© Bertrandt

AUTHOR

Dipl.-Ing. Kai Golowko
heads the Department for Vehicle Safety at Bertrandt in Gaimersheim (Germany).

LEGAL REQUIREMENTS

To reduce the number of accidents at the end of traffic jams, European legislation was introduced in November 2015 (Regulation (EC) 661/2009) to make advanced emergency braking systems and lane departure warning systems mandatory in all new trucks of 8 t and above, **FIGURE 1**. A second and more stringent stage of these requirements will be introduced in November 2018 and will apply to all newly registered trucks with a gross vehicle weight rating greater than 3.5 t [1]. However, the scenario involved is relatively simple and the solution will lead to only a small reduction in speed. The requirements represent the minimum functionality and specifically call for the introduction of corresponding functions [2, 3].

The systems developed most recently by the major manufacturers of commercial vehicles often have a much greater effect than that required by the legislation. For example, Daimler has recently launched Active Brake Assist 4, the fourth generation of an emergency braking system for heavy-duty commercial vehicles which includes a function for detecting pedestrians and cyclists. Volvo and MAN both have emergency braking systems that are far more efficient than the functions specified in the statutory regulations [4, 5].

Legislation to cover accidents caused when trucks turn off has not yet been introduced, but these represent a large proportion of the collisions that result in fatalities. In particular in commercial vehicles, functions of this type play more of a supporting role by alerting the driver to critical situations and, if necessary, intervening automatically. The challenge faced by these systems is avoiding incorrect activation and too frequent warnings.

TESTING FUNCTIONS DURING THE DEVELOPMENT PROCESS

These functions require intensive testing. The set-up for a traffic jam scenario is relatively simple and will consist of a stationary or decelerating target, but the situation in the case of the turning assistant is much more complex. This is where Bertrandt's X-Track mobile labo-

Testing ADAS Functions in Heavy-duty Commercial Vehicles

Assistance systems in commercial vehicles have been the subject of much discussion lately, because in particular in the case of more serious collisions, typical accident scenarios are repeatedly occurring in real life. With a mobile laboratory, Bertrandt wants to contribute to the tests of future Advanced Driver Assistance Systems (ADAS).

ratory comes in, **FIGURE 2**. The list of measuring and testing equipment it is fitted with gives an idea of the test options available [6]:
- inertial platforms based on dGPS to identify the position of the test vehicle and the target
- freely moving platform with a realistic vehicle target (0 to 80 km/h)
- test system for pedestrian and cyclist dummies with a long travel distance (> 80 m)
- driving robots
- measurement and camera systems
- mobile street light system
- weather station (records environmental conditions, such as temperature, brightness, road conditions)
- sensors for measuring temperature, pressure and force in the brake system.

