MOTORCYCLE RIDER PROTECTION THROUGH ADVANCED DRIVER ASSISTANCE SYSTEMS

Connected
Motorcycle
Consortium

Dr.-Ing. Ulrich Zoelch, BMW AG, Germany

BMW GROUP

BMW MOTORRAD

MOTORCYCLE RIDER PROTECTION THROUGH ADVANCED DRIVER ASSISTANCE SYSTEMS

Dr.-Ing. Ulrich Zoelch

MOTORCYCLE RIDERS ARE VULNERABLE ROAD USERS.

The Connected Motorcycle Consortium stands for an collaborative approach between motorcycles and passenger cars.

Safety Measures for Riders

Reduction of riding errors and risks via:

- Safety related PTW systems (ABS, ..)
- Rider safety training
- Personal protective equipment (rider gear)
- Upcoming ARAS systems

Automotive Safety Measures

Protection of motorcycle riders:

- Accidentology including motorcycle scenarios
- Research on effectiveness of active safety systems
- Implementation of ADAS/AEB systems in cars considering motorcycle specific characteristics

ADAS: Advanced Driver Assistance Systems
AEB: Autonomous Emergency Braking
ARAS: Advanced Rider Assistance Systems
PTW: Powered Two Wheeler

Because riders are Vulnerable Road Users, an overarching safety approach together with the automotive industry takes the interaction of passenger cars and motorcycles into account and provides benefit from technology transfer.

MOTORCYCLE SAFETY: ACCIDENT RESEARCH FINDINGS.

Research on motorcycle accidents

Riding accidents:
Main cause is loss of control over the motorcycle.
Collision type accidents:
In approx. 80% the opponent is a passenger car.

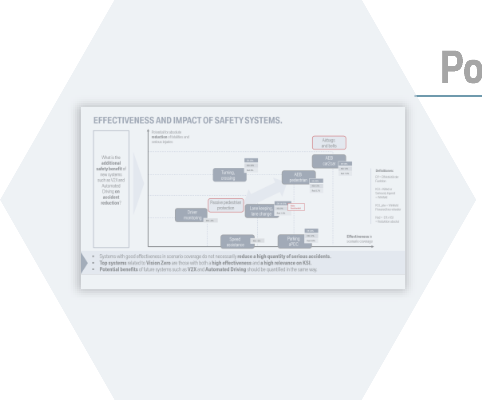
Influence of the car - accident scenarios from MUSE project, GIDAS, CMC

Influence of the rider and the bike

‚Riders are not the same as drivers'.
- Riding skills are crucial
- Control systems and advanced rider assistance systems are constantly evolving
- Technical systems need to be controlled in order to benefit

→Certified rider safety trainings

Potential und Effectiveness

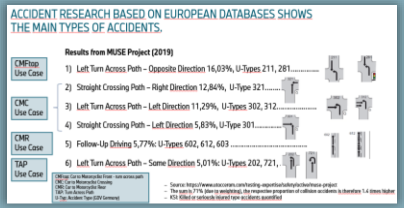


- Improving riding skills through continuous rider trainings is the foundation to avoid all types of motorcycle accidents.

MOTORCYCLE RIDER PROTECTION: ACCIDENT RESEARCH SHOWS THE NEED FOR ACTIVE SAFETY SYSTEMS IN PASSENGER CARS.

Research on motorcycle accidents

Influence of the car - accident scenarios from the projects MUSE, GIDAS, CMC



ACCIDENT RESEARCH BASED ON EUROPEAN DATABASES SHOWS THE MAIN TYPES OF ACCIDENTS.

Results from MUSE Project (2019)

CMFtop Use Case
1) Left Turn Across Path – Opposite Direction 16,03%, U-Types 211, 281

CMC Use Case
2) Straight Crossing Path – Right Direction 12,84%, U-Type 321
3) Left Turn Across Path – Left Direction 11,29%, U-Types 302, 312
4) Straight Crossing Path – Left Direction 5,83%, U-Type 301

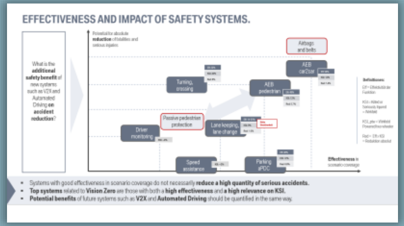
CMR Use Case
5) Follow-Up Driving 5,77%: U-Types 602, 612, 603

TAP Use Case
6) Left Turn Across Path – Same Direction 5,01%: U-Types 202, 721, …

Ranking of severe collision type accidents:
In most cases the accident is caused by the car driver.
1) Crossing traffic
2) Left turn/ farside turn

Influence of the rider and the bike

Potential und Effectiveness



Active safety functions show a high potential at crossing and turning scenarios.

