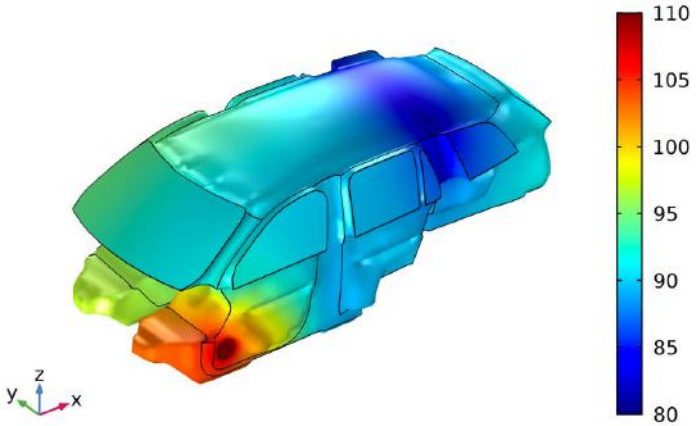
IAC (International Automotive Components) is a global supplier of instrument panels, consoles, door panels, overhead systems, bumper fascias, and exterior ornamentation. Headquartered in Luxembourg, IAC's reach spans the globe, with over 19,000 employees in 18 countries.

Acoustics departmental mission

The main mission of an acoustics department is to support innovative products, while providing characterization of materials; product testing and acoustic fine-tuning; vehicle testing, and development of acoustic tools—procedures; software, and simulation packages.

These activities are facilitated and enhanced by coöperation with external partners such as suppliers; research institutions, and customers for diagnosis; simulation, and testing.

Major challenges come from demands for weight reduction in a combination of materials capable of improving acoustic behavior, while achieving environmental objectives and complying with other specifications, such as temperature and fire resistance. Acoustics parts are positioned throughout the vehicle.



CAR CABIN SIMULATION FOR SPEAKER PLACEMENTS (HARMAN IMAGE)

Acoustical simulation is a key tool to develop the most innovative and effective solutions in acoustic prediction, within a competitive budget and time-to-market.

Acoustics Materials

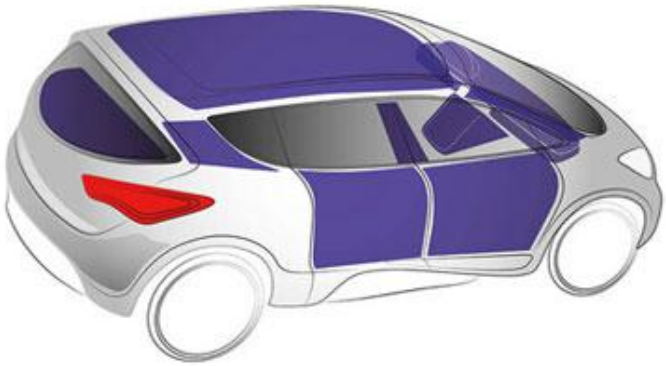
Polyurethane (PU) foam is a material readily shaped into widely different formulations with different properties, in order to achieve the desired performance. The mechanical performance of the foam; its density, cell structure, cell opening, Young's Modulus, and compression resistance are properties that offer acoustic comfort. PU is made out of polyol; isocyanates; catalysts; accelerators, and additives to create the right foam that meets the required properties.

Fibers are widely used, particularly in reinforced foams, for the likes of carpets; headliners, and other products. Natural and recycled fibers are used. Factors influencing the acoustic properties include the type of fiber; its diameter; length, and elasticity, combined with the industrial processes. Fibers are mostly made of glass, but increasingly alternative natural fibers like hemp and flax or carbon fibers are used to produce composites.

A composite is a matrix with reinforcement added by fibers to increase the stiffness and strength of the matrix itself. Fibers are embedded into a polymeric (thermoset or thermoplastic) matrix, allowing to have a high performance:weight ratio.