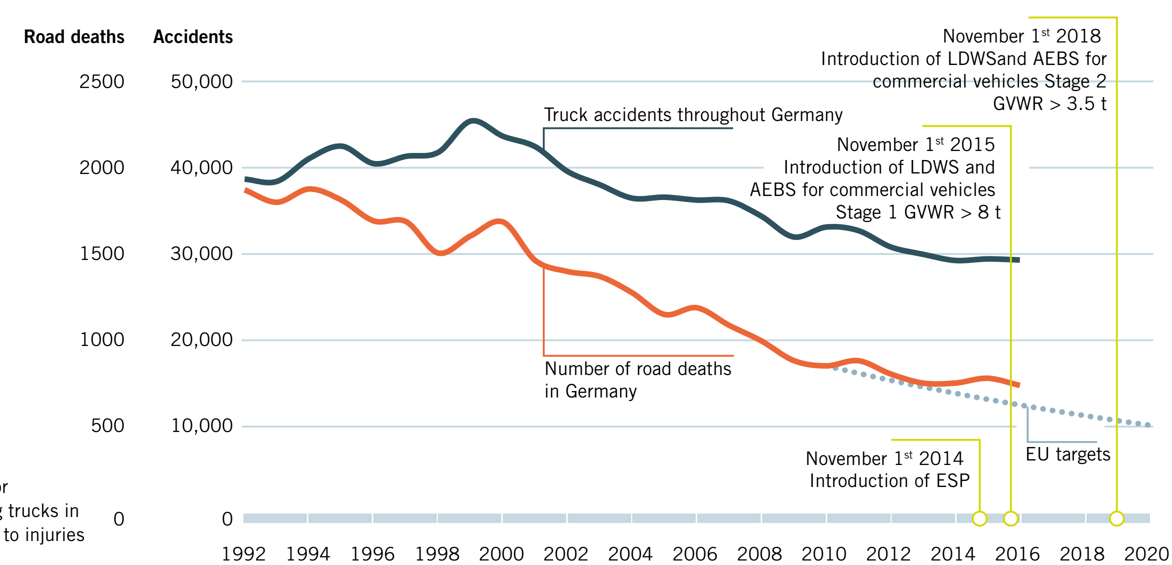

FIGURE 1 Figures for accidents involving trucks in Germany that lead to injuries (© Bertrandt)

As an example, Bertrandt set up a complex test scenario for a truck turning right. A cyclist dummy is used in the position where a real cyclist might be, in other words, parallel to the path of the truck being tested. During the test the parameters that are varied include the distance to the side of the truck (b_1) and the relative speed of the truck (v_1) and the cyclist (v_2) to provide wide-ranging test coverage for a turning function that warns the driver and intervenes if required, **FIGURE 3**.

The variance in the parameters, **TABLE 1**, immediately indicates the complexity of the process and the number of tests involved. If all the parameters are combined and each test is repeated five times to ensure that the results are reliable, the number of tests will already have reached 1575. Incorporating weather and environmental conditions, for example day/night or dry/rain, will double or quadruple the number of tests required.

THE X-TRACK PROJECT

The tests are based on a catalog of test scenarios which describes each function individually and can be adapted both for the accident situation and for the system in use in its active environment. Thorough planning is essential in order to gain a reliable overview of the effect of the function and also to reduce the number of faulty activations.

This presents major challenges and requires largely automated processes, which is the only way of running tests efficiently during the development of a function. Bertrandt's X-Track project provides the necessary conditions for efficient testing on a day-to-day basis.

The laboratory is installed in a van and is equipped with the facilities listed above. This allows the team to travel quickly to any potential test site with a full set of measuring and testing systems, **FIGURE 4**.

The X-Track tool chain can also be used in a real life environment, for example for analyzing an accident site that has been closed off or for carrying out user studies with real drivers on test tracks.

The dummies used meet the Euro NCAP standard for cars. This ensures that they are sufficiently robust and allows for accurate, reproducible tests. The self-driving platform gives the test

FIGURE 2 The equipment in the X-Track laboratory (© Bertrandt)

