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Are Self-Driving Delivery Vehicles Headed Underground?

By Angus Loten

Sertac Karaman, an assistant professor of aeronautics and astronautics at MIT, poses with one of his team's Persuasive Electric Vehicle.

Angus Loten/WSJ

CAMBRIDGE, Mass. — While Amazon.com Inc., A.P. Moller Maersk A/S and other big shippers look to the skies to speed up deliveries with drones, a group of Massachusetts Institute of Technology scientists are setting their sights far lower: Underground.

Researchers at the new MIT Institute for Data, Systems and Society, along with other MIT-affiliated logistic R&D groups, are examining the viability of underground networks of small, autonomous vehicles to deliver goods to businesses in crowded urban centers.

The group on Wednesday showcased a prototype autonomous three-wheeled vehicle at the school's annual supply chain and logistics conference in Cambridge, Mass.

For deliveries, subterranean drones have a number of advantages over unmanned aerial vehicles, said Sertac Karaman, an assistant professor of aeronautics and astronautics and one of the developers of

the robotic trike. For one, a lot of urban infrastructure–from sewers and subways to conduits for telephone, data and electrical cables–already resides underground. And then there's the safety issue: "It only takes a kid with a rock to take down a drone," he told CIO Journal. Or a well trained eagle.

Prof. Karaman credited much of the recent advances in robotics and autonomous-vehicle technology to a 2001 U.S. Congressional mandate calling for at least one third of all ground combat vehicles be unmanned by 2015. "They missed that target, but it helped spark a lot of research and development," he said.

His team leveraged that technology, which includes digital cameras, mobile radar, GPS systems and 3-D laser scanners, to create what they call "Persuasive Electric Vehicles," or PEVs, which are low-speed, tricycle-like vehicles designed to move goods — or people — in crowded urban centers.

The PEV currently runs computer vision algorithms on Nvidia Corp. computational equipment and uses cameras and one planar laser scanner. "That said, we rely mainly on cameras," Prof. Karaman said. The team hopes to eliminate the scanner for ultrasonic sensors like the parking sensors on a car. "This approach brings the cost down to about $2,000 to $3,000 for the electronics that we have in mind. Of course, if produced at scale, this cost would be much less," he said.

A prototype have been tested on MIT's campus and there are plans for more testing in Taipei, Taiwan this summer as well as in Andorra, Prof. Karaman said.

The PEV's underground routes would connect to distribution centers across the city, or other smaller depots and customer pickup centers, such as packages lockers, he said. The vehicles would be able to deliver goods more efficiently and reliably than heavy transport trucks to restaurants, shops and other small businesses throughout the city — without contributing to traffic congestion, he said.

The city planning and engineering required to build out such an underground network sounds formidable. But a decade or so ago, do did the idea of delivery by driverless vehicle.

To be fair, even Prof. Karaman admits the project is a bit of a moonshot, calling it a "wild idea."

For starters, digging out long subterranean channels for the delivery vehicles would be highly disruptive for city residents, and likely unpopular at city hall.

Other barriers include costs, he said. On the hardware side alone, high-end laser scanners that stay in alignment can render the commercial application of PEVs far too expensive, Prof. Karaman said.

For companies or logistics firms shipping goods to customers, another key issue is cybersecurity. Many worry about the possibility of autonomous vehicles being hacked or disabled — which can be as easy as disrupting a laser scanner with a mirror, Prof. Karaman said.

Used above ground, Prof. Karaman sees commuter PEVs solving problems arising from urban bike-sharing programs, where some stations end up without bikes and others have far too many. Instead, he said, the PEVs can travel to wherever they are needed, filling gaps in supply and demand for urban transportation.

But regulatory and insurance policies are another sticky area. Google is helping lead an effort, urging the U.S. Transportation Department to draw up a federal set of rules concerning autonomous vehicles. But as of yet only a handful of U.S. cities currently permit the use of autonomous vehicles of any kind, including

Nevada, California, Florida, Hawaii and Oklahoma.

Insurance is complicated with autonomous vehicles, since it's difficult to assign responsibility in the case of an accident. "At this point, driving on public roads is a grey zone," Prof. Karaman said.

Worse still, available software falls short when it comes to identifying obstacles that don't always act rationally, such as other cyclists or drivers, he adds: "We need to come up with algorithms that are better at reasoning." A number of companies, including Google and Seegrid Corp., a startup co-founded by robotics pioneer Dr. Hans Moravec, are dedicated to that challenge.