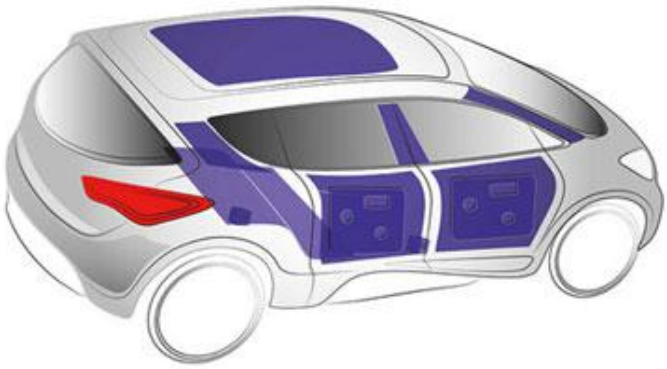
Interior Acoustics Products
(Adler Pelzer images)

Inner dashboard: separating the engine and passenger compartment, the inner dashboard is a key acoustical wall with combustion-engine powertrains. Shown here are the location and an example of inner dashboard and tunnel insulator pads.

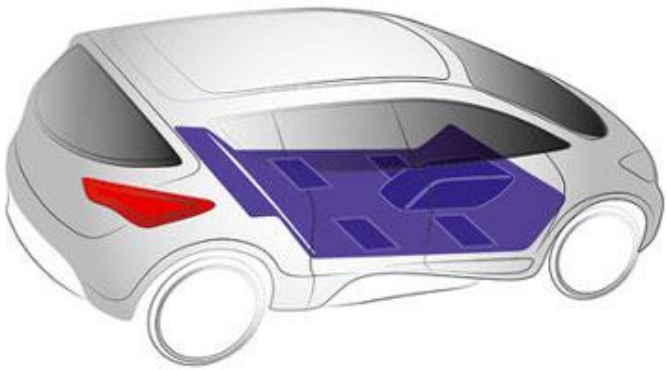


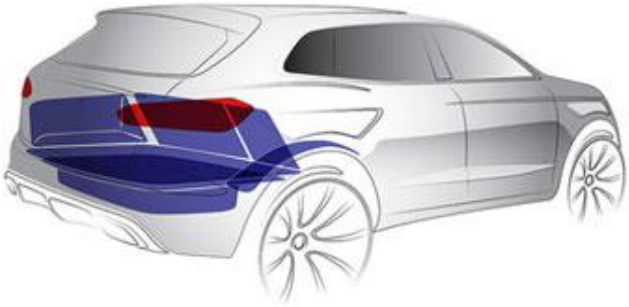
Interior trim: Mostly produced out of multilayered composite materials, designed to offer the end user the highest comfort and premium look and feel while meeting the requirements for improved acoustic performance and sound reduction needed in vehicles. Examples include the headliner/hoodlining; the dashboard, and the door panels.

Interior Insulation: Interior insulators are added to pillars; doors; roof, and seats in a multi-layer construction. Examples include pillar; headliner, and door insulation; door water shields; roof stiffeners; acoustically-tuned air ducts; HVAC housing encapsulation; insulation under rear seats, and seatbelt retractor insulation.



Floor Carpet: Usually an integrated floor carpet, with a surface material (dilour or a tufted surface carpet) and insulation backing.