MUSE: Motorbike Users Safety Enhancement
GIDAS: German in-Depth Accident Study
CMC: Connected Motorcycle Consortium

- More than half of the collision accidents with vehicles occur at junctions, in vast majority the car driver is the main causer.
- BMW sees the highest potential for mitigation of severe accidents in active safety systems in cars for crossing and turning.

ACCIDENT RESEARCH BASED ON EUROPEAN DATABASES SHOWS THE MAIN TYPES OF ACCIDENTS.

CMFtap
Use Case

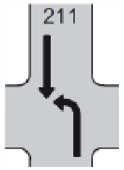
CMC
Use Case

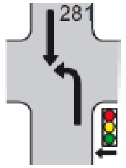
CMR
Use Case

TAP
Use Case

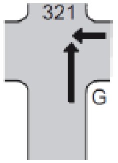
Results from MUSE Project (2019)

1) Left Turn Across Path – Opposite Direction 16,03%, U-Types 211, 281...............

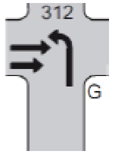




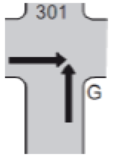
2) Straight Crossing Path – Right Direction 12,84%, U-Type 321........



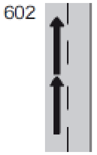
3) Left Turn Across Path – Left Direction 11,29%, U-Types 302, 312....................

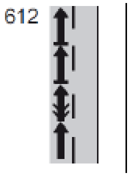


4) Straight Crossing Path – Left Direction 5,83%, U-Type 301.............

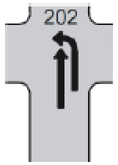


5) Follow-Up Driving 5,77%: U-Types 602, 612, 603 ....





6) Left Turn Across Path – Same Direction 5,01%: U-Types 202, 721,



CMFtap: Car to Motorcyclist Front - turn across path
CMC: Car to Motorcyclist Crossing
CMR: Car to Motorcyclist Rear
TAP: Turn Across Path
U-Typ: Accident Type (GDV Germany)

- Source: https://www.utacceram.com/testing-expertise/safety/active/muse-project
- The sum is 71% (due to weighting), the respective proportion of collision accidents is therefore 1.4 times higher
- KSI: Killed or seriously injured type accidents quantified

- The most frequent collision accident types are left turn and turning/crossing.

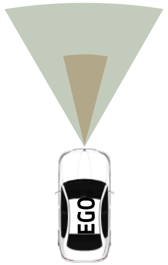
DETECTION PERFORMANCE OF ONBOARD-SENSOR SYSTEMS ON MOTORCYCLES.

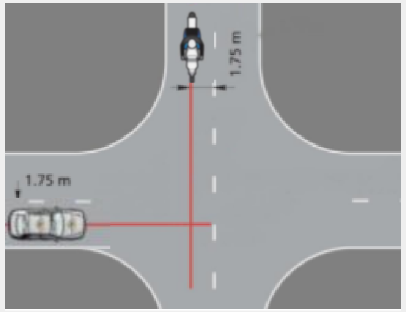
Motivation

- Validation of passenger car onboard-sensor systems regarding the detection performance on real motorcycles in addition to surrogates.

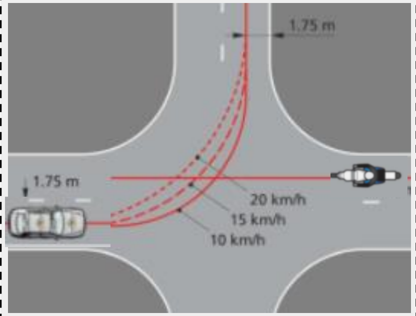
Test setup

- Several Tests were carried out in relevant scenarios for active safety functions with various vehicle configurations and different types of motorcycles.

