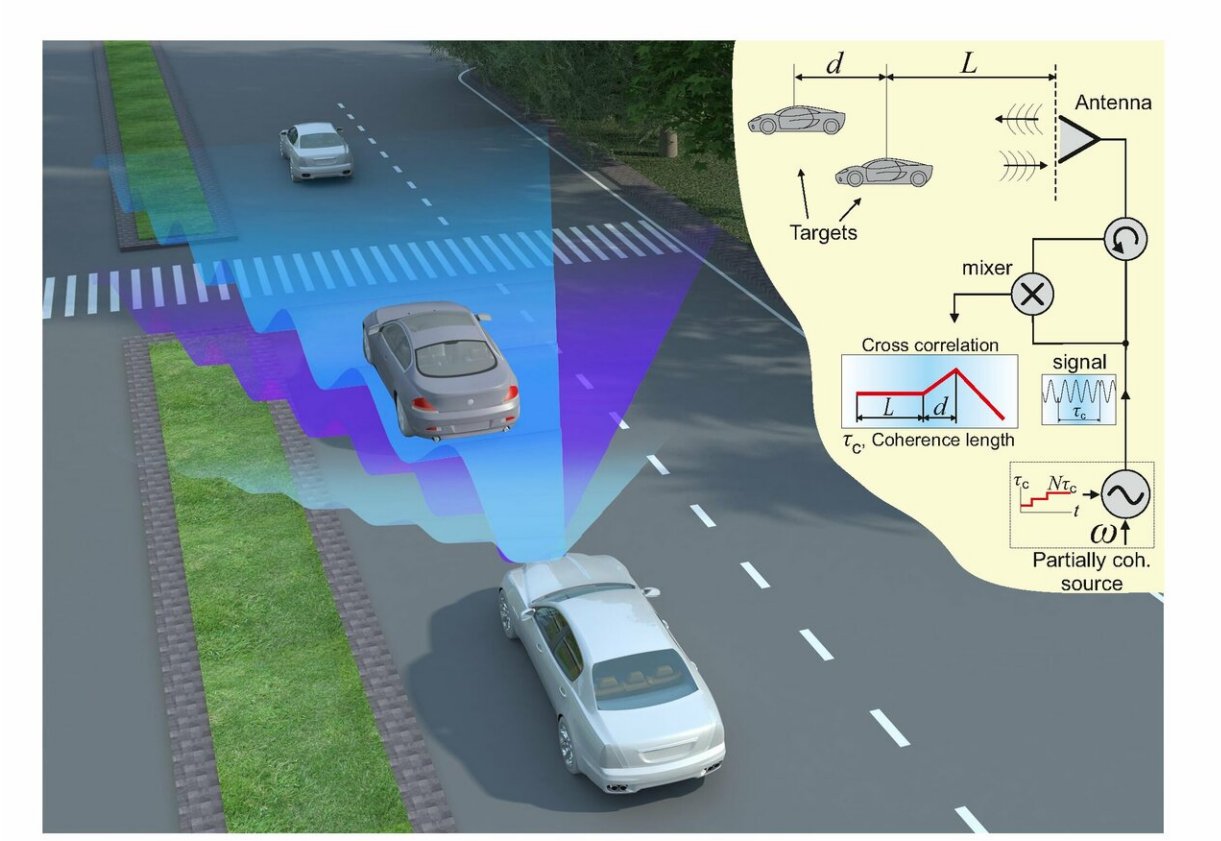
Low-bandwidth radar technology provides improved detection of objects

April 2 2019



Partially coherent radar operation schematics. Credit: *Nature Communications*.

Radar technologies were originally designed to identify and track airborne military targets. Today they're more often used to detect motor

vehicles, weather formations and geological terrain.

Until now, scientists have believed that radar accuracy and resolution are related to the range of frequencies or radio bandwidth used by the devices. But a new Tel Aviv University study finds that an approach inspired by optical coherence tomography (OCT) requires little to no bandwidth to accurately create a high-resolution map of a radar's surrounding environment.

"We've demonstrated a different type of ranging system that possesses superior range resolution and is almost completely free of bandwidth limitations," says Prof. Pavel Ginzburg of TAU's School of Electrical Engineering, one of the principal authors of the study. "The new technology has numerous applications, especially with respect to the automotive industry. It's worth noting that existing facilities support our new approach, which means that it can be launched almost immediately."

The new research was led and conducted jointly by Prof. Ginzburg, Vitali Kozlov, Rony Komissarov and Dmitry Filonov, all of TAU's School of Electrical Engineering. It was published on March 29 in *Nature Communications*.

It was commonly believed that radar resolution was proportional to the bandwidth used—the broader the range of frequencies, the more accurate the detection of objects. But the TAU researchers have now demonstrated that low-bandwidth radars can achieve similar performance at a lower cost and without broadband signals by exploiting the coherence property of electromagnetic waves.

Two wave sources are perfectly coherent if they have a constant phase difference, the same frequency and the same waveform. The new "partially coherent" radar is as effective at resolving targets when

compared with standard "coherent" radars in experimental situations.

"Our concept offers solutions in situations that require high-range resolution and accuracy but in which the available bandwidth is limited, such as the self-driving car industry, optical imaging and astronomy," Kozlov explains. "Not many cars on the road today use radars, so there's almost no competition for allocated frequencies. But what will happen in the future, when every car will be equipped with a radar and every radar will demand the entire bandwidth?

"We'll find ourselves in a sort of radio traffic jam. Our solutions permit drivers to share the available bandwidth without any conflict," Kozlov says.

"Our demonstration is just the first step in a series of new approaches to radiofrequency detectors that explore the impact of low-bandwidth radars on traditional fields," Prof. Ginzburg concludes. "We intend to apply this technology to previously unexplored areas, like rescue operations—sensing if an individual is buried in a collapsed building—or street mapping—sensing if a child is about to cross the street behind a bus that conceals him."

More information: Rony Komissarov et al, Partially coherent radar unties range resolution from bandwidth limitations, *Nature Communications* (2019). DOI: 10.1038/s41467-019-09380-x

Provided by Tel Aviv University