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Car-to-cyclist accident avoidance: new test concepts for active safety systems

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Introduction

The performance of current active safety ADAS systems has progressed far beyond the limits imagined only a few years ago. When looking at accidents involving vulnerable road users (VRU), current Automatic Emergency Brake (AEB) systems are able to at least mitigate a large section of pedestrian accidents.

However, there are a few barriers currently preventing them from avoiding high-speed pedestrian and a large share of bicycle accidents, namely the available sensor field-of-view, the available reaction times for the brake actuation and finally the fact that simply braking alone might not be the best strategy in some cases.

PROSPECT (Proactive Safety for Pedestrians and Cyclists) is a collaborative research project involving most of the relevant partners from the automotive industry (including the leading active safety vehicle manufacturers and tier-1 suppliers) as well as academia and independent test labs, funded by the European Commission in the Horizon 2020 research program. The project aims to develop and validate the next generation VRU active safety systems, especially by addressing the aforementioned barriers.

This abstract presents an overview of new test concepts for active safety systems, making emphasis on car-to-cyclist test scenarios.

Methodology

PROSPECT's starting point was a better understanding of relevant Vulnerable Road User (VRU) accident scenarios (combining multiple European accident studies with urban naturalistic observations) [2]. A new method was developed in which a case-by-case analysis of car-to-cyclist accidents was made taking into account the driver`s point of view [1] .

The most relevant car-to-cyclist accident scenarios were clustered in the 'Use Cases' addressed by the project [3]. Use cases include more detailed information about the road layout, right-of-way, as well as manoeuvre intention of the driver. The Use Cases are the key for the system specification [4], which is the basis for the development of the new active safety system within PROSPECT.

Improved VRU sensing and situational analysis (enlarged sensor coverage; earlier and more robust detection; sophisticated path prediction and intent recognition) will allow the developed functions and systems to act early and towards more vulnerable road users. Advanced HMI and especially vehicle control strategies (combined vehicle steering and braking for collision avoidance) will extend the benefit even further to those accident types

where the reaction time is still short. The functions will be shown in four vehicle demonstrators and one transportable mobile driving simulator, and tested using novel realistic VRU dummy specimen.

The robustness of the prototypes and demonstrators developed will be evaluated in the context of the trade-off between system effectiveness vs. number of false activations. For this purpose, a collection of 'test scenarios' representative for all accident scenarios is defined and specified within the project. These test scenarios take into account relevant parameters and values in order to test and validate the new systems to be developed in the project, resulting in a preliminary test protocol. The appropriate test tracks and locations and the deployment of appropriate test tools (in particular bicycle dummy and propulsion system) are considered for the conduction of the tests.

Vehicle-based functional tests will be conducted on test tracks and realistic surroundings. Additionally, testing in a driving simulator will be done for the study of driver reaction, as well as user acceptance tests, where balance between system performance and unjustified activations of the system will be evaluated.

Results

PROSPECT started in May 2015 and ends in October 2018. Test cases have been already defined according to the PROSPECT use cases. Apart from the test scenarios, a concept for testing already exists, including a concept for obstruction walls, for lane markings and intersection marking on test tracks [5]. The following table shows an excerpt of the defined test cases.

Table 1: Example Test Cases defined within PROSPECT corresponding to three Car-to-Cyclist accident scenarios

ID	No 1	No 2	Vehicle Under Test (VUT) Track	VUT Speed profile (km/h)	VRU Track	VRU Speed (km/h)	Signs / Clutter	Other
Test cases where VUT has priority								
CBIP 01	A	1	Large road (Track E)	Turning Left (30-60)	Large road (opposite VRU), Track A	20	Priority signs on large road	-
CBIP 02	E	6	Large road (Track E)	Constant (30-50)	Small road (from right), Track C	10	Priority on large road, yield on small road	Small road obscured
CBIP 03	H	-	Large road (Track A)	Constant (40-60)	Small road (from left), Track C	15	Priority on large road, yield on small road	Small road obscured

Baseline tests of current production vehicles in these test cases are currently in preparation for spring 2017.

The principle concept for the obscuration objects and a versatile intersection layout that allows the conduction of all defined intersection test cases are shown in next figures.

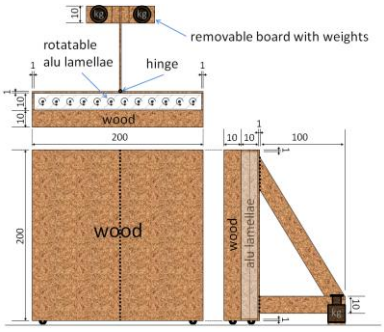

Figure 1: Basic structure of the mobile obstruction panel for the VRU in PROSPECT

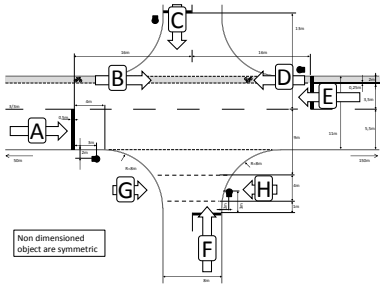

Figure 2: PROSPECT intersection with tracks

Conclusions

The European New Car Assessment Program (Euro NCAP) will include the testing of Cyclist-AEB systems from 2018 onwards in their safety assessment [8].

The CATS project (Cyclist-AEB Testing System) has worked on the introduction of Cyclist-AEB systems and the corresponding consumer tests in order to obtain a test setup and test protocol and results have been shared with Euro NCAP for their 2018 protocols [6] [7].

With respect to CATS, more complex car-to-cyclist scenarios will be implemented in demonstrators and assessed through testing activities within the PROSPECT project. The test methodologies generated in this project will be proposed to Euro NCAP for standardization. The test methodologies and tools shall be considered for 2020 Euro NCAP test programmes, supporting the European Commission goal of halving the road toll in the 2011–2020 timeframe.

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