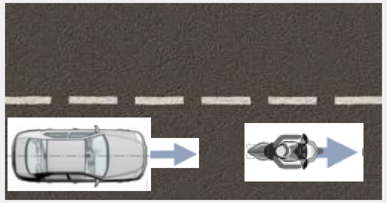




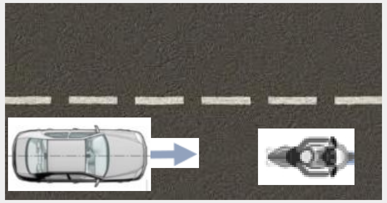
Car to Motorcyclist Crossing



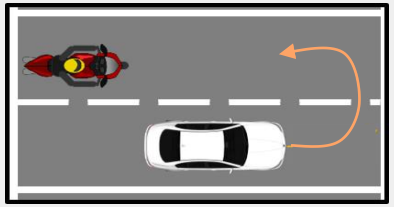
Car to Motorcyclist Front – turn across path



Car to Motorcyclist rear – moving powered two-wheeler



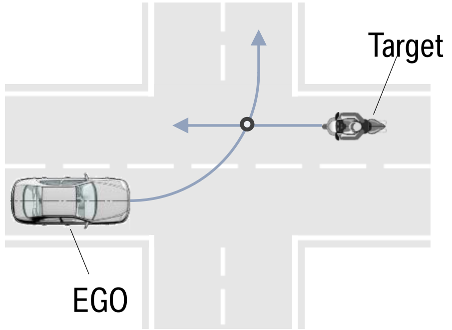
Car to Motorcyclist rear – stationary powered two wheeler



Turn Across Path – same direction

State-of-the-art sensor systems are able to detect real motorcycles and scooters.

LEFT TURN ACCIDENTS INVOLVING MOTORCYCLES AND CARS: ACCIDENT DATA ANALYSIS AND BMW ACTIVE SAFETY FUNCTION.



Front collision warning and braking function for turning with oncoming traffic

– Active safety function for turning situations in case of oncoming traffic
– The function reacts on oncoming motorcycles and cars up to 100 kph
– Basic configuration in the latest generation of BMW ADAS systems launched 2021

Data basis GIDAS Germany:

– Data freeze 7/2020
– Passenger cars (M1/N1) and motorcycles (> 125ccm) involved
– Accidents causing severe and fatal injuries (KSI)

Motorcycle target speed [km/h]

EGO-vehicle speed [km/h]	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	120
0	0,00%	0,00%	1,05%	1,05%	0,00%	2,11%	0,00%	0,00%	2,11%	0,00%	1,05%	0,00%	0,00%	0,00%	0,00%	0,00%
5	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	1,05%	1,05%	1,05%	1,05%	0,00%	1,05%	0,00%	0,00%	1,05%	1,05%
10	0,00%	0,00%	1,05%	0,00%	1,05%	1,05%	0,00%	0,00%	0,00%	1,05%	1,05%	0,00%	1,05%	1,05%	0,00%	0,00%
15	0,00%	1,05%	2,11%	2,11%	6,32%	3,16%	2,11%	0,00%	1,05%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
20	0,00%	0,00%	3,16%	0,00%	3,16%	2,11%	1,05%	0,00%	0,00%	1,05%	1,05%	0,00%	0,00%	1,05%	0,00%	0,00%
25	1,05%	1,05%	1,05%	2,11%	2,11%	1,05%	1,05%	1,05%	1,05%	1,05%	0,00%	1,05%	0,00%	0,00%	1,05%	0,00%
30	1,05%	1,05%	0,00%	0,00%	4,21%	3,16%	0,00%	0,00%	2,11%	0,00%	2,11%	0,00%	1,05%	0,00%	1,05%	1,05%
35	0,00%	0,00%	2,11%	1,05%	3,16%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
40	1,05%	0,00%	0,00%	0,00%	0,00%	1,05%	0,00%	1,05%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	1,05%	0,00%
45	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	2,11%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
50	0,00%	0,00%	0,00%	0,00%	1,05%	0,00%	1,05%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
55	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	1,05%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%

Euro NCAP 2023*
29,5%

BMW System
>80%

*) Euro NCAP AEB CMFtap:
Automated Emergency Brake
Car to Motorcyclist Front turn across path

- There is a significant amount of severe accidents involving motorcycles oncoming with velocities up to 100 kph.
- The BMW active system is capable to cover >40% more of severe accidents compared to the related Euro NCAP test scenario.

