Harmonized Scenarios for the Evaluation of Active Safety Systems based on In-Depth-Accident Data

2 authors:

Harald Feifel
Continental Autonomous Mobility

Michael Wagner
Continental AG

Harmonized Scenarios for the Evaluation of Active Safety Systems based on In-Depth-Accident Data

H Feifel, M Wagner

Continental Teves, Guerickestrasse 7, 60488 Frankfurt

Abstract - Accident data are prerequisite during the development and introduction of new active safety systems. Multiple in-depth databases are available worldwide using different accident collection and data coding methods. Harmonisation of accident data is needed to achieve comparable results during all phases of system development and thus provide for a systematic worldwide approach towards vision zero. Accident scenarios are the basis for developing sensor-based active safety systems. They describe the scene of the accident including the participants and their respective actions and intentions. This paper discusses possibilities of analysing in-depth accident data and deriving accident scenarios. Different databases are considered and an exemplary accident setup is used to demonstrate a consistent method. Also, a scenario catalogue is proposed.

1. BACKGROUND

Accident data are needed to evaluate the benefit of safety systems in real-world accidents. The field-of-action is analysed in which the system can become active to avoid or mitigate accidents, and essential requirements for the system development are derived. Additionally, the potential effectiveness of the safety system within its defined field-of-action is evaluated. For both development phases, a classification of accidents based on common characteristics, before and during the collision, is needed. Such common characteristics can be the trajectories of accident participants or the actual collision geometrics.

To classify traffic accidents, a set of pre-defined accident scenarios can be used. The commonly used terms scene, situation and scenario differentiate by the added level of detail. A scene describes all players and their local and dynamic properties within the surrounding environment. A situation additionally includes goals and values of the players. Besides the properties of the scene and the situation, a scenario also contains actions of the players and other decisive events [1]. Generally, an accident scenario describes the course-of-events that lead to a traffic accident, based on intentions and movements of the participants and other events and circumstances, at the scene and within the environment of the accident, and including the collision outcome. Thus, accident scenarios are well-suited for the description and definition of a safety system.

Vehicle safety systems are divided into primary, secondary and tertiary systems, with active safety systems (ADAS) addressing the primary safety by performing driver warnings and active interventions in the vehicle dynamics. This is based on a critical assessment due to ego kinematics data and object information provided by environment sensors. Therefore, a classification of accidents into accident scenarios, that are to be used for ADAS development, should be done using common sensor-relevant properties in the pre-crash phase. These are mainly the positions and movement directions of the accident participants.

Accident types describe the conflicts that lead to traffic accidents. They are generally represented by pictograms which show the first conflict between two traffic participants, regardless whether other participants are involved. Accident types are used to systematically classify and group traffic accidents. Each accident is classified by the respective accident causer and non-causer. The accident types are partly characterised by a very high level of detail [2]. Due to this segmentation they are generally unfavourable to represent the overall accident occurrence in a compact way.

This paper shows a method to cluster accident types into accident scenarios, considering characteristics and limitations of active safety systems. The focus shall be on the usability of the defined accident scenarios during the development of active safety systems. A scenario catalogues is proposed on the basis of the Cyclist-AEB Testing System (CATS) [3]. The method is demonstrated using the in-depth databases GIDAS, CIDAS, RASSI, iGLAD and FARS CRSS [4-8]. As an example the traffic accidents between passenger cars and motorcycles are analysed and visualised.

2. GOAL

The method shall allow to qualitatively and quantitatively analyse a particular accident occurrence in a simple and systematic way by using accident types only. This shall be regardless of the kind of vehicles and participants involved. The aim is a uniform representation of the accident focal points and the identification of unaddressed scenarios (white spots).

By clustering the three-digit accident types, standardised accident scenarios shall be derived. No further information shall be used initially. These accident scenarios form the basis for analysing the required functionality of active safety systems. By also considering further details, important insight into the design of the sensors, the algorithms and the actuators can be gained. The accident scenarios are also the basis for a prospective effectiveness assessment by simulation, according to PEARS (Prospective Effectiveness Assessment for Road Safety) [9].

The method shall be applied to a number of globally available in-depth accident databases. This allows comparable analysis results for the different regions. Equally, the standardised accidents scenarios and a generic scenario catalogues help create comparable results from different sources and research teams. Ideally, re-usable data mining tools are applied.

3. METHOD

Active safety systems prevent accidents by direct or indirect intervention in the longitudinal or lateral vehicle dynamics, due to sensor information in the pre-crash phase. A classification of traffic accidents that is based on the accident type definition is therefore particularly suitable for defining the field-of-action for an ADAS.

The GIDAS database describes the three-digit accident type UTYP for each recorded accident and classifies the two participants in the causal conflict as UTYPA and UTYPB. In general the causing accident participant is coded as UTYPA. The exception are accidents with pedestrians, who are always coded as UTYPB regardless of the question of guilt. Based on the parameters UTYP, UTYPA and UTYPB, the accidents are clustered into accident scenarios. Other databases such as CIDAS, RASSI and iGLAD also define suitable parameters. Figure 01 describes the necessary steps of the method.

