

Small-scale Doppler effect to help cyclists stay safe

June 12 2017, by Ethan Bilby, From Horizon Magazine



Researchers are looking into smart radar and on-bike avoidance tech to prevent accidents with cyclists. Credit: CC0 Public Domain

An extremely sensitive radar that can detect when different parts of people's bodies are moving at different speeds could help drivers avoid collisions with vulnerable road users such as cyclists.

Bicycles haven't changed much in function since Karl Drais took the first ride 200 years ago in Germany, but while cyclists once only

contended with horse-drawn buggies, modern city traffic leaves them more vulnerable than ever.

That's why researchers are looking at how to make cars smarter to help drivers avoid vulnerable road users like cyclists and pedestrians.

'The city has to be for pedestrians,' said Andres Aparicio, senior manager for ADAS and connected and automated vehicles at the Spanish engineering group IDIADA. 'Step by step the car needs to go out of the city.'

Until that happens, he is working with large automotive manufacturers like Audi, BMW, Daimler, Toyota, Volvo, Bosch, and Continental to develop prototype vehicles with automated systems that can help drivers avoid collisions.

Aparicio runs an EU-funded research project called PROSPECT which has developed a sophisticated radar and car-mounted camera system that can provide advance detection of cyclists and pedestrians at intersections — from up to 80 metres away. And it's not just a blip on a screen.

'These are long-range high-resolution radar systems that are able to detect a shape or an object ... it can detect the shape of the legs of a pedestrian or the square shape of a car,' he said.

The PROSPECT researchers are also using camera motion recognition and micro-Doppler effects from radar. The Doppler effect, the change in frequency of sound, light, or other waves from an object as it approaches a target, can be used to measure its speed. Micro-Doppler has an even tighter focus, and detects varying speeds of various parts of one object.

Predicting intent

'Different parts of the body moving at a different speeds, that helps predict pedestrian intent. If you are about to start walking or running, we can predict it,' said Aparicio.

Such judgements are made without a second thought by human drivers, but are harder for a machine. By using micro-Doppler, the system is better able to pick up subtle movement cues we take for granted.

'The cars are sensing not only cyclists that may be crossing, but also parked cars and walkers on the side of the road as well,' said Aparicio.

It's important that the system is not too sensitive though, or else the car would be overreacting to the stimuli for a busy urban environment.

It is therefore designed to provide drivers with a warning from metres away, but the collision avoidance only kicks in at the last second, choosing the best option, to steer around or to brake, to stop a crash.

Even though fully automated cars are on the way, the city is still the most complicated scenario and the hardest for vehicles to perform in, Aparicio explained.

'Full automation will first come in comfortable situations like highways, where cars are all going the same speed and things are more predictable.'

Fatalities

In the meantime, systems like these may be the last line of defence to protect vulnerable pedestrians and cyclists. While motorist deaths are on the decline in Europe, fatalities from two-wheeled vehicles, bicycles and motorcycles, remain stubbornly high.

Cyclists account for a stable or growing share of people injured in traffic accidents, with a rate 7–9 times higher than car travel, according to researchers.

Professor Luca Pietrantoni from the University of Bologna in Italy runs the EU-funded XCYCLE project, which has analysed hundreds of accidents between cyclists and cars to try and look for ways to cut down the numbers.

A common problem with cyclists is the crossing of junctions on red signals, so to cut back on this the team has tested a new system of timed green lights known as a green wave.

They are programmed so that if cyclists ride at a speed of 20 kilometres per hour, they will hit green lights all the way through their journey. The system is designed to coincide with cyclists flowing into city in the mornings and out in the afternoons.

'The system increases the comfort and safety of cyclists,' Prof. Pietrantoni said.

'This green wave strategy will be launched this summer in the bike-friendly city of Groningen in the Netherlands for user behavioural evaluation purposes,' said Prof. Pietrantoni.

Researchers on the project are also developing new systems for motorised vehicles, such as audio and visual warnings for lorry drivers that can help prevent one of the most common accidents — hitting cyclists when lorries turn across bike lanes.

'For example, a bicycle bell that rings as an auditory reminder to truck drivers to avoid a collision,' said Prof. Pietrantoni.

Kitting out bikes, especially electric bikes, with better avoidance systems could also help.

'Most of the on-bike systems available in the market give information to the cyclist about the route, but it's relatively uncommon to find a safety-related on-bike system,' said Prof. Pietrantoni.

The team was specifically interested in trying to understand the risk of a crash at an intersection. In a controlled area in Italy they tested a safety system installed on the handle bar of a bicycle which provided visual and auditory warnings to the [cyclist](#), preventing an unsafe encounter between them and any nearby vehicles.

The team found that cyclists will adapt their behaviour if they have access to such additional avoidance tools.

'Some cyclists are quite reluctant to have expensive technology on their bike, but other types of consumers who are using electric bikes are more willing to accept this type of safety-related tech,' said Prof. Pietrantoni.

Provided by Horizon: The EU Research & Innovation Magazine

Citation: Small-scale Doppler effect to help cyclists stay safe (2017, June 12) retrieved 5 June 2024 from <https://phys.org/news/2017-06-small-scale-doppler-effect-cyclists-safe.html>

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