Better AV performance in the last 50-feet is crucial

More focus should be placed on delivering a smooth beginning and end to the autonomous vehicle ride experience. By Will Girling

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The market for vehicle sensors is growing—Verified Market Research calculated its 2021 value at US$26.9bn globally, with the potential to reach US$46.3bn by 2030. The broader adoption of electric vehicles (EVs) and increasing consumer awareness of sensors' safety benefits are key motivators for this growth. However, the concurrent development of autonomous vehicles (AVs) is putting the full potential of sensor technology to the test.

The ultimate goal of this ongoing industry research—SAE Level 5, or fully autonomous vehicle self-driving—is being facilitated by one key piece of technology: LiDAR. The 3D environment mapping capabilities of these sensors make them ideal for helping a vehicle make sense of and safely navigate its environment. In fact, the 'arms race (https://www.automotiveworld.com/articles/lidars-for-self-

driving-vehicles-a-technological-arms-race/)' to develop LiDAR has been joined by a plurality of OEMs and transport service providers, including Mercedes-Benz, BMW, Toyota, Waymo and Uber.

One notable exception is Tesla, with Chief Executive Elon Musk even calling LiDAR a "fool's errand." However, Paul Drysch, Chief Executive and Co-founder of PreAct Technologies, does not agree. He tells *Automotive World* that the secret to better AV motion control could still depend on LiDAR, but with a different approach.

Ripe for disruption

Originally a contractor in Washington DC supplying high-speed sensors to the defence industry, PreAct spun-off in 2018 to bring similar technology to automotive. "Traditional sensors like ultrasound and radar are very old-school and haven't changed much in 50 years. We knew that it was a huge market, and it was ripe for disruption," says Drysch. Taking knowledge and IP of "active protection systems" capable of detecting incoming missile attacks, the company developed "near-field LiDAR sensing" for use in vehicles.

"Initially, we were trying to perform imminent collision detection using just cameras, like the Tesla approach. It was all about exploring how to mitigate injuries or fatalities in a vehicle in the microseconds before impact." However, PreAct soon realised that this approach alone, even when augmented by AI and neural networks, was not satisfactory for the task. Easily distorted by weather and environmental conditions, and with inadequate processing power, cameras could not reliably prevent collisions.

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Drysch explains that the solution came by combining a new approach with an older technology called time-of-flight (ToF) sensors: “ToF is common today in simple things like supermarket doors. What we did was take these low-cost, off-the-shelf components and enhance them with software to operate in a new way.” Software upgrades included improving sensor function in brightly lit areas and boosting range capacity beyond the standard three metre limit.

Lower cost, higher frame rate

Near-fielding LiDAR combines with cameras to produce an optimal safety result—Drysch emphasises that “there is no one-size-fits-all solution for self-driving vehicle sensors. Tesla and Waymo both use a range of radars, and they still have lots of issues.” In fact, a large quantity of sensors may even be counterintuitive for good AV motion control. By reducing the number of ultrasonic sensors, short-range radar, and even some cameras, he believes a better result can be achieved. Also, because the sensors are software-defined, new features can be added iteratively to “future-proof” cars and move in-step with AV progression.

“Near-field LiDAR is low-cost, and its high-resolution point cloud is more accurate than ultrasound and radar.” Savings can be made on manufacturing because PreAct’s software mitigates the lasers and split arrays of traditional LiDAR set-ups. Overall, Drysch claims the frame rate for near-field LiDAR can be up to 15-times faster—picture capturing speed is essential for self-driving systems, as it helps determine whether an object is accelerating or decelerating while being tracked.

Slow ADAS

In terms of near-field LiDAR's use cases in self-driving cars, PreAct has been working with a number of automakers and Tier 1s on "slow ADAS" (advanced driver-assistance system). Focusing on what Drysch calls "the last 50-feet", the company has been focusing on slow-speed applications instead of faster, highway-based motion. "Performance in the last 50-feet of a journey is honestly the most important aspect of self-driving vehicles," he states. "The industry has focused on the broader journey and done very little on when the vehicle has almost arrived, but that's where vehicles interact with customers the most."

If fully self-driving vehicle services are to be realised, the cars will need to safely stop and allow the passenger to get in or out. Vehicle fleets such as Waymo in San Francisco have laid the foundation for future AV development, yet operations are far from perfect. Slow ADAS can add value by making the beginning and finishing stages of a journey feel smoother, like a human driver. "Waymo cars generally stop in the middle of the street when they should actually find an open parking or safe spot to pick somebody up. That's the next phase of AV technology," says Drysch. It's a phase that the AV sector urgently needs to reach—with the veracity of high-profile systems like Tesla's Autopilot facing scrutiny, building a solid safety profile for self-driving technology is imperative.

Incremental change

In terms of AV motion control's overall progression, Drysch is optimistic for the long term but believes there are still challenges to overcome. Human-driven and self-driving cars will need to coexist for the foreseeable future, and he reasons that incidents could be more frequent as the two interact with each other in unexpected ways.

An example of PreAct's near-field LiDAR sensor technology

"The good thing is that, because self-driving vehicles are taking longer to develop than everybody thought, a lot of innovative technology is being developed and integrated into traditional cars," Drysch says. Level 2 features such as steering and acceleration control in Cadillac's Super Cruise system, or the Level 3 environment detection capabilities of the Audi A8, are notable examples. Safety, he continues, is likely to improve incrementally, as will vehicle autonomy generally. Customers will be introduced to new, convenience-based features on a gradual basis so that "when the time comes for Level 5, they'll be comfortable with it."

As far as AV motion control is concerned, it's clear that little details can make the difference. When customers become accustomed to enhanced ride performance and better end-to-end self-driving experiences, PreAct reasons that autonomous features will become table stakes in the same way as power steering and adjustable seats decades earlier.