# Smarter cars are gaining traction (w/ Video)

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(PhysOrg.com) -- Lives can depend on a vehicle's moment-by-moment traction. New European technology promises to make cars as good as experienced, alert drivers at sensing and adjusting to wet, snowy or icy roads.

You're heading into a curve at highway speed when you spot a suspicious patch of road just ahead. You have a few tenths of a second to guess if it's wet, snow-packed or icy and adjust your speed accordingly.

Today you're on your own, but within a few years your car might detect that water, ice or snow before you do, calculate how much traction your car could lose, and flash you a warning or even apply the brakes and stabilise the car as much as physically possible.

With tens of thousands of deaths per year from traffic accidents in Europe alone, up to 20 percent of which involve a driver misjudging the safe speed, vehicles that can sense and react to friction-reducing road conditions could save thousands of lives every year.

## Letting cars see the road

Until very recently, cars and trucks have been totally blind. Today, a few high-end vehicles feature radar or laser systems that can detect large objects just ahead - such as a rapidly braking car - and can warn the driver or slow the vehicle. However, cars and trucks remain blind to road conditions like water, snow or ice that can cause a driver to lose control.

Two years ago, the EU-funded research project FRICTION set out to remedy that problem. They've now designed and tested a suite of smart sensors that let vehicles "see" the road ahead, determine its condition, and calculate the maximum amount of friction available for braking or steering.

Existing anti-lock braking systems (ABS) can determine the maximum friction available between a vehicle's tyres and the road once slipping has begun. But predicting the maximum possible friction before braking has proven to be far more difficult.

"Friction is easy enough to measure once you start slipping," says Pertti Peussa, the FRICTION project coordinator. "But our aim was to have a good estimate of the maximum friction even when driving steadily on a straight road. That's a very difficult problem."

The FRICTION researchers realised that they would need to combine information from several different kinds of sensors in order to accurately determine road and weather conditions and estimate available friction.

One device that proved useful was the Road Eye sensor, developed by a small Swedish company, Optical Sensors. The Road Eye uses lasers to illuminate a spot on the road just ahead of the vehicle with two wavelengths of infrared light. A light-sensitive diode measures the amount of light reflected back at each wavelength.

Tests showed that the Road Eye was good at discriminating between dry asphalt and asphalt covered with snow, ice or water. It had a harder time telling the difference between ice and water, although a modified system using a particular orientation of polarised light may do better.

The team also studied the kind of laser scanners that are already being used on some cars to measure the distance to nearby vehicles. They found that the same lasers can be used to tell whether it is raining or snowing, and to track a car's speed even if it's in a skid or a slide.

A camera that detects polarised light reflected from the road about 25 metres ahead also proved useful. It can see farther than the Road Eye, but because it relies on ambient illumination, it does not work as well under low light conditions. Still, tests showed that it can detect a wet or icy road with up to 80 percent accuracy.

The group also experimented with a radar system operating at 24 gigahertz. They found that by comparing the amount of energy reflected back from the road at two different polarisation angles, they could tell the difference between a dry, wet, icy or snowy surface up to 30 metres ahead.

Another area the researchers explored was an optical sensor built into each tyre whose output could be used to determine front-to-back and side-to-side forces, and also to detect the onset of aquaplaning. The researchers found this system useful for research, but too complex and costly to appear in cars or trucks any time soon.

## Making sensors smart

Although they had identified several promising sensor systems, the engineers still faced the challenge of integrating several streams of environmental and on-board information to calculate the traction available for a particular manoeuvre.

They chose a data fusion approach which combines information from different sensors to produce an accurate and reliable friction estimate.

The first step is to use information from available sensors to generate several independent estimates of friction, plus detect the presence of specific conditions such as aquaplaning.

Previous research has shown that a car on dry asphalt can grip the road with a force close to its weight. In contrast, packed snow might provide 20 to 40 percent of that traction, and ice just 5 to 25 percent.

These first, provisional estimates are then combined into a final determination of road conditions and friction, plus a value for its certainty.

“If the environmental sensors give us a range of 0.7 to 0.9, for example, and chassis measurements give us .75, we can combine them to make the final estimate more accurate,” says Peussa.

The processing hardware they used makes hundreds of estimates per second - far faster than any driver, and fast enough to provide useful information to existing and future automatic safety systems. It also learns to make better estimates by comparing its predictions with measurements from actual manoeuvres.

Extensive testing showed that the system can predict available traction as well as an alert driver with experience on a wide range of surfaces. The difference, of course, is that many drivers lack experience, and even experienced drivers are not always alert.

Peussa expects that FRICTION's automotive partners, Fiat and Volvo, and other manufacturers as well, will introduce friction sensing features to their safety packages in the near future.

"Collision avoidance or mitigation systems that use this kind of environmental information may come fairly soon, maybe within a couple of years," he says.

**More information:** FRICTION project -- friction.vtt.fi/

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