Future Ideas for Regulation 151

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Motivation

➲ Regulation 151-00 guarantees that drivers of heavy vehicles are notified about endangered bicyclists in due time.

➲ Main critisicm: **Information signal is given too early**

➲ Focus of this presentation: reasons and proposed improvements

➲ Presented for first feedback from GRSG members

Possible information signal timings

➲ **1** before potential swerving (as implemented in current R151)

➲ **2** for comfortable stopping (as proposed in initial document)

➲ **3** possible auto-brake activation

Figure qualitative
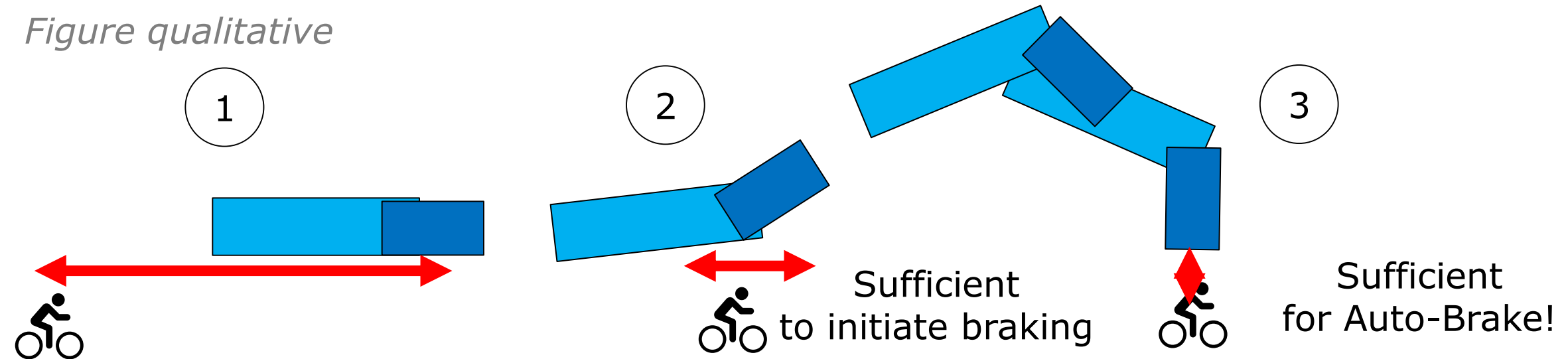
1

2

3

Sufficient
to initiate braking

Sufficient
for Auto-Brake!

➲ The BSIS shall inform the driver about nearby *bicycles that might be endangered during a potential turn, by means of an optical signal, so that the vehicle can be stopped before crossing the bicycle trajectory*.

Needs additional definitions or at least interpretation

➲ It shall also inform the driver about approaching bicycles while the vehicle is stationary *before the bicycle reaches the vehicle front, taking into account a reaction time of 1.4 seconds.* This shall be tested according to paragraph 6.6.

Clear performance requirement

➲ The BSIS shall warn the driver, by means of an optical signal, acoustical signal, haptic signal or any combination of these signals, when the risk of a collision increases.

Needs interpretation

Test Case	$v_{bicyclee}$ [km/h]	$v_{Vehicle}$ [km/h]	$d_{lateral}$ [m]	d_a [m]	d_b [m]	d_c [m]	d_d [m]	$d_{bicycle}$ [m]	$l_{corridor}$ [m]	$d_{corridor}$ [m]	For information only (not influencing test parameters)	
											Impact Position [m]	Turn Radius [m]
1	20	10	1.25	44.4	15.8	**15**	26.1	65	80	vehicle width + 1 m	6	5
2	20	10			22	**15**	32.3				0	10
3	20	20			38.3	**38.3**	65				6	25
4	10	20	4.25	22.2	43.5	**15**	43.2				0	25
5	10	10			19.8	**19.8**	65				0	5
6	20	10		44.4	14.7	**15**	26.1				6	10
7					17.7		29.1				3	10