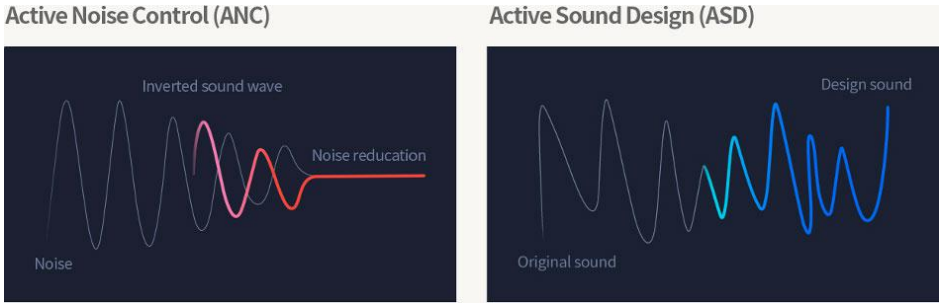


Trunk insulation: The trunk compartment is an important part of the vehicle—even more with EV, as there's an additional frunk. For the rear trunk, the acoustic barrier is mostly the parcel shelf, especially in hatchbacks. Examples in this vicinity include load floor insulation; trunk carpeting and insulation; parcel shelf trim and insulation; trunk side trim, and spare tire covers.

In addition to all these kinds of passive insulation items, there's active noise design, where the overall acoustics performance is designed from the early development stage. Here's an example from Hyundai, illustrating their progress from active noise control (electronico-acoustically zapping noise) to active noise design (engineering the vehicle so objectionable noise isn't made in the first place):

GENESIS GV80 (HYUNDAI TECH IMAGE)

In the past, and as described here before, NVH development was mostly focused on reducing or eliminating the sound from a vehicle, but now it's important to design the sound that suits the car. Under a certain level of quietness, making intense engine sound for high-performance cars, and
luxurious sound for premium cars are more important.
Car makers sometimes *add* noise to electric vehicles deliberately—not just outside so hearing-impaired pedestrians can detect an approaching vehicle, but also in the interior, in the belief that drivers won't feel accelerated due to the lack of engine sounds, or will be annoyed by sounds that have always previously been drowned out by powertrain noise. This calls for virtual engine sounds and sophisticated noise reduction technology exclusively for electric vehicles, respectively.



HYUNDAI TECH IMAGE

Creating good sound starts with reducing the amount of bad sound you don't want to hear. ANC is a typical noise reduction technique that cancels out noise by releasing a soundwave that is opposite to external noise; this makes the technology practical. On the other hand, the one that corresponds to the customer emotion would be the Active Sound Design (ASD). It is to create a rich and dynamic engine sound by adding a new sound to the existing engine sound.

HYUNDAI VELOSTER (HYUNDAI IMAGE)

The engine sound equalizer technology applied to the Veloster offers three different engine sound choices: Refine; Dynamic, and Extreme, depending on the driver's preference. The engine tone can also be adjusted (low, medium, high), and users even can change the sound response depending on the use of the accelerator pedal; the system allows the driver to customize the engine sound.

Interior News

Magna + Seeing Machines: DMS-Integral Mirror

INTERIOR NEWS

MAGNA IMAGE

Seeing Machines, an Australia-based advanced computer vision technology company designing AI-powered operator monitoring systems to improve transport safety, has collaborated with Magna on a rearview mirror demonstrator with inbuilt DMS combining camera, electronics, and mirror technology. In-mirror DMS has been **previously covered** in DVN-I.

The demonstrator melds Magna's mirror technology, camera design, integration and packaging expertise with Seeing Machines' approach to an optimized and co-designed optical path; embedded processing, and enhanced AI vision algorithms for DMS. This technology, the company says, addresses the critical challenges associated with managing vehicle electronics integration and cost, with the need for seamless camera packaging across a diverse line of vehicle models.

Seeing Machines' enhanced Fovio eDME (embedded Driver Monitoring Engine) algorithms and processor optimized and accelerated software, which solves the need for an optimized processing footprint, low thermal dissipation, and the small overall mechanical size and weight needed for a viable all-in-one Mirror-based DMS solution.

Seeing Machines says they have addressed the difficulties associated with a movable mirror/camera combination through use of vision-based dynamic real-time detection and calibration techniques. While providing an effective and simplified DMS solution, the integrated mirror location also offers an effective cabin camera position and field of view for both driver and occupant monitoring for many passenger vehicles; the camera is not too high in the vehicle cabin to obtain information critical for NCAP and regulatory standards associated with driver distraction and impairment, and not too low for an expanded interior occupant view, enabling a range of safety and convenience features inside the cabin.

