TELSONIC ULTRASONICS

The material challenges of autonomous vehicle technologies

Ultrasonic technology from Telsonic supports the new materials

PLASTIC WELDING | METAL WELDING | CUTTING | CLEANING | SIEVING

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An overview by Telsonic's Dr Joseph Laux on the many challenges to be overcome in selecting suitable materials for the integration of autonomous vehicle enabling technologies.

01 Radar sensor automotive

02 Torsional plastic welding (SONIQTWIST®)

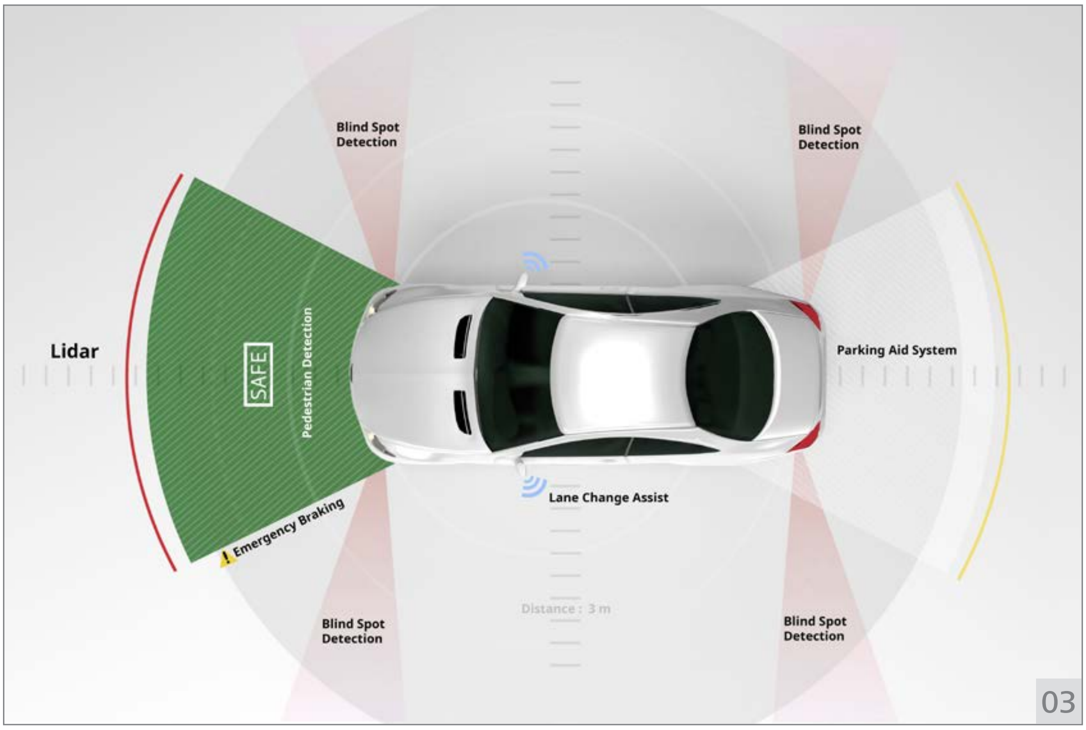
Setting The Scene

There is little doubt that the automotive sector has been responsible for the introduction and proliferation of new and often exciting technologies within the vehicles that we drive today. This trend continues with the quest to continually enhance the safety and navigational aids available to the driver, with the ultimate aim of launching fully autonomous vehicles, namely, Advanced Driver Assistance Systems Level 5 (ADAS L5). At this stage, all the occupants will be passengers.

Whilst we, the public, gladly accept and benefit from each new driving aid, we are often completely unaware of the extensive and often arduous research and development cycles behind these innovations which are necessary not only to homologate the technologies and materials but also incorporate them safely within the cars we drive.

Technology – Materials & Integration Challenges

Of course, there have always been challenges to be overcome within the automotive sector as each new innovation has become available, and we must not dismiss the time and effort which has gone in to make the technologies we already use today safe and reliable. The current levels of driver assistance range from well-established systems such as parking sensors through to more sophisticated driver aids including adaptive cruise control, lane assist, autonomous



03 Smart amalgamation of Ultrasonic, Camera, Radar and LIDAR technologies

emergency braking and more (ADAS L2 and L2+). These rely on a smart amalgamation of Ultrasonic, Camera, Radar and LIDAR technologies. Although these are useful safety aids, the driver ultimately still has full control over the vehicle.