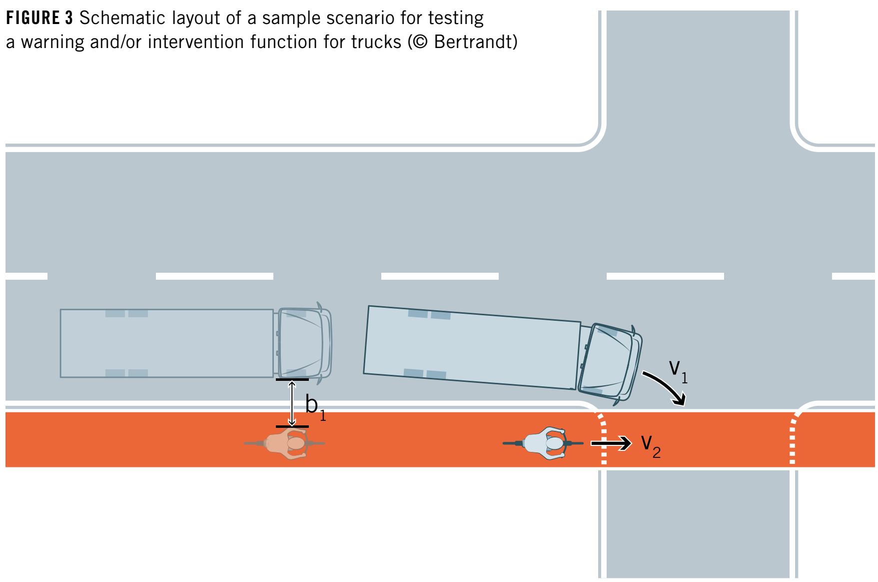

FIGURE 3 Schematic layout of a sample scenario for testing a warning and/or intervention function for trucks (© Bertrandt)

Truck	Cyclist	Distance between truck and cyclist
v_1 [km/h]	v_2 [km/h]	b_1 [m]
10	6	0.8
15	9	1
20	12	1.2
25	15	1.4
30	18	1.6
35	21	–
40	24	–
45	–	–
50	–	–

TABLE 1 Sample parameter range (© Bertrandt)

FIGURE 4 The mobile test laboratory X-Track, installed in a van (© Bertrandt)

FIGURE 5 Vehicle (C2 target) and pedestrian dummy (adult pedestrian) in combined use (© Bertrandt)

team even greater freedom for assessing real objects with free trajectories in crashes. For example, this allows the traffic queue scenario that is specified by law to be extended to include robustness tests relating to the variance in speed and coverage, **FIGURE 5**.

The target vehicle also has a realistic shape, which ensures good 3-D detectability. This brings significant benefits in particular in the case of camera-based functions and high installation positions in the truck. Collisions are possible with all the targets, which means that neither the test vehicle nor the test equipment is put at risk during the testing process.

FLEXIBLE AND EFFICIENT SUPPORT FOR TESTING

Accidents involving trucks are important in statistical terms and often involve serious injuries. Assistance systems can provide effective help in this area. The relevant legislation has already been passed and the systems that are currently available often exceed the requirements of current legislation. Accident hot spots for vulnerable road users in inner city areas occur at junctions where trucks turn off. The wide range of parameters involved in testing assistance functions that will help to prevent these accidents results in highly complex tests. The X-Track mobile laboratory provides all the equipment needed to allow for flexible and efficient test processes.

REFERENCES

[1] European Commission: Commission Regulation (EU) No 351/2012 of April 23, 2012. Online: https://publications.europa.eu/de/publication-detail/-/publication/59c0adba-4994-4e24-87a9-3601d888d9f3/language-de, access: June 12, 2018

[2] Deutscher Bundestag: Vermeidung von LKW-Auffahrunfällen auf Bundesautobahnen durch Notbremssysteme. Online: https://www.bundestag.de/blob/477598/fe909742f-0b8e21a7a43d69eddd888cb/wd-5-069-16-pdf-data.pdf, access: June 12, 2018

[3] Deutsche Verkehrswacht: Zu Fahrerassistenzsystemen FAS für Straßen- und speziell Nutzfahrzeuge. Online: http://www.landesverkehrswacht.de/fileadmin/downloads/Wissensblaetter/Wissensblatt16FAS.pdf, access: June 12, 2018

[4] Daimler: Notbremsassistent Active Brake: Assist 4 mit Fußgängererkennung und Abbiege-Assistent. Online: http://media.daimler.com/marsMediaSite/de/instance/ko/Mercedes-Benz-Lkw-Sicherheit-Neue-Assistenzsysteme-Notbremsassistent-Active-Brake-Assist-4-mit-Fussgaengererkennung-und-Abbiege-Assistent.xhtml?oid=12367326, access: June 12, 2018

[5] Volvo Trucks: Notbremsassistent. Online: https://www.volvotrucks.de/de-de/trucks/innovationen/notbremsassistent.html, access: June 12, 2018

[6] Golowko, K.: Complex equation. Online: https://www.bertrandt.com/fileadmin/data/downloads/02_Presse/03_Fachartikel/2017-12_x-track_Vision-Zero_en.pdf, access: June 12, 2018