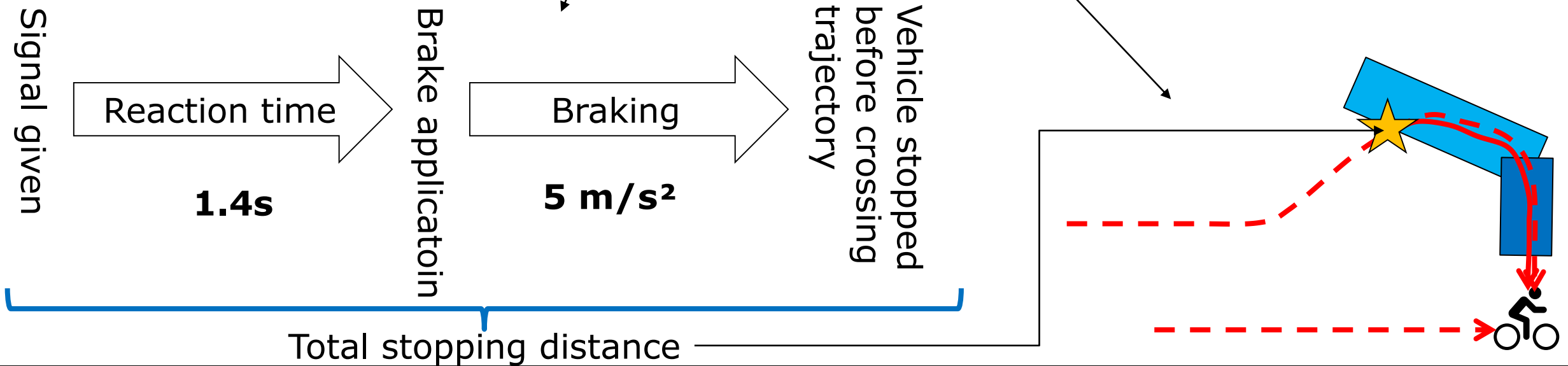*Add. Assumption: Signal activated before outside swerve (since that's not tested, as requested by Industry)*
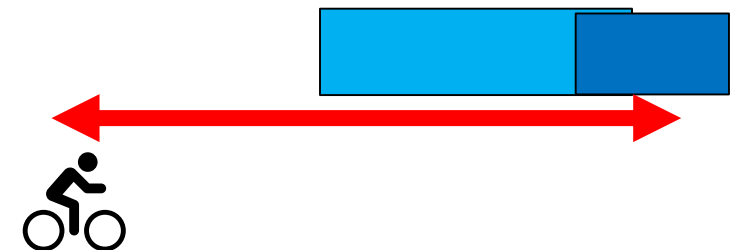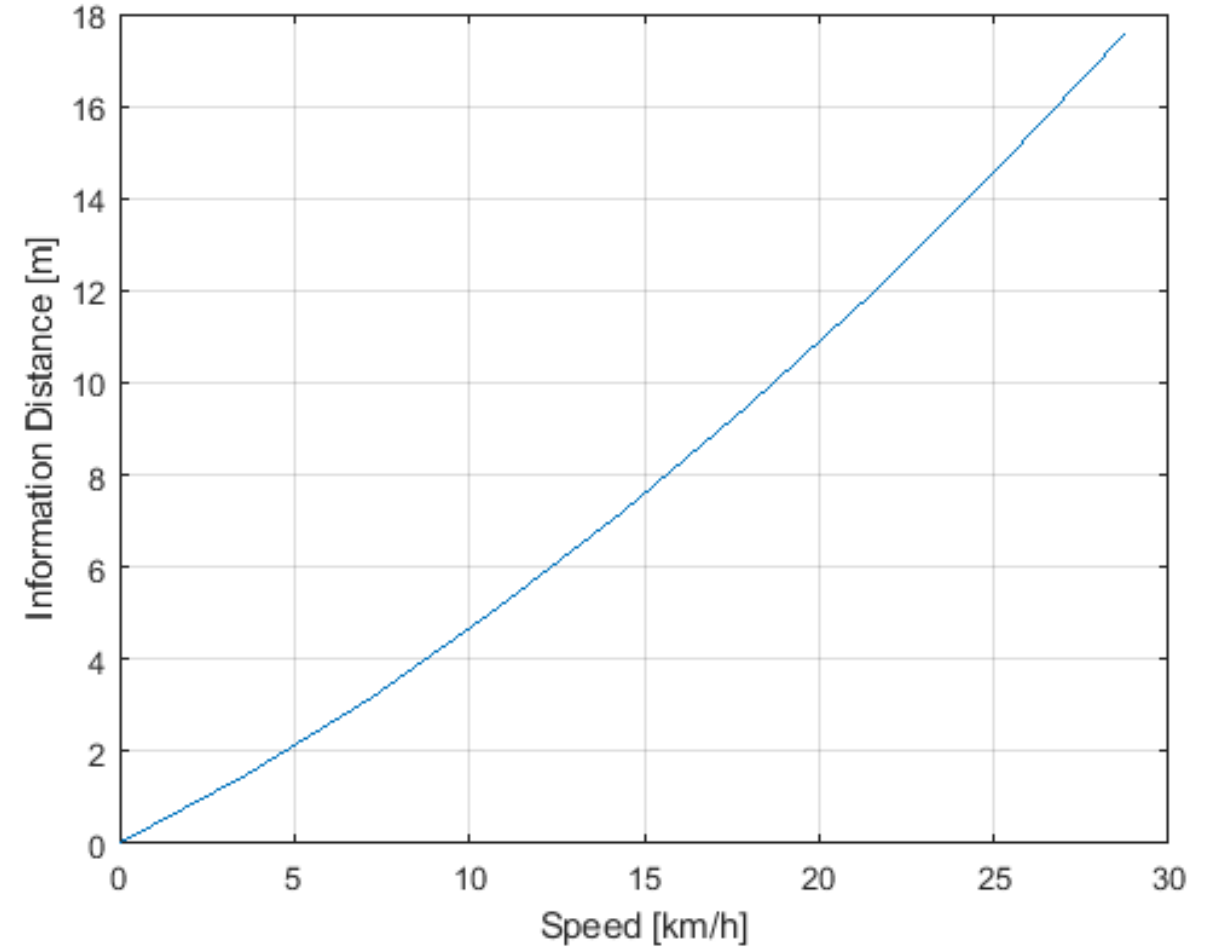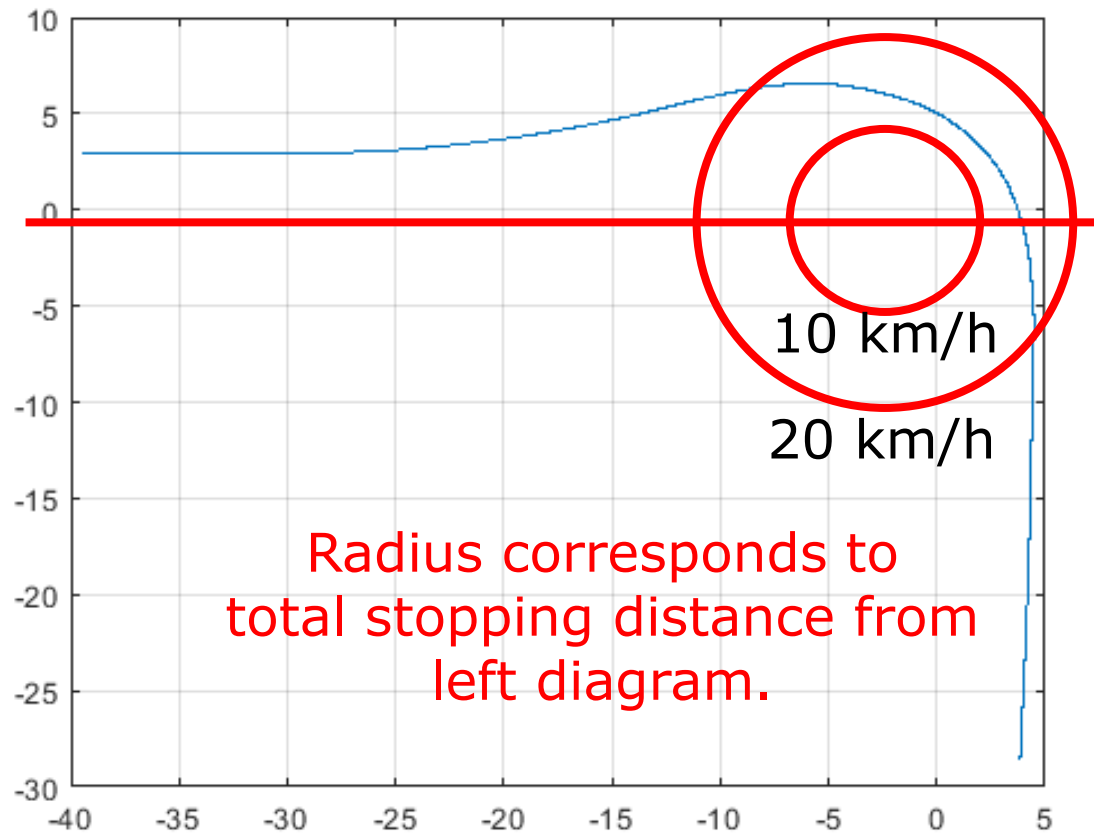
Original pass-fail criteria, including turning
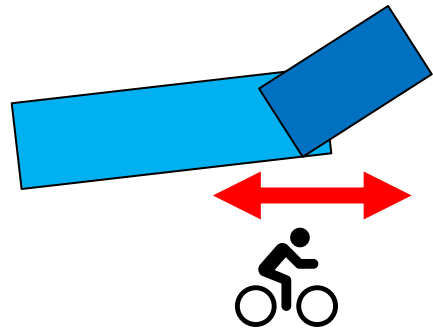
New Test Case	r_{turn}	$v_{vehicle}$ [km/h]	$v_{Bicycle}$ [km/h]	$d_{lateral}$ [m]	d_c [m]	$d_{bicycle}$ [m]	$l_{corridor}$ [m]	$d_{corridor}$ [m]	$d_{corridor,outer}$ [m]	Include cone to account for initial swerving?
1	5	10	20	1.5	**4.3**	< 55	> 70	vehicle width + 1m	5	Yes
2	10	10	20		**4.4**				2	Yes
3	25	20	20		**10.7**				1	No
4	25	20	10	4.5	**10**				1	No
5	5	10	10		**2.4**				6	Yes
6	10	10	20		**3.4**				3	Yes
7									2	Yes
8	5	10	20	1.5	**4.3**				1	No
9	10	10	20		**4.4**					No
10	5	10	10	4.5	**2.4**					No
11	10	10	20		**3.4**					No
12	10	10	20							No