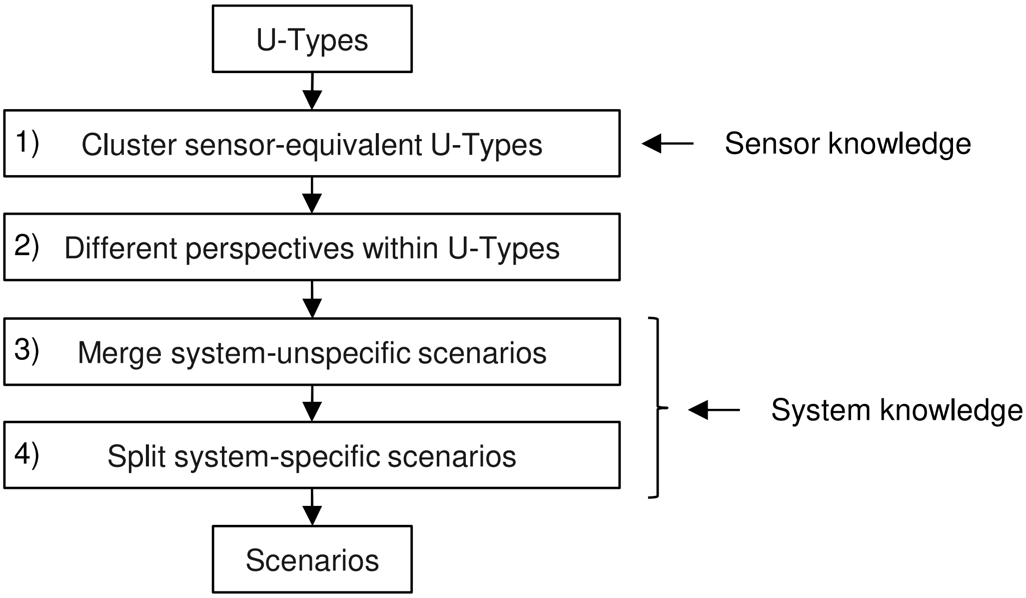


Figure 01: Generation of accident types from accident types (U-types)

In the first step, sensor-equivalent accident types are clustered. These are all accident types the environment sensor cannot distinguish and which therefore represent identical scenarios. For example, scenario L1 describes run-up collisions. In run-up collisions, for the approaching vehicle it is not decisive on which lane the accident occurs and whether the front vehicle is braking, standing still or turning. From the point of view of participant A, all of these accident types are represented by scenario L1, see Figure 02.

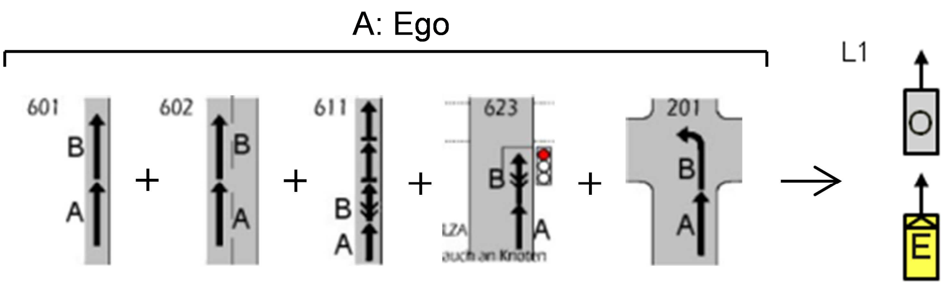


Figure 02: Clustering of sensor-equivalent accident types to scenario L1

The second step combines the perspectives of both participants. Each accident type represents a different scenario depending on the point of view and can therefore be grouped into two different scenarios. Different accident types can be grouped into the same scenario depending on the perspective of the participant, accordingly. Thus, the accident types have always to be considered from the perspective of participant A and from the perspective of participant B. Figure 03 shows how the crossing-scenario C1 consists of different accident types, taking into account both participants involved. From the point of view of the ego vehicle, the accident scenario is crossing collision from right.

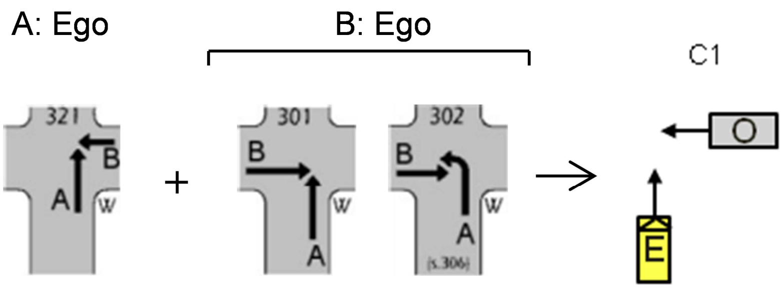


Figure 03: Perspective change when creating scenario C1

Step three combines system-unspecific scenarios that the safety system does not need to differentiate. This reduces the number of scenarios to a necessary level. For a back-up assist system it is irrelevant from which side a collision object is approaching. Scenario B can therefore include object collisions from all directions, see Figure 04.