Seeing Machines CEO Paul McGlone says, "Building a solution that brings a fully integrated DMS into the rear-view mirror responds directly to the increasingly difficult packaging environment for car makers with expanding infotainment and advanced driver assistance electronics complexity and ever larger cockpit displays".

Mitsubishi Electric's Cockpit Platform and DMS

INTERIOR NEWS

MITSUBISHI ELECTRIC IMAGE

Mark Rakoski is engineering VP at Mitsubishi Electric Automotive America, which recently formed an advanced engineering arm called Filament Labs with Rakoski in charge. He says, "According to NHTSA, more than 94 per cent of accidents are caused by manual errors. We developed the Inca Jay automotive cockpit platform with advanced ADAS features designed to help enhance safety and UX on future vehicles".

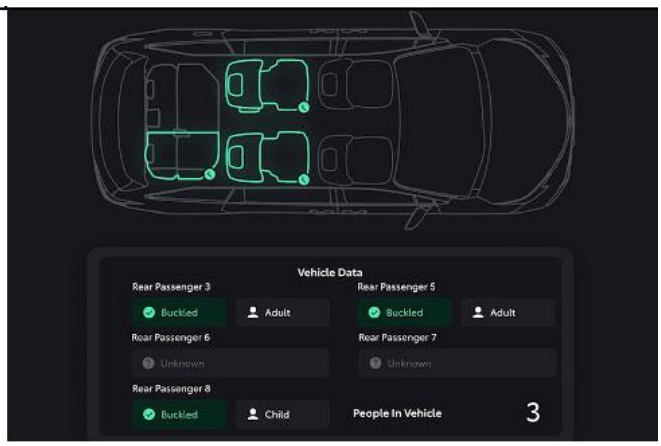
The OMS in the Inca Jay further elevates the technology, with an onboard near-infrared camera to detect driver drowsiness or sudden sickness based on facial expressions (closed eyes, open mouth, etc.) and other body information, including pulse and respiration rates. In addition, face-tracking and image-processing technologies detect slight variations in skin tone due to changes in heartbeat, even in the presence of vehicle vibrations and/or changes in ambient light. If abnormal physical conditions are detected, the system suggests the driver stop to rest, or can activate an automated emergency-parking function to prevent possible accidents. A near-infrared camera can detect the presence of occupants and uses the position of a passenger's face and upper body skeletal points to accurately determine body size. For additional safety, a cabin sensor uses the signals' reflective and transmissive properties of radio waves to detect the presence of children in the camera's blind spots, such as wrapped in a blanket or down in the footwell and will alert the driver and others nearby in case children are left in the vehicle unattended.

With 100 years of experience, Mitsubishi Electric is a recognized world leader in the manufacture, marketing, and sales of electrical and electronic equipment used in information processing and communications, space development and satellite communications, consumer electronics, industrial technology, energy, transportation and building equipment. The company recorded a revenue of J¥4,191.4bn (about USD $37.8bn) in the fiscal year ended 31 March 2021.

Toyota's 4D Radar Cabin Awareness Concept

INTERIOR NEWS

Sienna above, test screens below (TCNA images)



Last year in the U.S., up to 23 children cooked to death in parked vehicles; a quarter of them got in the car while it wasn't in use. Toyota Connected North America (TCNA) now presents their Cabin Awareness concept, which uses high-resolution 4D imaging radar to detect occupants and pets left behind in a vehicle. The 4D imaging radar is highly sensitive and can detect a heartbeat or even breathing anywhere in the cabin, including all the seats, the cargo area, and even the footwells.