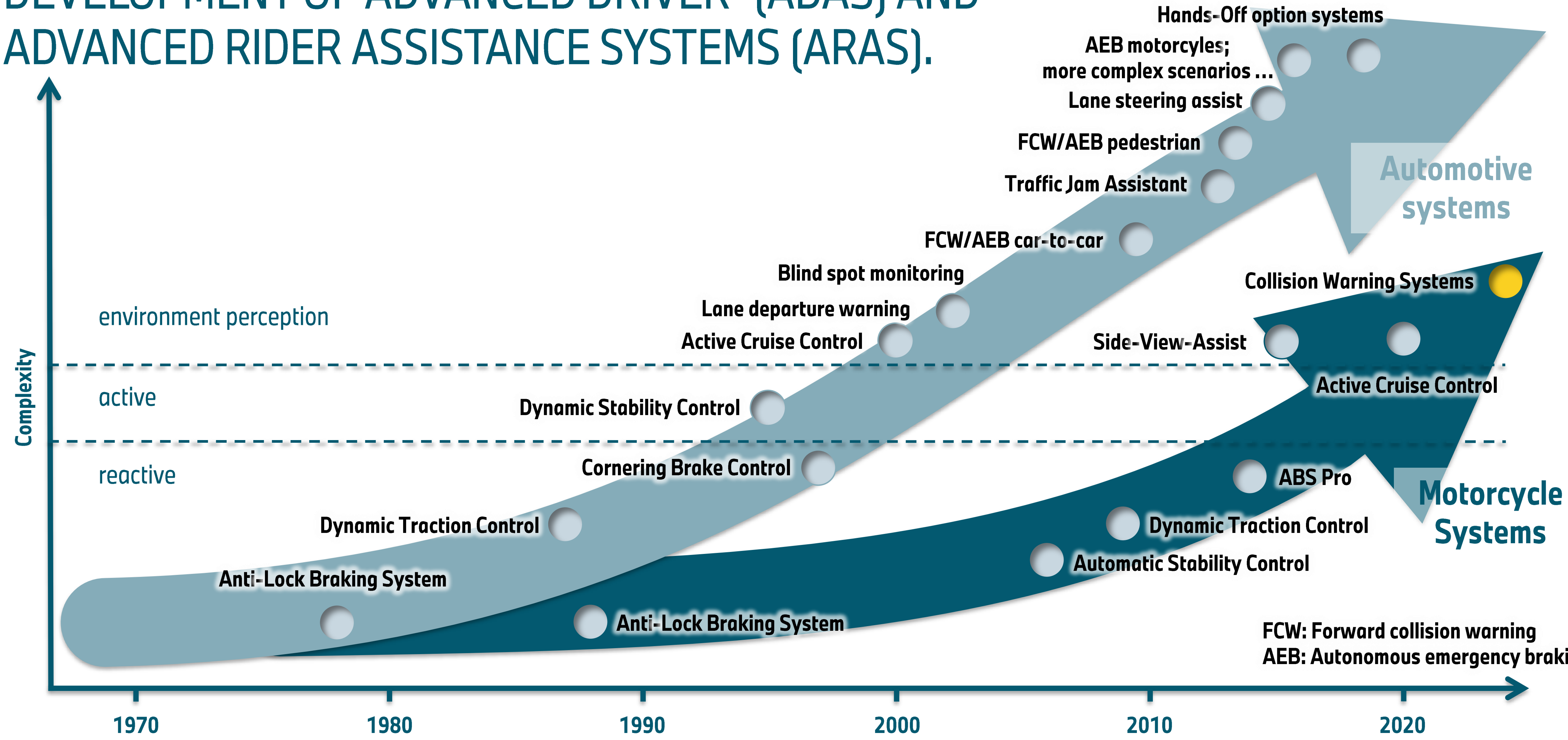
BMW GROUP

BMW MOTORRAD

INCREASING MOTORCYCLE SAFETY ON PTW SIDE

UPCOMING ADVANCED RIDER ASSISTANCE SYSTEMS

DEVELOPMENT OF ADVANCED DRIVER- (ADAS) AND ADVANCED RIDER ASSISTANCE SYSTEMS (ARAS).



FCW: Forward collision warning
AEB: Autonomous emergency braking

There is a time delay between the introduction of advanced driver assistance systems in passenger cars and their introduction in the motorcycle segment that allows the motorcycle industry to learn from automotive systems.

EXAMPLE OF UPCOMING ADVANCED RIDER ASSISTANCE SYSTEMS: FRONT-COLLISION WARNING.

