Avoidance criteria for cut-in situation

5.2.5.2. The activated system shall detect the risk of an imminent collision with a suddenly cutting in vehicle and avoid a collision,

- provided the cutting in vehicle maintains its longitudinal speed and

- when the distance between the vehicle's front and the cutting in road user's rear corresponds to a TTC calculated by the following equation:

$$TTCLaneIntrusion > vrel/(2 \cdot 6m/s^2) + [0.35s]\ ^3$$

Where:

vrel = relative velocity between both vehicles, positive for vehicle being faster than the cutting in vehicle

TTCLaneIntrusion = The TTC value when the outside of the tyre of the intruding vehicle's front wheel closest to the lane markings crosses a line 0.3 m beyond the outside edge of the visible lane marking to which the intruding vehicle is being drifted.

v_ALKS	v_cut-in	v_relative	Resulting cut-in distance
60 km/h	50 km/h	10 km/h	1,6m
60 km/h	60 km/h	0 km/h	0m

➢ **There should be a minimum cut-in distance.**

➢ **a vehicle that cuts out of this line of trucks, will not have been observed by the ALKS system previously**
➢ **Therefor greater detection time than 0,1s is needed to determine the behaviour of the cut-in vehicle.**

Example calculation of required latency

| No.	Current State of the art				Name	Description	
	Time process(ACC)		Time process(AEB)				
	Total	Process	total	Process			
1	100ms	100ms	100ms	100ms	Information in the front end	Occurrence of event till information is available in the Imager/Receiver of sensor	
2	200ms	100ms	200ms	100ms	Receiving of signal	Signal to be send to the signal processing unit	
3	500ms	300ms	1000ms	800ms	Detection	3 cycles (for ACC) 8 cycles (for AEB)	Detection function with confidence estimation , starting object tracking and classification(8 cycles)
4	600ms	100ms	1100ms	100ms	Single-sensor-object-list	Single-sensor-object-list to be checked for plausibility with other sensor-object-lists	
5	700ms	100ms	1200ms	100ms	Planning of reference-trajectory	Prediction of situation and estimation of a reference-trajectory of the object	
5'	800ms	100ms	1260ms	60ms	Planning of ego vehicle trajectory and speed		
6	820ms	20ms	1280ms	20ms	Deriving signal for actuator	Determination of the reference control value for the vehicle movement(e.g. deceleration signal)	
7	1320ms	500ms	1488ms	208ms	Reaching target value	Actuator triggering by deceleration signal until target braking value is reached	

When Cut in vehicle's lateral speed is 1.5 m/s,

820ms (Latency from detection and signal processing) **+ 250ms** (Half the latency from the pressure build-up) **= 1070ms**
→ **1.1sec**