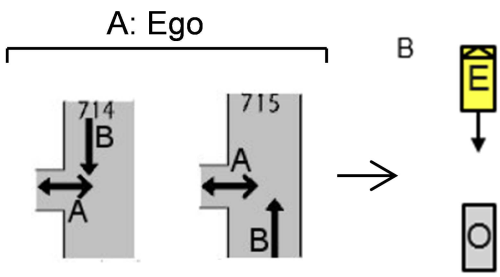


Figure 04: System-unspecific scenario B

In contrast, accident scenarios are separated in the fourth step, because the contained accident types are not equivalent regarding the safety system under consideration. These system-specific accident types are addressed by different ADAS. Preferably, particularly frequent accident scenarios are split up into multiple sub-scenarios. Oncoming collisions, for example, are equivalent from a sensor perspective and therefore initially depicted in a common accident scenario. For the design of an appropriate safety system, however, it is crucial whether the collision object meets a-priori on the same lane or whether the ego vehicle has provoked the collision by a lane change. From an ego perspective, very different approaches are used to avoid or mitigate the accident. Scenario On1 can be addressed by an advanced emergency braking system (AEBS-Oncoming), while scenario On2 can be prevented by a lane keep assist (LKA) system. The composition of the scenarios On1 and On2 from the perspective of A and B is shown in Figure 05.

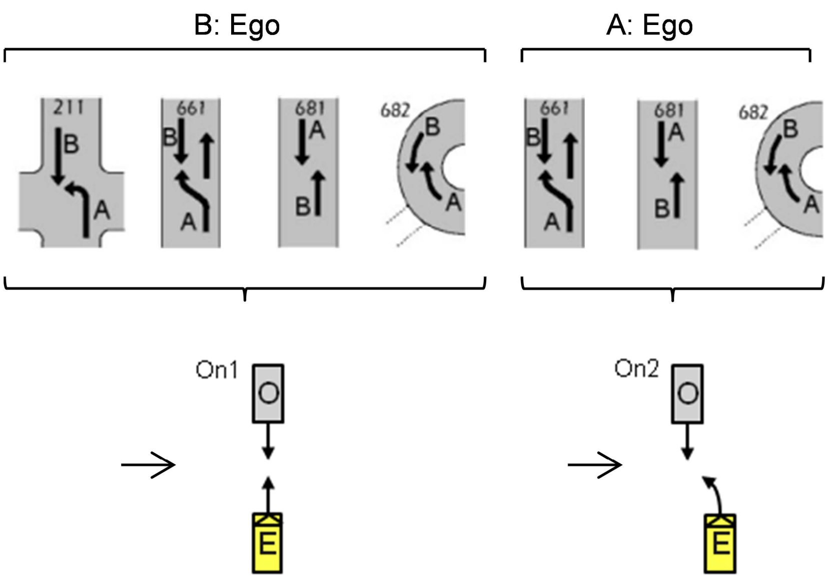


Figure 05: System-specific scenarios On1 and On2

Prerequisite for the methodology is a clear identification of the two participants involved in the causal accident conflict. Therefore, the accident causer and non-causer have to be identified as A and B. This, however does not need to imply the guilt in a legal sense. The definition of A and B still allows a simple analysis regarding the accident causation.

Accident types are defined by the positions and movements of the involved participants. In general, the movement intention can be detected for the ego vehicle, but not for the object vehicle, using internal and external sensors. For this reason, and to keep the number of accident scenarios manageable, only the ego vehicle is represented with a movement intention, depicted by a curved arrow. Table 01 shows which movement states and intentions are possible for ego and object vehicle.

Table. 01: Perspective change when creating scenario C1

Property	Ego	Object
Position	yes	yes
Heading	yes	yes
Movement state	yes	yes
Movement direction	yes	yes
Movement intention	yes	no

A number of in-depth databases are suitable for the generation of accident scenarios. Data mining tools and analysis methods should be easily adaptable to corresponding databases. Table 02 shows possible accident databases and the parameters used to determine the accident type information needed for the accident scenario generation.

Table. 02: Suitable databases for scenario generation

Database	Region	Attributes
GIDAS	Germany	UTYP, UTYPA, UTYPB
CIDAS	China	UTYP, UTYPA, UTYPB
RASSI	India	PRECREV, PRECRA, PRECRB
iGLAD	worldwide	ACCTYPE, ACCTYPEA, ACCTYPEB

The method classifies traffic accidents into accident scenarios, taking into account the perspective of both accident participants. Out of m considered accidents, the method generates n=2*m accident scenarios, since every accident can be found in two different scenarios. The accident analysis on a scenario level allows for a holistic view, which is necessary for a thorough description of the field-of-action of safety systems. Figure 06 shows the various levels on which the accident occurrence can be analysed.