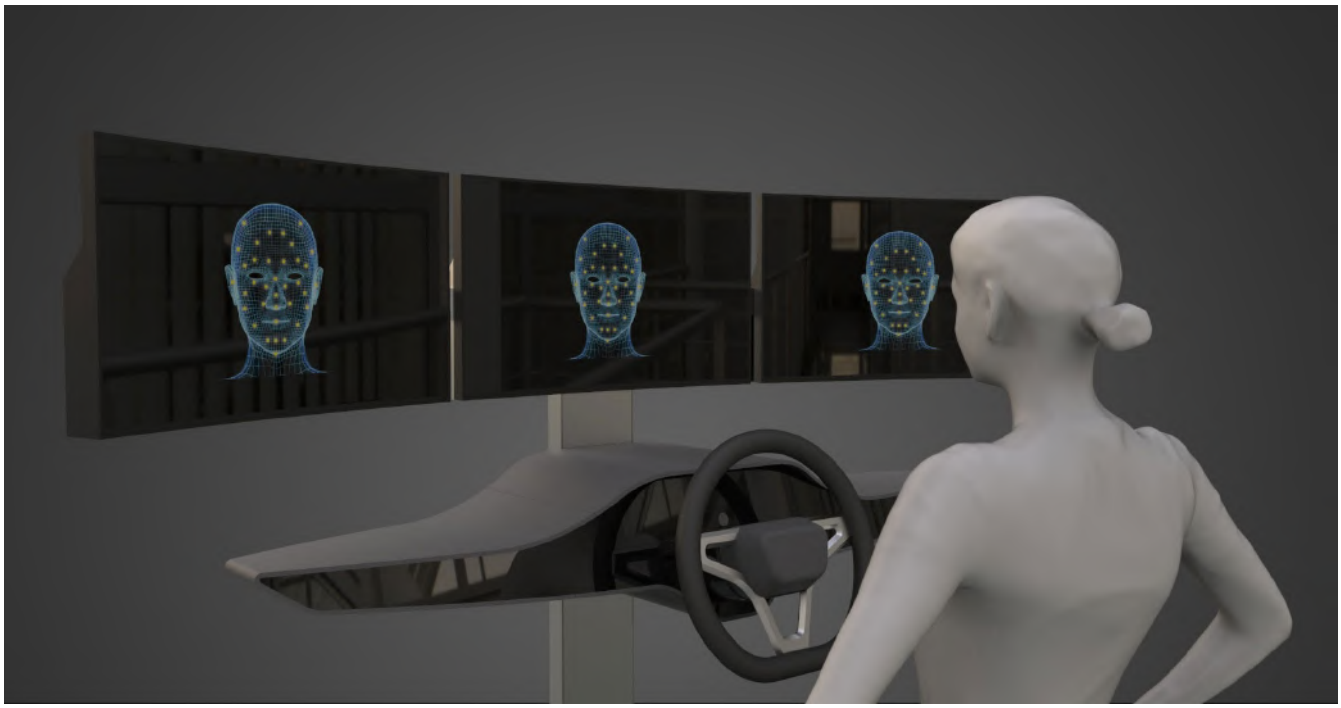
TCNA worked with Vayyar Imaging's in-cabin monitoring platform. Vayyar's high-resolution, single chip, 4D imaging radar is the only one which can monitor an entire vehicle cabin with just the one sensor. The platform provides exceptionally dense point cloud imaging, enabling developers to independently develop a wide range of advanced applications and deploy them remotely using over-the-air software updates.

The Cabin Awareness concept has several means of alerting the owner and passers-by. If a driver misses the warning to check the rear cabin of the vehicle, a warning light on the instrument cluster will pop up. The horn and lights have been programmed to honk and flash, and if even that goes unnoticed, text messages and notifications

via the Toyota app will be sent to the owner's phone. Beyond that, the system can send alerts to emergency contacts, smart home devices, or, through the emergency contact system, first responders.

