Two Start-Ups That Are Out to Take Radar to Next Step

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Executive Summary

U.S.-based Lunewave and Israel's Arbe are taking uniquely different approaches but arriving at the same result: high-performance radar at today's prices.

MARKETING EXECUTIVE BEN JO SHOWS OFF LUNEWAVE'S 3D-PRINTED SPHERICAL ANTENNA THAT'S SMALLER THAN A GOLF BALL.

More affordable, solid-state lidar may be grabbing the headlines, but it's radar that is much more likely to make big gains in applications near term as automakers begin rolling out next-generation advanced driver-assistance system technology to retail customers.

While developers have been working to bring lidar costs to below $1,000 and ultimately closer to radar outlays at $100 per unit, radar technology has not been sitting still, and there are numerous companies working to close the performance gap with lidar without increasing radar's price.

I recently spent time with two of them, U.S.-based Lunewave and Israeli developer Arbe Robotics, each with promising approaches designed to take radar technology the next step. Neither start-up suggests radar would eliminate the need for lidar in a Level 4 autonomous vehicle, but they do believe their sensors will meet requirements for coming Level 2-plus and Level 3 ADAS applications expected in the market soon.

Lunewave is interesting for two reasons. First, its antenna is based on 75-year-old technology that has yet to find its way into the automotive market. Second, that antenna is 3D printed, meaning its size and design easily

can be customized and production volumes can be scaled quickly and relatively inexpensively.

The Lunewave antenna is spherical and smaller than a golf ball, and its multi-chambered surface makes it look like the "Star Wars" Death Star. While all of today's radars are based on planar phased-array technology, the Lunewave device is a Luneburg lens antenna, a concept that dates to the 1940s.

Lunewave antennas, which have been used on fighter jets for years, are complicated and costly to build, and a compact version that could work in an automobile has been the "holy grail of radar antenna," Lunewave cofounder and CEO John Xin says.

Radar has some inherent advantages over vision sensors that make it a critical part of most coming ADAS features such as automated parking, highway-pilot systems, active steering and more reliable automatic emergency braking. Unlike cameras, radar works well at night or in inclement weather, but current radars suffer from a limited field of view and resolution.

Lunewave's sensor solves those two problems, developers say.

Unlike current technology, Lunewave's radar can distinguish individual objects at a distance even when they are clustered together. For example, it can spot a pedestrian near a disabled car at the side of the road or pick out a stalled vehicle under an overpass. The Lunewave radar can sense objects up to 980 ft. (300 m), roughly 30% farther than most current radars. It boasts an angular resolution down to 0.5 degrees, not far off the bar lidar has set of 0.1 degrees.

Because of its 360-degree field of view (if mounted on the vehicle's roof) and high resolution, Xin says a single Lunewave sensor potentially could do the job of six conventional radars.

Lunewave is the only company that has been able to apply Luneburg technology to automotive, he notes, crediting modern additive manufacturing with making it possible.

"For a very complicated structure and small amount of volume, 3D printing is perfect," Xin says, noting the material used for the antenna is a proven automotive-grade acrylic.

Another problem with current radar is the limited number of broadcast channels. As more and more radar sensors are employed on more and more vehicles, there's a high likelihood of signal interference.

"(A conventional) sensor is going to go blind," Xin says, adding Lunewave's proprietary software will calculate data 10 times faster than existing radars and help avoid that radio interference.

Lunewave isn't "trying to take over the world and become a Tier 1 supplier," the executive says. It wants to produce the antenna and the software but let others take over the supply chain management, distribution and fabrication of the microchips that provide the computing power. The company is in active discussions on production programs with several Tier 1s, Xin says.

As for production of the antenna, a single 3D printer can knock out 1,000 per day. Increasing that volume is just a matter of adding printers.

Lunewave has raised $5 million in seed money. Investors in the company, based in Tucson, AZ, and staffed by about 30 people, include BMW Venture, Baidu Ventures and SAIC.

More conventional in its design and manufacturing is Arbe's Phoenix, but in performance it's a far cry from today's front-facing radars.

I've written about Arbe before, and it now appears the developer may be getting some traction in the market with its technology. Like Lunewave's sensor, its radar is designed to cover more ground and provide better resolution.

Today's radars are good for current adaptive-cruise-control applications, but "that's really about it," Ram Machness, vice president-product, tells me. Because they can't differentiate between an upcoming freeway overpass and the cars traveling through it, current radars can't be counted on to do much more than track the vehicle directly ahead. A camera can distinguish stationary objects in the right environment, but it's not failsafe, and additional feedback from either radar or lidar will be needed as automation goes to Levels 2-plus and beyond.

Thanks to its proprietary chipset, Machness says the Arbe radar offers two orders of magnitude higher resolution. Where today's radars typically have four receivers and three transmitters for a total of 12 channels, the Arbe unit offers up to 2,300 channels.

Even with next-gen chipsets coming from other players that promise 192 channels, "we're still 10 times higher," he says. "That's why we're saying (Arbe's solution) is a revolution. It's really getting ADAS to the next level and making it much more bulletproof."

The secret sauce is the high-density RF transmitter chip that is scalable from 24x12 output/receiver channels to 48x48 combined with the software that can process the 30 frames per second generated at a speed of three terabytes per second.

Like the Lunewave unit, the Arbe radar boasts impressive specs. It has a field of view of 100 degrees azimuth (along the horizon) and 30 degrees elevation at a distance of nearly 1,000 ft. (300 m). It would take just four Arbe sensors for 360-degree coverage around the vehicle. Package size is equivalent to today's radars.

Arbe expects production applications in Western markets around the '24 model year, but Machness says the Chinese are pushing toward Level 2-plus and beyond applications more aggressively, meaning the sensor could find its way into that market by 2022.

One of the drivers for higher-level radar performance are the upcoming NCAP safety standards in Europe.

"It's very clear to the OEMs that they need a much higher resolution radar to meet the future NCAP," Machness says. "Is it going to be 2024, 2026? It doesn't really matter, because they understand they need to go in that direction and other OEMs are going in that direction."

Cost is expected to be on par with today's radar, so OEMs may not have to pay a premium for the additional performance, meaning the Arbe unit could replace current front-facing radars one for one as automakers update their platforms, then multiply as rear-facing or sideview applications are added to expand safety features.

"The whole point is you get this high resolution for basically the same price that you have today," Machness says.

Arbe was founded in 2015 in Tel Aviv. It has raised $55 million to date from the venture-capital sector, including the AI Alliance in which Hyundai is a partner. The company says field testing of its sensor is under way.