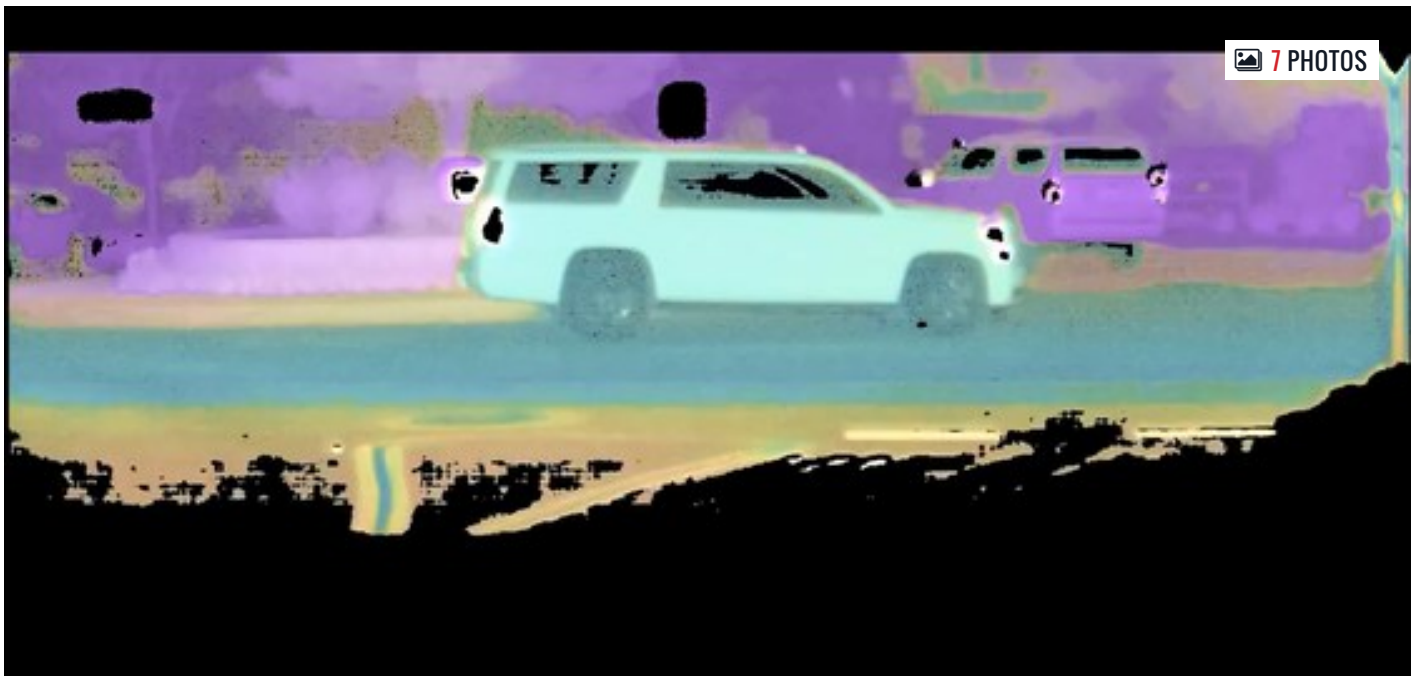
CAR LISTS FUTURE CARS

# 2018 CES TECH: SIX BUDGET LIDAR SYSTEMS

Will one become the "eyes" of your next Honda Accord?




**Frank Markus** Words - January 19, 2018



Autonomy requires gobs of sensors, and although Elon Musk and Tesla have publicly said “no thanks” to laser-based lidar sensing in favor of cameras, most of the rest of the industry expects to augment cameras with this “light detection and ranging” technology. For the past few years, the race has been on to replace those spendy spinny laser scanners festooning the roofs of the current crop of robo-taxis and autonomous prototype test vehicles with cheaper, smaller, lighter designs that are easier to integrate into the bodywork. At CES, plenty of options were found featuring lasers that still move, mirrors that move (microelectromechanical systems, or MEMS), and completely solid-state flash lidar concepts. One even involves cameras to interest Mr. Musk.

## TetraVue 4D Lidar


This design adds a new dimension: time. That's because 20 times per second, it flashes the road ahead with an infrared light pulse recording 60 megabits per second. The reflected 2.0-megapixel image is recorded on an optical camera chip in raw form and in an infrared modulated form. The images are compared, and the degree to which any pixel on the modulated image is dimmer than its unmodulated counterpart indicates that photon's "time in flight," from which distance to that object is calculated. Many competing flash systems integrate computational circuitry on the receiving sensor board, which diminishes resolution, but here every pixel counts. Range is said to be 100-plus meters, the optimal viewing angle is 54 degrees, visible light levels don't affect it, and rain, fog, and dust merely curtail a bit of the system's ultimate range. The resulting image is detailed enough to consider integrating object detection in this device, simplifying the sensor fusion task of the host vehicle. Cost in high-volume production is expected to be $200 or so. Several OEs have expressed interest.