Osram Icarus DMS Concept

INTERIOR NEWS



OSRAM IMAGE

Osram has presented a DMC concept called Icarus, which demonstrates how such a system mounted in the instrument cluster or A-pillar can be extended. The AMS Osram 3D sensor system provides high-resolution depth maps (<±0.5% depth accuracy at a range of 45-70 cm) using Structured Light. It also uses a depth extraction algorithm. The system is based on near-infrared (NIR) surface emitting lasers (VCSELs) and point pattern projectors, and can determine the 3D position of the driver's eyes and head posture.

This data can be used for DMS such as AR-HUD and driver authentication. The 3D measurement of the driver's head position also enables the implementation of software to detect microsleep and other advanced signs of drowsiness. The POC shows how DMS designs with 2D NIR sensing can be extended to a 3D sensing system by adding a NIR dot pattern projector and supporting depth extraction software.

AMS Osram's global in-cabin sensing manager Firat Sarialtun says "Structured Light sensing technology has proven itself in the consumer market, where it is used for secure facial authentication in cell phones, for example… until now, 3D sensing in the automotive world has only been implemented with dedicated iToF (Indirect Time-of-Flight) cameras. The Icarus system shows [how to] easily and cost-effectively upgrade existing 2D NIR-based DMS systems a single laser component".

Peugeot TPU 3D Printing for Interior Accessories

INTERIOR NEWS

PEUGEOT IMAGE

Peugeot has launched a range of interior accessories for their 308 model, produced solely using additive manufacturing techniques with a flexible polymer material.

The accessories are the result of a joint effort by Peugeot's Design, Product and Research and Development teams and are 3D-printed using the latest HP Multi Jet Fusion (MJF) 3D printing technology.

Peugeot says their designers' objective was to create accessories that were visual, innovative and crafted from modern materials. The range of accessories was drawn up after a detailed analysis of how customers use storage in the car. As traditional materials did not meet the specifications, the Colour and Material team within the Peugeot design department worked with partners including HP to develop a more suitable material.

The result is a TPU called Ultrasint, a polymer developed jointly by HP and BASF said to have a number of advantages over existing materials. It is flexible, and can be rapidly manufactured into its final form while incorporating a high level of detail. The use of TPU in a car interior is a new approach, which has been patented by Peugeot's corporate parent, the Stellantis Group. The 3D printing technique offers advantages including:

- Design freedom: fewer manufacturing constraints and endless possibilities for part complexity, since no injection molding is required. t's not only malleable and flexible, but can be used to print highly accurate details;
- Optimized structures: reduced weight, higher strength, less assemblies, flexibility through the use of mesh, and
- Agile production: infinite customization possibilities, mass production with shorter lead times and no inventory thanks to on-demand production.

Hella's Newest Ambient Interior Lighting

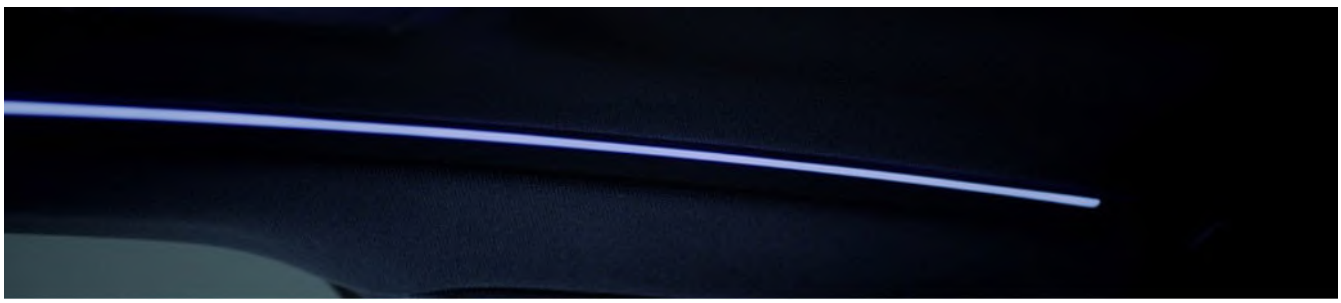
INTERIOR NEWS

HELLA IMAGE

The new Hella Slim Light system can indirectly set the scene for the interior and also enable wide-area lighting, such as in the door. The most striking feature of this system is its slim design and light weight. It can be embedded between several layers. The 8-mm system can thus also illuminate previously unused space in the dashboard; headliner, or door. It can provide indirect or wide-area illumination.