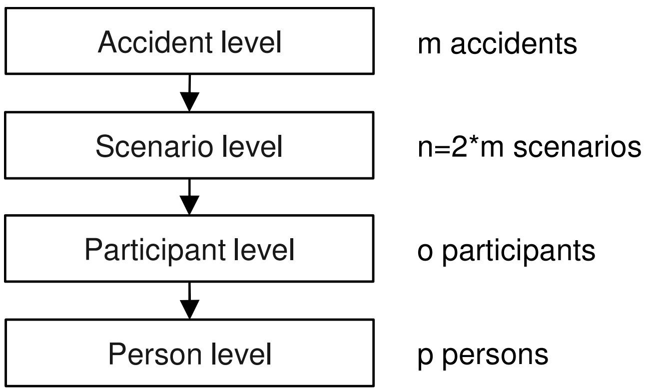


Figure 06: Different levels of accident data analysis

Knowledge of the safety functions and systems is essential for creating an accident scenario catalogue. In the first step of the described method, sensor-equivalent accident types are clustered. In step three and four, system-unspecific scenarios are combined and system-specific scenarios are separated, respectively. Without the detailed information on the functionality and performance of used environment sensors and viable active safety systems, accident scenarios cannot meaningfully defined. Conversely, the accident scenarios are subject to adaptations due to new technological developments in sensor technology, algorithms and actuators, deployed in active safety systems.

By detailed analysis within specific accident scenarios, the requirements regarding the sensor recognition quality, the algorithm functionality and the actuation of the corresponding ADAS can be derived. For this purpose, the field-of-action of the ADAS is examined and the effectiveness is evaluated by prospective simulation. Figure 07 shows the interaction between the definition of accident scenarios and the generation of requirements for the active safety system.

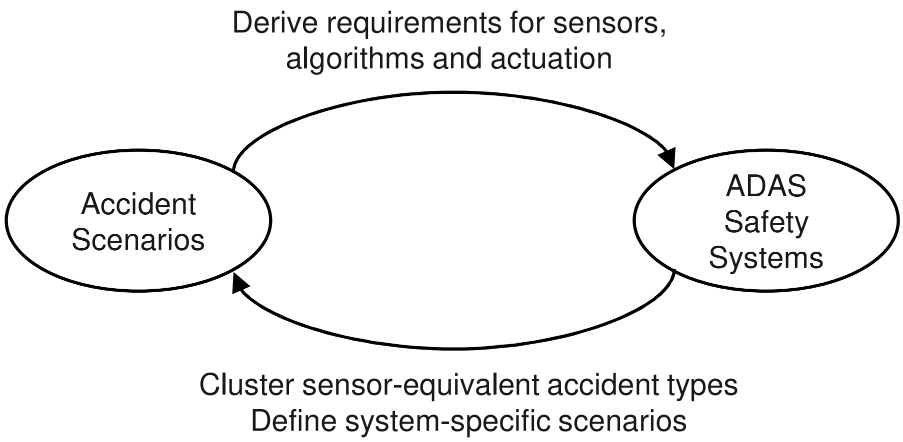
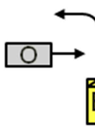
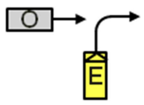
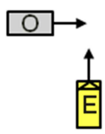
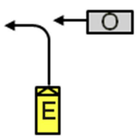
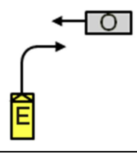
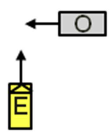


Figure 07: Interaction between system development accident scenarios definition

Every accident can be viewed and addressed from the point of view of the first or the second participant. Therefore, every accident is covered by two reciprocal accident scenarios. Thus, at the scenario level, the accident analysis can preferably be performed from the perspectives of both participants involved. During a participant exchange, both participants are considered as ego vehicle and as object vehicle, respectively.

The relevance of a safety system results from the sum of possibilities to prevent the corresponding accidents. Each accident can be addressed by both participants within two reciprocal scenarios. For example, accidents between two passenger cars can be prevented by appropriate safety systems in both cars. Table 03 shows crossing collisions from the point of view of both participants. Identical crossing-from-left scenarios from the perspective of participant 1 correspond to crossing-from-right scenarios from the perspective of participant 2. An ADAS that prevents intersection accidents can become active in both scenarios. It can also be seen in this example, more degrees of freedom are defined for the ego vehicle than for the object vehicle, to emphasis the driving intention of the ego vehicle.

Table. 03: Reciprocal crossing scenarios

First participant as ego		
T4 	T10 	C2 
Second participant as ego		
T9 	T14 	C1 

5. EXAMPLE

The methodology is demonstrated using an example with accidents between cars and motorcycles. Both, the cars and the motorcycles are depicted in the role of the ego vehicle. Requirements can be derived for the development of advanced driver assistance systems (ADAS) and of advanced rider assistance systems (ARAS).