Idea: What If We Could Verify The System With Robot Testing?

⮑ The BSIS shall inform the driver about nearby *bicycles that might be endangered during a potential turn, by means of an optical signal, so that the vehicle can be stopped before crossing the bicycle trajectory*.

Signal given

Reaction time

1.4s

Brake applicatoin

Braking

5 m/s²

Vehicle stopped before crossing trajectory

Total stopping distance

Vehicle Speed and Information Signal Timing

10 km/h

20 km/h

Radius corresponds to
total stopping distance from
left diagram.

Verification Approach

- Current R151 & almost all other regulations define specs (e.g. inform at this distance)
- Specifications will be verified in a test
- This limits manufacturer flexibility and requires assumptions for the system design

Validation Approach

- Define Requirements (e.g. inform in time to stop, given the driver reaction time, possibly given the vehicle deceleration)
- Validate requirements a posteriori (after impact)
- This gives maximum flexibility but also responsibility to manufacturer

# Proposal for alternative test method

- ➲ 1. When using driving and dummy robots, all vehicle movements are pre-programmed

- ➲ 2. Every vehicle location is known at all times

- ➲ 3. It is possible to verify the signal activation without impact to the dummy

- ➲ 4. It is possible to verify the signal activation in more realistic scenarios (including swerving to the outside)

- ➲ 5. It is safe to return to the „old" pass-fail-criteria!

- ➲ 6. NO changes to actual specification section in R151 required

How does it look like?