Actual traffic observation data of Cutting-in
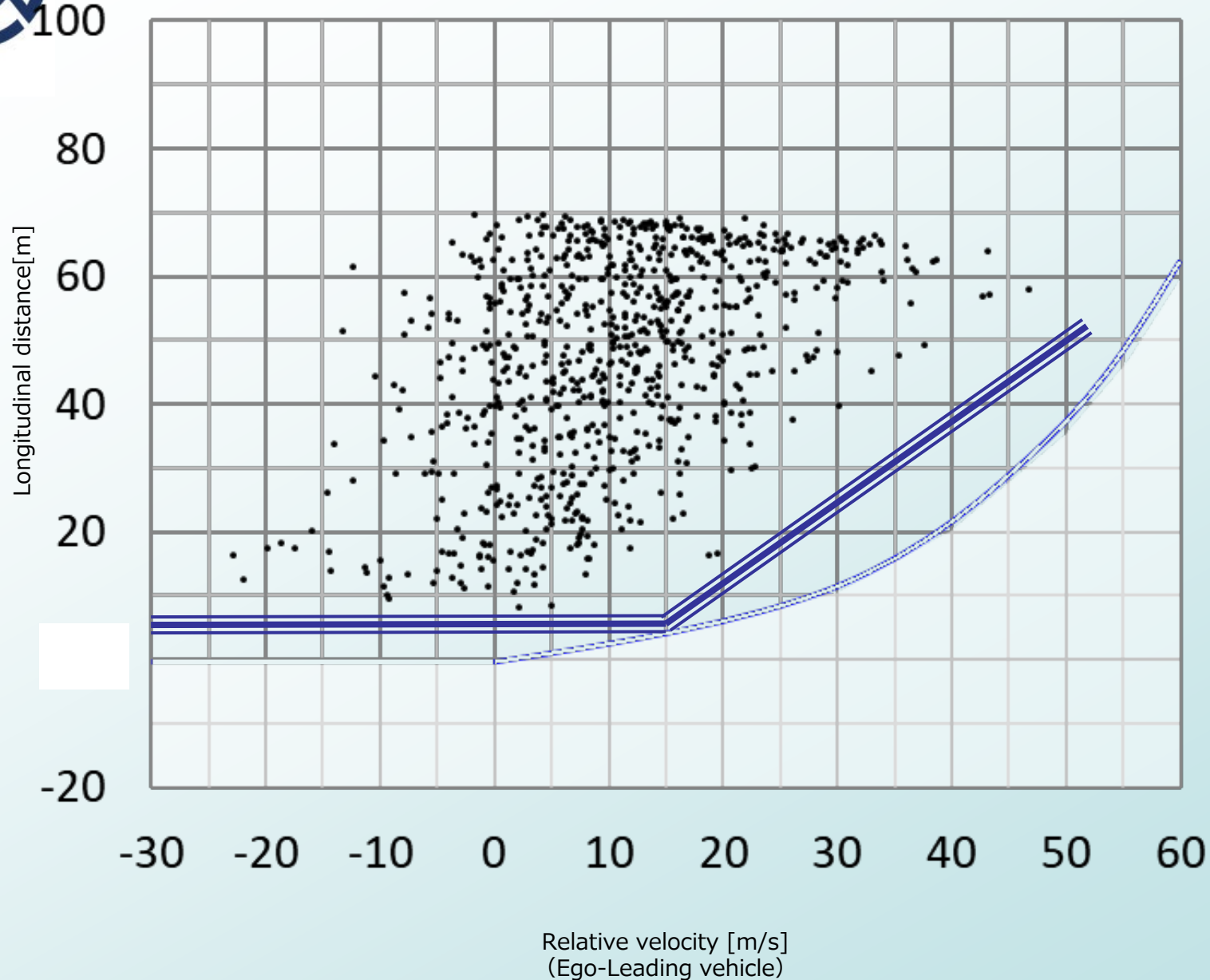
There were no cut-in maneuvers observed at a cut-in distance below 5m.

➢ **Industry propose to introduce a lower cut-in threshold of 5m distance between the two vehicles.**

5.2.5.2. The activated system shall detect the risk of an imminent collision with a suddenly cutting in vehicle and avoid a collision,

- provided the cutting in vehicle maintains its longitudinal speed and

- **When the distance between the vehicle's front and the cutting in road user's rear at the point in time when the outside edge of the respective front tyre of the intruding vehicle has crossed the inner edge of the lane marking of the ego lane by at least 30 cm is at least 5m.**

- when the distance between the vehicle's front and the cutting in road user's rear corresponds to a TTC calculated by the following equation:

$$TTCLaneIntrusion > vrel/(2 \cdot 6\text{m/s}^2) + [\mathbf{1,1}s]$$

Where:

vrel =   relative velocity between both vehicles, positive for vehicle being faster than the cutting in vehicle

TTCLaneIntrusion =   The time-to-collision value when the outside edge of the respective front tyre of the intruding vehicle has crossed the inner edge of the lane marking of the ego lane by at least 30 cm.