The scenarios are then grouped in four scenario bundles:
- Crossing
- Motorcycle run-up
- Car run-up
- Oncoming

Figures 08 and 09 show the distribution of accident bundles for accidents between cars and motorcycles from both perspectives.

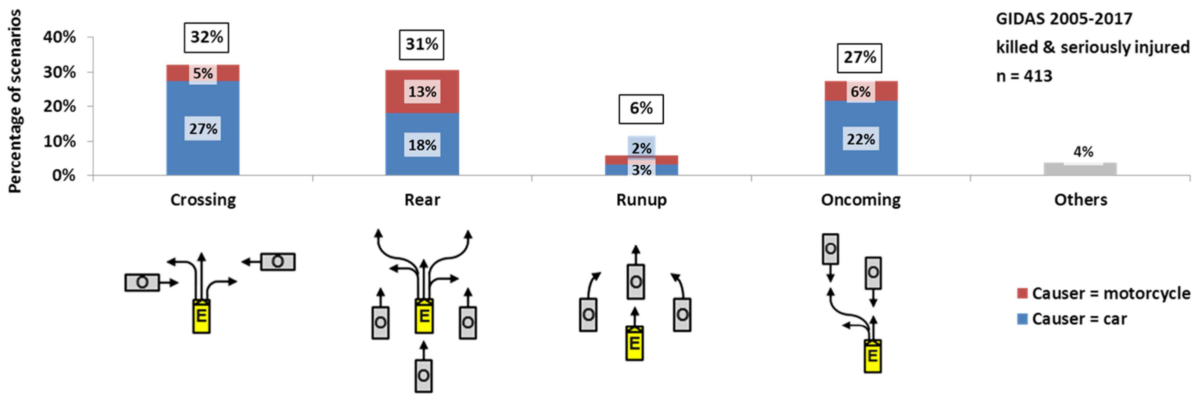


Figure 08: ADAS perspective: Ego=car, object=motorcycle

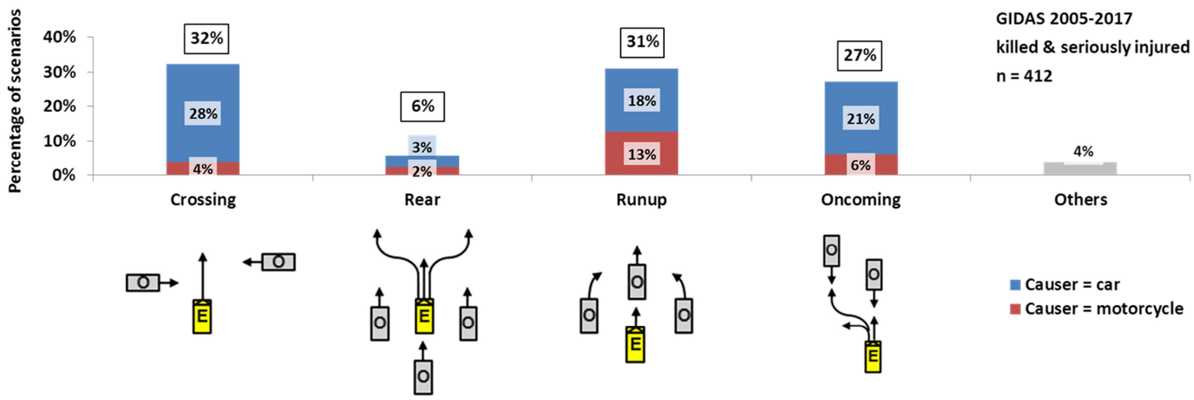


Figure 09: ARAS perspective: Ego=motorcycle, object=car

In Annex 2 the accident scenarios between cars and motorcycles are listed in tables 04 and 05. The scenarios bundles are listed in tables 06 to 09.

5. DISCUSSION

The method describes a systematic approach for analysing the accident occurrence or a particular participant configuration. In several steps, accidents types are clustered to accident scenarios. These allow a description of the field-of-action of active safety systems and are also used as input vectors for the effectiveness evaluation by simulation.

Ideally automated data mining tools are used for the scenario-based accident analysis and the visualisation of the results. These can be adapted to regional specifics of different worldwide in-depth databases.

The method was demonstrated using a case example with accidents between cars and motorcycles. From the point of view of the cars and the motorcycles, the complete accident occurrence could be presented using four scenario bundles, which will the basis for the development of corresponding ADAS or ARAS systems.

Annex 1 shows example the accident analysis between car and motorcycles using the proposed accidents scenarios.

