October 2016

Self-driving cars: what to think of them from the perspective of motorcycle safety?

For FEMA author Harold de Bock takes a closer look at the technology that is supposed to make riding safer.

www.fema-online.eu

ITS – self-driving cars and motorcycles

It came as quite a shock to motorcycle riders reading in their newspapers: recently a driver of a Tesla on 'autopilot' was killed in an accident when his Tesla did not notice a truck trailer and crashed into it at full speed. The instant question popping up in the bikers' minds is: if the self-driving system is not seeing a big truck trailer, will it then see a motorcycle? Self-driving cars: what to think of them from the perspective of motorcycle safety?

ITS principles

Self-driving cars are part of the wider concept of ITS, Intelligent Transport Systems. These are technological innovations designed to improve traffic safety by having road users communicate with each other as well as with the road infrastructure. In order to warn car drivers and motorcycle riders for potentially dangerous situations. Or in order to directly intervene with how the car or motorcycle is moving on the road. If the Tesla system had worked properly, it would have 'seen' the trailer and would have slowed the car down to a safe driving distance from the trailer. Major companies are developing self-driving cars. Not only Tesla. This year, Mercedes – under driver supervision – successfully managed to have a self-driving car drive through downtown Amsterdam. Google is working on one and found out that accidents may easily occur. Taxi company Uber is developing a car that doesn't need a driver at all.

Self-driving ITS systems are primarily developed from the perspective of a car. And precisely that is of utmost concern to motorcycle riders. Is ITS also making riding a motorcycle safer or just the opposite: creating an additional danger? Every reason for FEMA and its Dutch member organization MAG to closely monitor ongoing ITS developments. FEMA and MAG are not opposed to ITS. Both organizations want to ensure that whatever ITS systems are allowed onto the European roads are also beneficial to motorcycle safety. And in doing so: both organizations listen closely to European motorcycle riders' ideas and fears about ITS.

ITS Applications

ITS applications do not involve just one 'i', but three 'i's. They form a chronological chain of components.

1) i of intelligence: measuring the situation of the motorcycle itself and its environment;
2) i of interaction: informing the motorcycle and/or the rider of an observed important situation;
3) i of intervention: immediately and automatically applying built-in motorcycle technology or intervening in the riding of the bike itself.

FEMA's recent RIDERSCAN project distinguishes no less than 53 different ITS applications where all three 'i's are involved. A survey among about 17,000 motorcycle riders from 20 European countries measured the riders' opinion about each of these 53 ITS applications: beneficial or dangerous for motorcycle safety?

FEMA's 53 ITS applications fall into 9 categories:

1) Warning and information
2) Technical diagnosis

3) Lights and visibility
4) Brakes
5) Stability and balance
6) Fatigue
7) Vehicle-to-vehicle communication (v2v)
8) Vehicle-to-infrastructure communication (v2i)
9) After-crash assistance

Some of these ITS applications are already in use. Others are being tested. And again others are still on the drawing boards.

Motorcyclists about ITS

This is the European motorcycle riders' the top-10 ITS application *most beneficial* for motorcycle safety:
1) ABS, anti-lock braking systems
2) vision-improving helmet, i.e. preventing the visor from fogging up by heating or dehumidification
3) monitoring tire temperature and pressure
4) vision improvement by contrast reinforcement in bad weather conditions
5) brake assist for maximum brake performance in emergency situations
6) connected brake systems activating both front and rear brakes when only one is engaged
7) impact-sensitive systems disabling motorcycle functionalities for safety reasons
8) engine diagnosis of mechanical or technical problems
9) headlights beaming into turns
10) stability controls preventing rear wheel traction loss and front wheel lift

This is the European motorcycle riders' the top-10 ITS application *most dangerous* for motorcycle safety:
1) projecting motorcycle information helmet visor
2) speed reduction by warning the rider or automatically educing speed when speed limit is exceeded or making it impossible to accelerate over the speed limit
3) warning and automatically reducing speed when engaged cruise control speed is exceeded
4) continuous on/off stroboscope lights (implies the danger that a moving object is perceived as immobile)
5) real-time rearview image projected onto helmet visor or wind screen
6) adaptive cruise control that maintains a constant distance to vehicle in front
7) lane change warning
8) projecting motorcycle information on wind screen
9) information on intersections about other vehicles' speed, location and direction
10) GPS-based warning for too high a speed or motorcycle tilt

Almost all top-10 most beneficial applications apply to the motorcycle itself. Motorcycle riders consider as most dangerous to motorcycle safety ITS applications that (suddenly) confront them with distracting extra information as well as ITS applications that automatically intervene with riding and riding options without the rider having and holding full control.