In a fully autonomous vehicle (ADAS L5), all the decisions will be made by the information gained by the different sensing technologies and processed by the onboard computers. It is essential therefore that the data obtained by the different sensors is accurate and consistent if the vehicle is to maintain its course, avoid obstacles, adapt to traffic patterns and operate safely. Each of the different sensing technologies have their own unique strengths, and weaknesses. For example, long-range Radar, operating at 75 – 81 GHz, will work better in adverse weather conditions and is more effective at distance under these conditions. LIDAR on the other hand provides better resolution and is ideal for 3D mapping, whilst cameras are smaller and less expensive than LIDAR and can identify colour – red or green traffic lights etc. The downside is that cameras need a clear field of vision and are susceptible to the influence of rain, fog and contamination from the road surface.

This is where the challenges of integration begin, deciding which combinations of technologies should be used, where they should be located, and importantly which materials should be selected to ensure that each of the different technologies is able to achieve optimum performance. For example, LIDAR (Light detection and ranging), operating at 1550 nm wavelength to avoid potential eye issues associated with 905 nm, needs to be kept clean. Also, in the future this will be solid state LIDAR , as opposed to the rotating mirror systems seen on the roof of vehicles. The compact nature of solid-state LIDAR means that it may be possible to integrate this within head lamp modules, front grill or as part of the rear-view mirror, however material selection will have a significant influence on how this technology will be integrated.

The protecting material encapsulating the solid-state LIDAR sensor must be “transparent” at 1550 nm. Polycarbonate, which is 90% transparent at this wavelength would seem an ideal candidate, however it is susceptible to damage from stone-chipping and the influence from UV. One alternative being considered is Aliphatic Thermoplastic Urethane (Ali-TPU), which is also around 90% transparent at 1550 nm, but has the benefits of being stable under UV and more resilient to stone - chipping damage.

Radar technology presents its own challenges. As for LIDAR, there will be at least two prime objectives – ensuring safe and consistent operation, and integration within the vehicle in such a way that it delivers optimum performance without overly impacting the design aesthetics. Even today, traditional PDC sensors are still obvious on the front and rear bumpers of cars. Whilst the ideal scenario for Radar sensors would be to have them integrated in the front and rear bumpers and in the front grill, much work has still to be done to determine the potential impact of paint thickness, metallic paints, different colours and most importantly the substrate material and wall thickness. Just as Telsonic were instrumental in developing the award winning SONIQTWIST® ultrasonic welding solution for PDC sensors on thin wall section bumpers, Telsonic is now working alongside other key stakeholders to identify solutions for these new sensing technologies.

04 Dr Joseph Laux, TELSONIC AG

Ongoing and pro-active liaison such as this is an essential part of the development process, as not only must the different sensing technologies operate safely and reliably, it is essential that any joining and assembly processes are optimised for production. The World's OEM's have spent years fine-tuning lineside production processes to reduce the time taken for each step, therefore any new processes or technologies must be capable of at least keeping pace with target cycle times.

Telsonic's ultrasonic experts are currently actively involved in evaluating a range of new material candidates from a number of suppliers. Trials are performed on each material to identify the optimum ultrasonic joining parameters such as frequency, amplitude, pressure, weld time etc. In addition, evaluation of optimised joint design, sonotrode and fixture design are a key part of the what will be the final production level solution.

05 Dennis Bazin, Project Engineer, TELSONIC AG

In addition to the work relating to advanced driver assistance technologies, Telsonic is also actively involved in a wide range of automotive applications, both on current model variants from a number of premium vehicle manufacturers, and in the development of new applications to support the increasing use of plastics in vehicle construction. Examples of this work include the development of joining concepts for plastic liftgates and the integration of camera technology within components such as "Shark Fin" antenna's and spoilers etc.

By Dr Joseph Laux, Tecnical Advisory Board, TELSONIC AG, Dennis Bazin, Project Engineer, TELSONIC AG and Tom Pettit, Genesis Sales & Marketing Limited