The following advantages of the method could be demonstrated:

- Accident data analysis is based on a small set of abstract accident scenarios
- Scenarios are derived from accident types
- Scenarios describe the accident pre-crash phase
- Scenarios are independent of the involved participants (no participant-binding)
- Scenarios are independent of the accident causer (no causer-binding)
- Scenarios are system-specific
- Scenarios are basis for ADAS and ARAS development
- Scenarios are basis for field-of-action analysis and effectiveness evaluation
- Comparable accident research results from different sources
- Applicable to worldwide databases
- Focus on visual sensors, such as radar and camera

These limitations need to be considered:

- Limitation to the casual conflict situation
- Not applicable for passive safety systems
- Application for V2V requires an extension of the scenario catalogue

Annex 2 shows the proposed scenario catalogue and the composition of accident scenarios from accident types.

REFERENCES

1 Ulbrich S., et al. Defining and Substantiating the Terms Scene, Situation and Scenario for Automated Driving. IEEE 2015.
2 German Insurance Association (GDV). Accident Types Catalogue 2016.
3 Op den Camp O., et al. Cyclist Target and Test Setup for Evaluation of Cyclist-Autonomous Emergency Braking. International Journal of Automotive Technology 2017.
4 German In-Depth Accident Study GIDAS Codebook.
5 China In-Depth Accident Study CIDAS Codebook.
6 Road Accident Sampling System India RASSI Codebook.
7 Initiative for the Global Harmonisation of Accident Data iGLAD Codebook.

8 FARS / CRSS Coding and Validation Manual 2016.
9 Page Y., et al. A comprehensive and harmonized method for assessing the effectiveness of advanced driver assistance systems by virtual simulation. ESV 2015.

ANNEX 1: EXAMPLE WITH ACCIDENTS BETWEEN CARS AND MOTORCYCLES

Table. 04: Combination of cars and motorcycles, from car perspective, GIDAS 2005-2017

Ego	Opponent	Scenario	Causer	Occurrence	Percentage	Bundle
Car	Motorcycle	T1	Car	18	1,0%	Rear
		T3	Car	246	13,8%	Oncoming
		T4	Motorcycle	1	0,1%	Crossing
		T4	Car	231	12,9%	Crossing
		T5	Car	209	11,6%	Rear
		T9	Car	53	2,9%	Crossing
		T10	Car	47	2,6%	Crossing
		T14	Car	8	0,5%	-
		C1	Motorcycle	20	1,1%	Crossing
		C1	Car	84	4,7%	Crossing
		C2	Motorcycle	37	2,1%	Crossing
		C2	Car	77	4,3%	Crossing
		L1	Motorcycle	2	0,1%	Run-up
		L1	Car	77	4,3%	Run-up
		L2	Motorcycle	39	2,2%	Run-up
		L3	Motorcycle	21	1,2%	Run-up
		L4	Motorcycle	298	16,6%	Rear
		L5	Car	65	3,6%	Rear
		L6	Car	87	4,9%	Rear
		On1	Motorcycle	72	4,0%	Oncoming
		On2	Car	35	1,9%	Oncoming
		S1	Car	2	0,1%	-
		S2	Car	2	0,1%	-
		B	Car	30	1,7%	-
		Rest		32	1,8%	
		Total		1793		
		Bundles		Occurrence	Percentage	
		1) Crossing		550	31%	96%
		2) Rear		676	38%	
		3) Run-up		139	8%	
		4) Oncoming		353	20%	

Table. 05: Combination of cars and motorcycles, from motorcycle perspective, GIDAS 2005-2017

Ego	Opponent	Scenario	Causer	Occurrence	Relative	Bundle
Motorcycle	Car	T1	Motorcycle	2	0,1%	-
		T3	Car	9	0,5%	-
		T3	Motorcycle	26	1,4%	-
		T4	Car	5	0,3%	Crossing
		T4	Motorcycle	8	0,5%	Crossing
		T5	Motorcycle	25	1,4%	-
		T9	Car	3	0,2%	Crossing
		T9	Motorcycle	5	0,3%	Crossing
		T10	Motorcycle	4	0,2%	Crossing
		T14	Car	2	0,1%	-
		T14	Motorcycle	3	0,2%	-
		C1	Car	364	20,3%	Crossing
		C1	Motorcycle	31	1,7%	Crossing
		C2	Car	142	7,9%	Crossing
		C2	Motorcycle	8	0,4%	Crossing
		L1	Car	10	0,5%	-
		L1	Motorcycle	298	16,6%	Run-up
		L2	Car	296	16,5%	Run-up
		L3	Car	81	4,5%	Run-up
		L4	Car	77	4,3%	Rear
		L5	Motorcycle	19	1,1%	Rear
		L6	Motorcycle	15	0,8%	Rear
		On1	Car	277	15,5%	Oncoming
		On2	Motorcycle	38	2,1%	Oncoming
		B	Motorcycle	2	0,1%	-
		Rest		43	2,4%	
		Total		1792		
		Bundles		Occurrence	Relative	
		1) Crossing		570	32%	93%
		2) Run-up		675	38%	
		3) Rear		110	6%	
		4) Oncoming		315	18%	