Examples of motorcycle ITS

A useful and generally accepted ITS application is ABS. For an ABS motorcycle rider it is self-evident that when a powerful brake attempt is registered (the 'i' of intelligence), that this attempt is communicated to the ABS-system (the 'i' of interaction) and that subsequently ABS is automatically activated (the 'i' of intervention).

An example of a dangerous ITS application is when the road infrastructure decides to intervene with a motorcycle rider passing by. Sensors built into or placed alongside the road measure that the rider is exceeding the speed limit (the 'i' of intelligence). This speeding is immediately reported to the rider on his dashboard or by projection onto his helmet visor or wind screen (the 'i' of interaction). Subsequently, ITS automatically cuts the bike's throttle to reduce its speed (the 'i' of intervention).

Equally dangerous it would be when an ITS application during riding measures that the tire pressure is too low (the 'i' of intelligence). This low tire pressure is immediately reported to the rider on his dashboard or by projection onto his helmet visor or wind screen (the 'i' of interaction). Subsequently, ITS automatically cuts the bike's throttle forcing the rider to make a full stop (the 'i' of intervention).

Fear of ITS

FEMA's RIDERSCAN survey among about 17.000 European motorcycle riders shows that they are especially afraid of two types of ITS applications:

1. ITS applications that create unexpected situations. Motorcycle riders do not want:
a) sudden projection of extra information on their helmet visor or windscreen because that distracts from the continuous concentration required to monitor the road, traffic situations and riding conditions;
b) automatic intervention with riding itself as that implies a very serious risk of losing control potentially resulting in a (fatal) accident.

2. ITS applications that impact car and motorcycle driving behavior based on communication from the riding environment;
a) v2v communication between vehicles regarding location, speed and direction;
b) v2i communication between vehicle and road infrastructure thereby limiting for example speed and acceleration potential.

This communication is dangerous because it is unclear how car drivers and motorcycle riders will react to the sudden information they receive and automatic intervention they experience.

ITS and motorcycle accidents

MAG NL's recent elaborate survey among about 4,000 Dutch motorcycle riders produced a top-13 causes responsible for more than half of all motorcycle accidents in The Netherlands. Combining these data with the results of the European RIDERSCAN survey among about 17,000 European riders makes it possible to determine in what ways ITS may help prevent motorcycle accidents.

ITS has its greatest beneficial potential in preventing one-sided or single accidents in which no collision with other vehicles or road users is involved. Two major causes may easily be solved

by ITS: braking errors and blocking brakes, and steering errors especially in turns. The braking problem may be addressed by three ITS applications motorcycle riders really appreciate: ABS, also functioning safely in turns, brake assist for maximum braking performance and connected brake systems that automatically activate front and rear brakes when only one is engaged. The steering problem may also be addressed by three ITS applications riders really appreciate: a headlight that beams into turns, vision-enhancing helmet (no fogging up) and vision improvement through contrast reinforcing helmet visor under bad weather conditions. Here are direct opportunities for the industry to develop and market innovative products.

In case of motorcycle accidents involving a collision, potentially beneficial ITS applications are on the drawing boards. They still require motorcycle-specific test programs before they can be classified as improvement for motorcycle safety. The most dangerous collision situations are:
a) car does not yield to motorcycle on intersection;
b) car drives onto the road from a parking area, gas station et cetera;
c) oncoming car makes a left turn just before the motorcycle;
d) oncoming car is in the wrong lane.

This 4-point causality list defines what kinds of ITS tests are needed from the perspective of motorcycle safety. Without such tests being successful, an ITS application may not be declared safe for motorcycle safety and may not be licensed as fit for production cars.

ITS tests must unequivocally prove that the ITS applications 'see' motorcycles in accident risk situations a through d, under a variety of conditions at least differing in 1) speed, b) busy traffic situations and c) weather.

The idea behind ITS is that ITS applications help prevent human errors responsible for motorcycle accidents. From a policy perspective, the most difficult to answer question will be: what margin of error is acceptable for each ITS application? Because ITS application can and will fail occasionally.

European ITS regulations

It is reassuring to know that FEMA has managed to convince Brussels that cars and motorcycles require a different ITS approach. Motorcycle are vulnerable balance vehicles with far fewer safety features than cars. Mandatory European ITS regulations for cars will therefore not automatically also apply to motorcycles. This especially applies to ITS applications that automatically intervene in riding behavior itself such as speed. Even if such ITS applications would be declared mandatory for cars, they will not automatically apply to motorcycles as well. So, the 'njet' of European motorcycle riders against such ITS applications has been accepted.

On the to do list remains to ensure that ITS tests for cars also involve motorcycles and specifically address the four most risky motorcycle collision situations. It must be ensured that ITS applications for self-driving cars replace the car driver in a motorcycle-safe way. Then these ITS applications can be trusted to improve and not further endanger motorcycle safety. And most important of all: the motorcycle riders must always remain in full control of his motorcycle and his own riding behavior.