## InnovizOne

7 PHOTOS

Israel-based **Innoviz** showed off a high-accuracy, low-cost MEMS solid-state lidar, which features 7.5-megapixel/second resolution, a 25-frames/second refresh rate, and a 120-degree horizontal/25-degree vertical field of view. It aims the laser light with a micromirror that is as thin as a human hair. Innoviz's optical coding method is said to be particularly resistant to false reports from other signals in lidar-rich traffic environments. CEO Omer Keilaf claims his design will be the first solid-state lidar to reach volume production in late 2019 for use shortly thereafter on a European brand.

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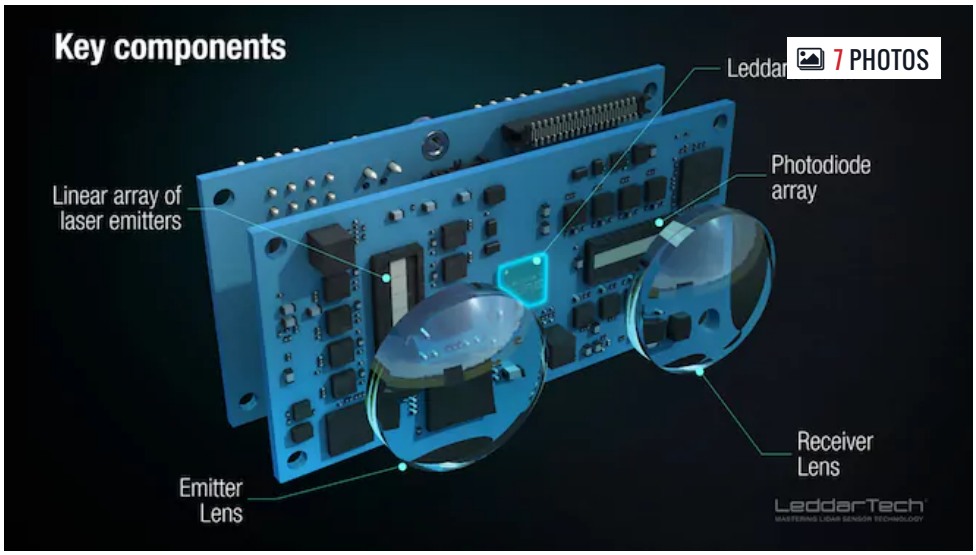
## LeddarTech LCA2




Billed as “the world’s first solid-state 3-D lidar integrated circuit,” Quebec-based LeddarTech’s LCA2 3-D system-on-chip flash lidar is said to be ready for 2020 production. The field of view is customizable to customer needs, but the demo unit scanned 60 degrees horizontally and 20 degrees vertically. At 30 frames per second, it supposedly generates 1.3 billion data points per second, arithmetically computing 245,000 waveforms from them. LeddarTech provides the lidar engines and intellectual property for the lidar units produced by many Tier 1 suppliers. This device was named a CES 2018 Best of Innovation Awards Honoree in two categories, one for Vehicle Intelligence and Self-Driving Technology and another for and Embedded Technologies.

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## Pioneer 3D-LiDAR

7 PHOTOS

Pioneer would like to remind everyone of its abundant experience with laser devices back in the LaserDisc entertainment era (millennials please picture a DVD the size of a vinyl album that held a max of about two hours of standard-def video). The company offers raster-based laser scanning where the laser scans a tight line back and forth, wobbling type where the laser wags back and forth through a wider angle, and a new MEMS type offering that is said to be particularly good at detecting dark objects and seeing through rain and snowfall. They can also combine signal processing and object recognition that further add value to what are claimed to be lower-cost units.

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## Velodyne Velarray


No lidar wrap-up would be complete without checking in with **Velodyne**, the alpha manufacturer in the segment and maker of most of those spinning roof-mounted sensors that still generally cost $4,000 and up. The company is beginning to offer designs that can integrate into the bodywork of a customer-owned car, with solid state and “hybrid solid-state” partially rotating designs. Velarray offers a 120-degree horizontal and 35-degree vertical field of view at a range of 200 meters and is expected to cost a few hundred dollars at mass-production volumes. The company representative was not optimistic about the prospects of competing technologies ultimately demonstrating automotive-grade reliability. We shall see.

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## Foresight QuadSight


Israel-based **Foresight** proposes to provide forward-vision and laser-range findings by using two pairs of stereoscopic cameras—one recording visible light, the other infrared. The former handles tasks such as lane finding, traffic sign recognition, object detection, etc., while the latter computes distance to said objects and "sees" through rain, snow, and fog (all of which do somewhat limit total range of perception somewhat). Foresight was proposing to mount one IR camera in each A-pillar because they cannot tolerate any absorption of the infrared light entering, and all windshields block infrared to reduce climate-control loads. Lucky for them, Japan's **Asahi Glass Company** was demonstrating a zero-absorption infrared windshield over at the Velodyne booth. AGC preserves the upper central sensor area as clear glass and treats the rest of the windshield with an infrared filter applied to the inner layer of the rest of the glass. Foresight plans to begin production at the end of 2019.