Table. 06: Bundle with relevant crossing scenarios

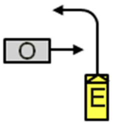
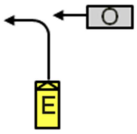
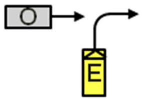
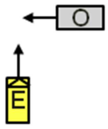
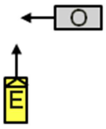
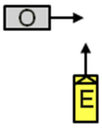
Car is Ego				
T4 	T9 	T10 	C1 	C2 
12.9%	2.9%	2.6%	5.8%	6.4%
Motorcycle is Ego				
C1 	C2 			
22.0%	8.0%			

Table. 07: Bundle with relevant motorcycle-run-up scenarios

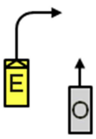
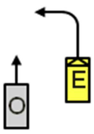
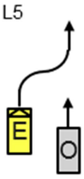
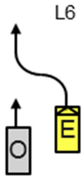
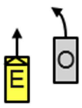
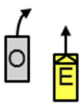
Car is Ego				
T1 	T5 	L4 	L5 	L6 
1.0%	11.6%	16.6%	3.6%	4.9%
Motorcycle is Ego				
L1 	L2 	L3 		
17.1%	16.5%	4.5%		

Table. 08: Bundle with relevant car-run-up scenarios

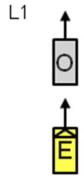
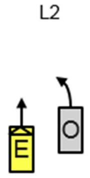
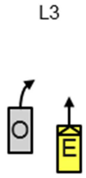
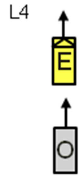
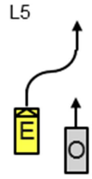
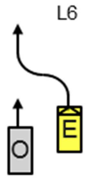
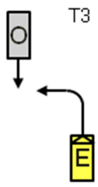
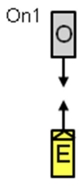
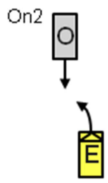
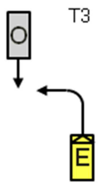
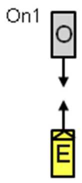
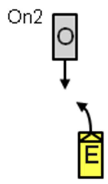
Car is Ego		
		
4.4%	2.2%	1.2%
Motorcycle is Ego		
		
4.3%	1.1%	0.8%

Table. 09: Bundle with relevant oncoming scenarios

Car is Ego		
		
13.8%	4.0%	1.9%
Motorcycle is Ego		
		
1.9%	15.5%	2.1%

ANNEX 2: SCENARIO CATALOGUE AND COMPOSITION FROM ACCIDENT TYPES

Table. 10: Turning scenarios

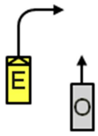
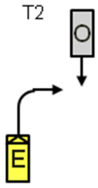
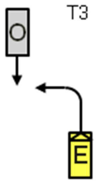
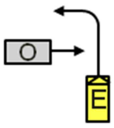
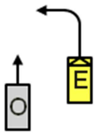
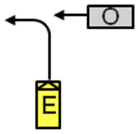
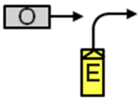
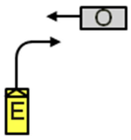
Turning		
T1 	T2 	T3 
T4 	T5 	T9 
T10 	T14 	

Table. 11: Crossing scenarios

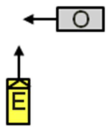
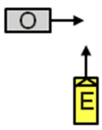
Crossing	
C1 	C2 

Table. 12: Longitudinal scenarios

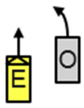
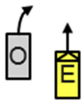
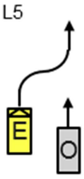
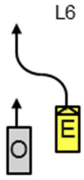
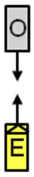
Longitudinal		
L1 	L2 	L3 
L4 	L5 	L6 
On1 	On2 	

Table. 13: Other scenarios

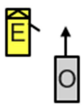
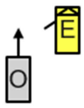
Other		
B 	S1 	S2 