Lateral Distance: 1.75 m and Lane Width: 8 m
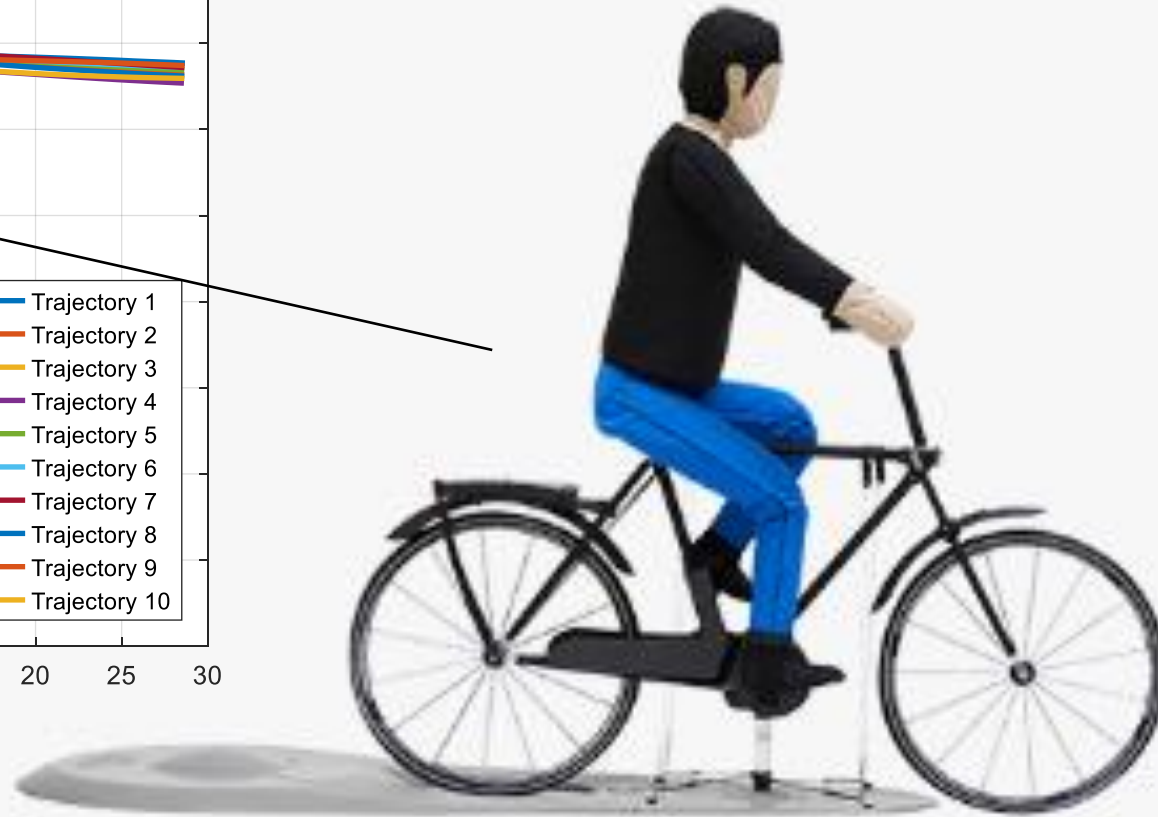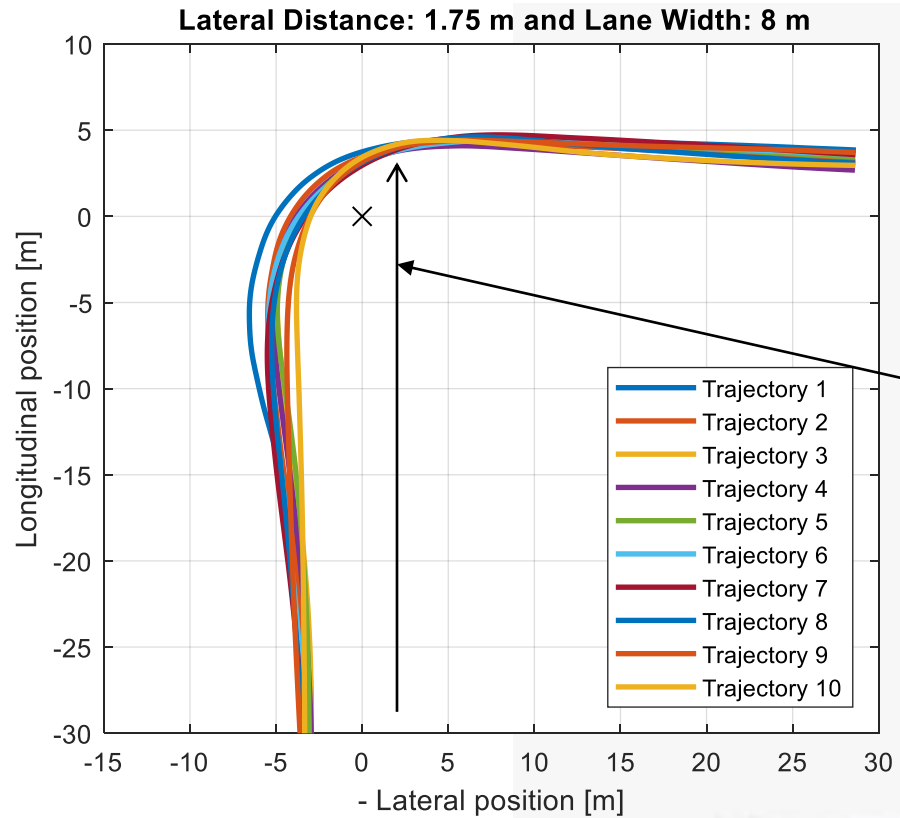
Possible BSIS and AEB timings in example trajectories