Various surface materials and designs are possible, depending on customer requirements. Up to four LED modules can be used to display individual colors and dynamic lighting scenarios. A light guide ensures even light distribution, while the Hella High Power Module provides day and night visibility; it is said to offer around eight times more light output than standard RGB LED modules.

According to Hella, the installation space gained can be used for the integration of further sensor functions. In combination with smart lights integrated into the instrument panel; trim; or doors, the system can also support communication between occupants and the vehicle. For example, a light strip in the door could provide visual warnings for the blind spot assistant, a light bar could dynamically light up in turquoise when a phone call comes in, or a light bar below the windshield flashes in red if you are tailgating.



HELLA IMAGE

The interaction of lighting solutions and sensor technology brings more intelligence into the vehicle and, in turn, ensures greater comfort; wellbeing, and safety. Hella has put an initial concept into series production for two vehicle models in the North American market.

The Design Lounge

Coffee Corner

THE DESIGN LOUNGE

PEUGEOT FRACTAL CONCEPT OF 2015 (NETCARSHOW IMAGE)

A car, as an orchestra, would have brass and percussion in the engine compartment with strings and woodwinds all over the place. Buzz; squeak; rattle…noise and vibration have always been integral to the automotive dance. Beyond visible and tactile sensations, car interior acoustics—particularly with respect to NVH and BSR—require a particular sense of understanding.

While the subject appears late in automotive history there is a rapid progression within R&D departments. Following the era of telecaster guitars and all television and radio sound, prerecorded music entered car interiors in the form of first an under-dash record player (believe it or not, "Highway Hi-Fi" was available in cars built by Chrysler in the late '50s and early '60s), then 8-track tape cartridges and then cassettes and CDs. With a much-improved source than scratchy radio reception, sound quality awareness and desire moved to the forefront. People own their music—at least they did before the streaming era—and by extension the ambience in which they drive.

Then in March 2014, during a design brief session, where a little bit of our soul seemed to die every time Design Director Matthias Hossan said "next slide"…he was more or less asking designers to drop their pencils and design a car by sound!

About a year later, closely working with sound engineers, the first ever prototype with acoustic signature was revealed. Quite a particular car because it focused on hearing! Anechoic surfaces were designed by generative design, a process that led to an ideal soundproof part…for every part. In addition, the entire visual dynamic reversed assumptions on car interiors which had held sway with designers for nearly a century. Spontaneously (and proudly), I say: amazing!

News Mobility

Audi + Navistar = Safer Roads for School Buses, Ambulances

NEWS MOBILITY

Last summer, the Volkswagen Group assimilated Navistar, the last iteration of a longstanding American maker of commercial vehicles (originally International Harvester), and folded it into Traton, a VW subsidiary that is now the world's largest maker of trucks and buses.

Now VW is beginning to transfer their sophisticated C-V2x (cellular vehicle-to-everything) technology to Navistar for use in emergency vehicles and school buses. C-V2x can help vehicles communicate with each other and offer 360° of awareness, enhancing both road safety and autonomous driving.

In one of the development projects, Audi and Navistar are working with Applied Information and Traffic Control of Reston, Virginia, on how to improve safety and driver information in school zones and school bus stops. Connected-vehicle technology has the potential to prevent some of the roughly 25,000 school-zone injuries and 100 fatalities reported annually, according to a NHTSA study.

The technology under development will give school bus drivers a visual and audible warning signal of a vehicle that is approaching a school bus stop but may not be able to stop. The warning is designed to let the bus driver warn passengers about to get off the bus to wait until it is safe.