Prewarning:

- Visual warning
- Haptic warning pulse draws the rider's attention to the imminent collision

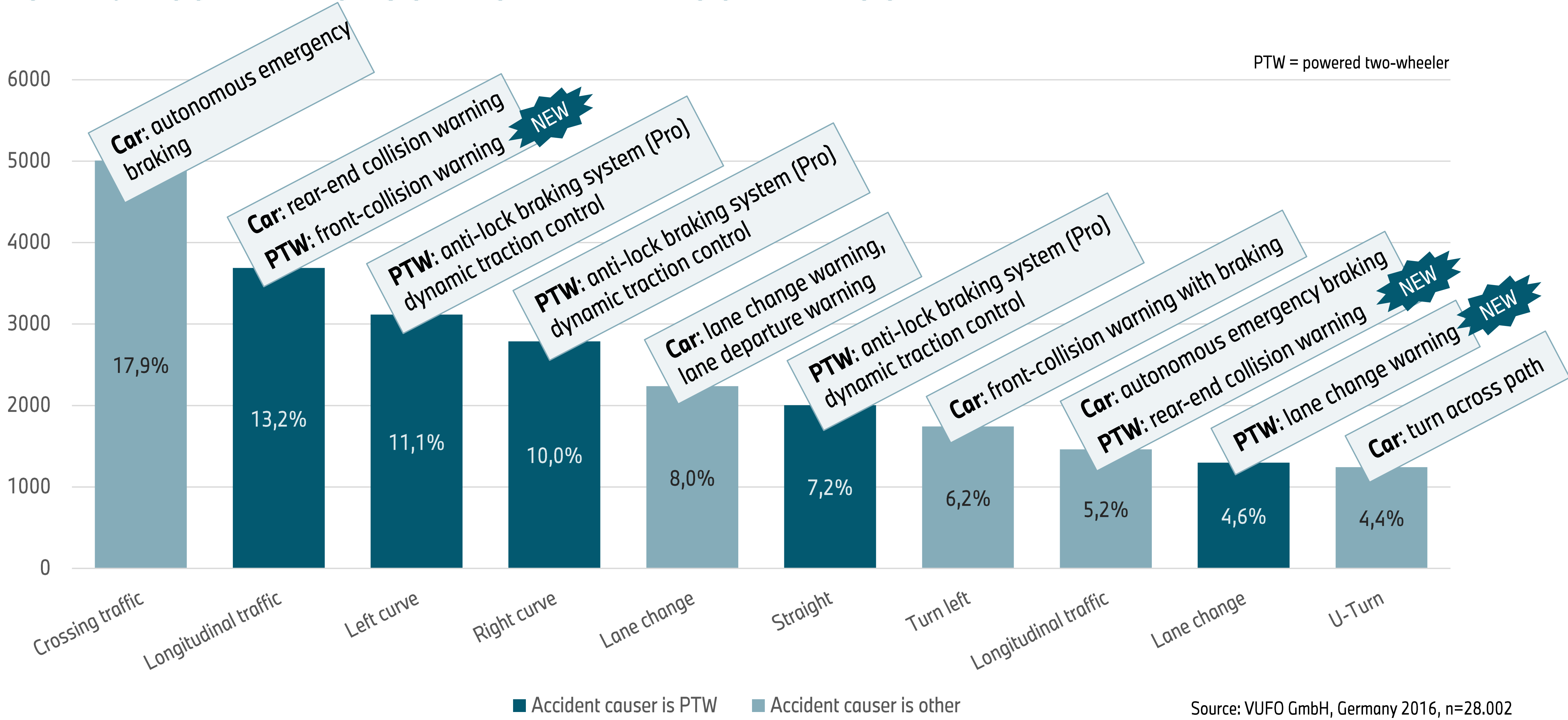
Acute warning:

- More intense visual warning
- Only displayed if criticality increased since prewarning

Haptic brake support:

- During the rider's reaction time the haptic brake support already decelerates to mitigate the collision.

TOP 10 ACCIDENT CAUSATION IN PTW SCENARIOS.



Source: VUFO GmbH, Germany 2016, n=28.002

More and more accident types are addressed by Advanced Driver- and Advanced Rider Assistance Systems.

SUMMARY

- A safety approach of the Motorcycle Industry together with the Automotive Industry leads to benefit for both sides
- The highest potential for mitigation of severe accidents lies in Autonomous Emergency Braking functions at crossing and turning scenarios
- Sensor-based ADAS are state-of-the art technology in series production with proven reduction of accidents and are subject to continuous further development
- BMW has expanded the Euro NCAP requirements for its ‘Car to Motorcyclist Front - Turn Across Path’ function and covers more than 80% of left-turn collision accidents according to the GIDAS database
- Now this ADAS technology is being transferred by the Motorcycle Industry to PTW as ARAS systems
- More and more accident types are addressed by Advanced Driver- and Advanced Rider Assistance Systems

Connected Motorcycle Consortium

Thank you for your attention

www.cmc-info.net

contact@cmc-info.net