Truck positions
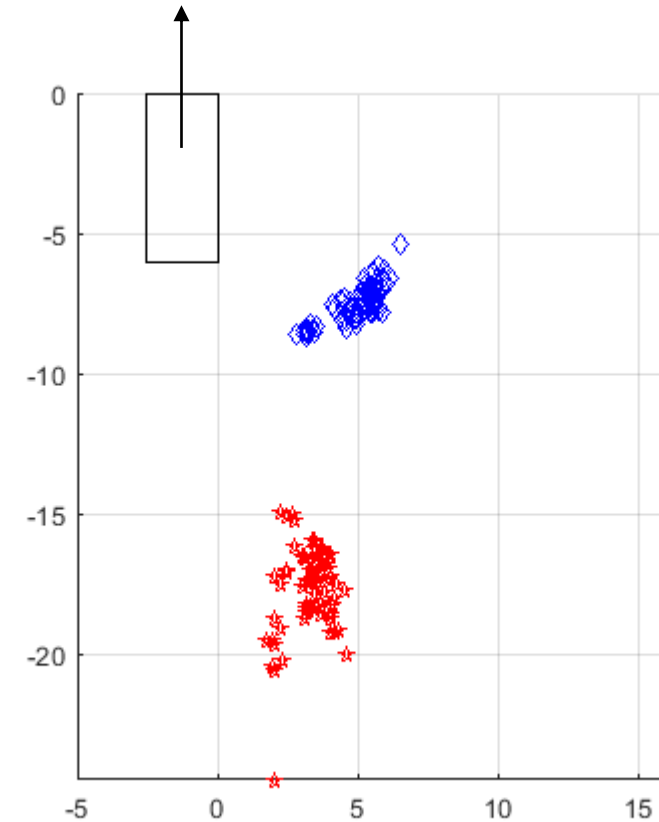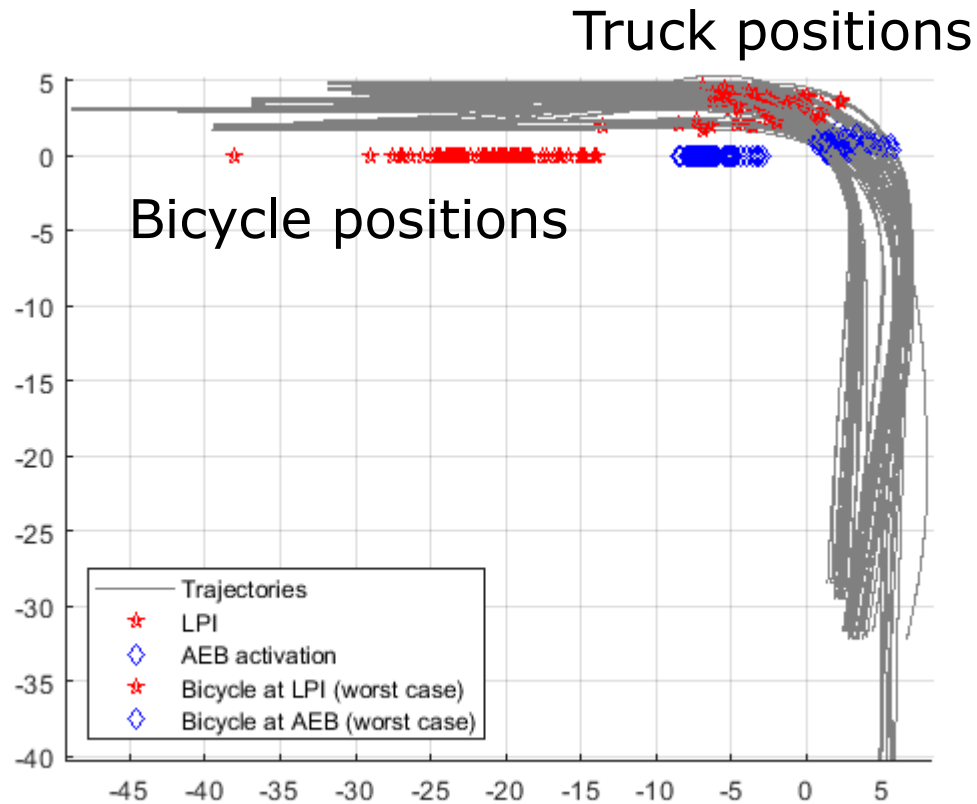
Bicycle positions

Bicycle positions
relative to truck at LPI & AEB

Conclusions

➲ When sufficiently-advanced technology is available, it will be possible to test requirements instead of specifications

➲ This will give the manufacturer much more flexiblity and responsibility

➲ This approach should be possible with introducing an alternative testing annex into R151 (no change in specs in core text!)

➲ Auto-brake could possibly be included as an alternative to the warning strategy (more requirements for AEB to be discussed intensively)