Table. 14: Clustering of accident types to accident scenarios

UTYP	UTYPA	UTYPB	UTYP	UTYPA	UTYPB	UTYP	UTYPA	UTYP	UTYPA
201	L1	L4	301	C2	C1	401	C2	489	n/a
202	T5	L2	302	T4	C1	402	C2	491	C2
203	L2	n/a	303	T10	C1	403	C2	492	C1
204	T5	L2	304	n/a	n/a	404	C2	493	C1
209	n/a	n/a	305	T5	L2	405	C2	494	C2
211	T3	On1	306	T4	T14	409	C2	499	n/a
212	T3	n/a	309	n/a	n/a	411	C2		
213	n/a	n/a	311	C2	C1	412	C2		
214	n/a	n/a	312	T4	C1	413	C2		
215	T3	T3	313	T10	C1	414	C2		
219	n/a	n/a	314	n/a	n/a	419	C2		
221	T5	n/a	315	T5	L2	421	C1		
222	T3	n/a	319	n/a	n/a	422	C1		
223	T5	n/a	321	C1	C2	423	C1		
224	T3	n/a	322	T9	C2	424	C1		
225	n/a	n/a	323	T14	C2	429	C1		
229	n/a	n/a	324	n/a	n/a	431	C2		
231	L1	L4	325	On2	On1	432	C2		
232	T1	L3	326	T14	T4	433	C2		
233	T1	L3	329	n/a	n/a	434	C2		
239	n/a	n/a	331	C1	C2	435	C2		
241	T1	n/a	332	T9	C2	436	C2		
242	T2	n/a	333	T14	C2	439	C2		
243	T1	n/a	334	n/a	n/a	441	C2		
244	T2	n/a	335	On2	On1	442	C2		
245	n/a	n/a	339	n/a	n/a	443	C2		
249	n/a	n/a	341	C2	n/a	444	C2		
251	L5	L3	342	C1	n/a	449	C2		
252	L6	L2	343	C2	n/a	451	C1		
259	n/a	n/a	344	C1	n/a	452	C1		
261	C1	T4	349	n/a	n/a	453	C1		
262	C2	T14	351	On1	T3	454	C1		
269	n/a	n/a	352	C2	T9	455	C1		
271	C1	C2	353	C1	C2	459	C1		
272	n/a	n/a	354	T3	On1	461	C2		
273	n/a	n/a	355	C1	C2	462	C2		
274	n/a	n/a	359	n/a	n/a	463	C2		
275	n/a	n/a	361	n/a	n/a	464	C2		
279	n/a	n/a	362	n/a	n/a	465	C2		
281	T3	On1	363	n/a	n/a	469	C2		
282	n/a	n/a	364	n/a	n/a	471	C1		
283	n/a	n/a	369	n/a	n/a	472	C1		
284	n/a	n/a	371	C1	n/a	473	C1		
285	n/a	n/a	372	C2	n/a	479	C1		
286	T14	T4	373	L2	n/a	481	T5		
289	n/a	n/a	374	L2	n/a	482	T3		
299	n/a	n/a	379	n/a	n/a	483	T2		
			399	n/a	n/a	484	T1		

UTYP	UTYPA	UTYPB	UTYP	UTYPA	UTYPB	UTYP	UTYPA	UTYPB
501	L1	L4	601	L1	L4	701	n/a	n/a
502	L1	L4	602	L1	L4	702	n/a	n/a
509	n/a	n/a	603	L1	L4	703	n/a	n/a
511	L6	L2	604	L1	L4	709	n/a	n/a
512	L5	L3	609	L1	L4	711	B	L1
519	n/a	n/a	611	L1	L4	712	B	L1
521	On2	On1	612	L1	L4	713	B	n/a
531	L1	n/a	613	L1	L4	714	B	C1
532	L1	n/a	614	L1	L4	715	B	C2
533	L1	n/a	619	L1	L4	719	B	n/a
534	L1	n/a	621	L1	L4	721	T5	L2
539	n/a	n/a	622	L1	L4	722	T3	On1
541	L1	L4	623	L1	L4	723	T3	On1
542	L1	L4	624	L1	L4	724	n/a	n/a
543	On2	On1	629	L1	L4	729	n/a	n/a
549	n/a	n/a	631	L6	L2	731	O2	n/a
551	L6	L2	632	L6	L2	732	O2	n/a
552	L5	L3	633	L6	L2	741	O2	n/a
553	On2	On1	634	L6	L2	742	O2	n/a
554	On2	On1	635	L6	L2	749	O2	n/a
559	n/a	n/a	639	L6	L2	751	O2	n/a
561	C2	C1	641	L5	L3	752	O2	n/a
562	C1	C2	642	L5	L3	753	O2	n/a
569	n/a	n/a	643	L5	L3	759	O2	n/a
571	B	C1	644	L5	L3	761	O1	n/a
572	B	C2	645	L5	L3	762	O1	n/a
579	B	n/a	646	L5	L3	763	O1	n/a
581	S2	n/a	649	L5	L3	771	n/a	n/a
582	S1	n/a	651	L5	L3	772	n/a	n/a
583	L1	L4	652	L5	L3	773	n/a	n/a
584	L1	L4	661	On2	On1	774	n/a	n/a
589	n/a	n/a	662	L1	n/a	775	n/a	n/a
591	n/a	L4	663	L1	n/a	779	n/a	n/a
592	n/a	L4	664	L1	n/a	799	n/a	n/a
593	n/a	n/a	669	n/a	n/a			
594	n/a	n/a	671	L1	n/a			
599	n/a	n/a	672	L1	n/a			
			673	L1	n/a			
			674	L1	n/a			
			679	n/a	n/a			
			681	On2	On1			
			682	On2	On1			
			683	T14	T4			
			689	n/a	n/a			
			699	n/a	n/a			