The potential benefits of C-V2X also extend to emergency vehicles. Each year, 100 firefighters die and another 100,000 are injured in about 30,000 crashes. And NHTSA estimates there are 1,500 injuries and 29 deaths due to ambulance crashes in an average year. To improve safety for emergency vehicle operators and drivers, Audi and Navistar subsidiary International Truck, as well as technology partners Applied Information and Commsignia of Santa Cruz, California, will demonstrate an expanded C-V2x application for emergency vehicles.

When an emergency vehicle is on call, Audi vehicles equipped with the new software can receive an audible and visual warning from the direction from which an ambulance or other emergency vehicle is approaching.

Magna's 360° Vision for Toyota Tundra

NEWS MOBILITY

MAGNA IMAGE

Toyota's new Tundra will use Magna's newest cameras and electronic control units to enable the vehicle's 3D and surround-view systems.

The Tundra has Magna's complete surround-view system, including five cameras and an electronic control unit to provide a high-resolution view around the vehicle to assist the driver. Data from the cameras is fused and the system can render a seamlessly stitched, flyaround 3D image of the vehicle and its environment upon startup. This feature gives the driver a commanding view of the surroundings and greater reassurance when maneuvering the vehicle.

Magna's advanced trailer assist and off-road functions have also been launched for the first time as part of the system. This includes the Trailer Guidance system, a semi-automated function that helps a driver back a trailer into the desired position, which is particularly useful when backing into tight spaces.

The Tundra also features a multi-terrain view that allows drivers to customize their view between bird's eye, front, side and rear, enhancing visibility from different angles. Furthermore, a 'see-through hood' feature enables drivers to see under the front hood of the vehicle, an idea first presented by Land Rover and **covered by DVN** in 2014, so drivers can avoid rocks and other obstacles while off-road.

General News

Yanfeng, ARC in Inflator JV

GENERAL NEWS

Yanfeng and US-based ARC Automotive have formed a new joint venture to produce airbag inflators.

The collaboration is centered around hybrid airbag inflator technologies. The partners intend to primarily serve the European market at first, then expand to become a global partnership. The partnership includes ARC facilities and state-of-the-art equipment in Skopje, Macedonia.

ARC Automotive, based in Knoxville, Tennesee, produces a full complement of inflators for all kinds of automotive airbags.

Yanfeng's expertise is in interior; exterior; seating, and cockpit electronics, and also passive safety.

Yangfeng Safety Systems VP and general manager Mike Hague says "Inflator development and production are strategically important for Yanfeng, and with ARC we have a reliable partner that will allow us to grow together leveraging the obvious synergies from both companies. With this partnership we can provide a full complement of inflator products for all airbag applications including driver, passenger, side curtain, and knee airbags. By combining our expertise, we can accelerate development activities, providing advantages for our customers along the entire value chain, tailored to their needs".

Tokyo Motor Show is now Japan All-Industry Show

GENERAL NEWS

LEXUS LF-30 CONCEPT AT 2019 TOKYO MOTOR SHOW. (HANS GREIMEL IMAGE)

The Tokyo Motor Show is rebranding. Next year it will be the Japan All-Industry Show, says Japan Automobile Manufacturers Association, who have hosted the event since the start in 1954. JAMA Chairman Akio Toyoda said it is important to bring together different sectors at a time when collaboration is needed to achieve carbon neutrality.

"We want to rename next year's Tokyo Motor Show the Japan All-Industry Show, going beyond the mobility industry, with all of Japanese industry working as one team, including startups," Toyoda said. "We aim to make a totally new show, transforming it in both name and reality."

Toyoda, put in charge of the sputtering show, set a goal of attracting a million visitors in 2019, and the 12-day show finished with more than 1.3 million attendees—a 70-per-cent increase over the 771,200 who visited in 2017. Attendance had been in something of a free-fall, from 902,800 visitors in 2013 to 813,500 in 2015; a far cry from the 1991 record of 2.02 million people.