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 criticism: **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. Sufficient to initiate braking
2. Sufficient for Auto-Brake!
R151 requirements ...

- 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.
- 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.
- 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.
... & pass-fail criteria

<table>
<thead>
<tr>
<th>Test Case</th>
<th>$v_{bicycle}$ [km/h]</th>
<th>$v_{Vehicle}$ [km/h]</th>
<th>$d_{lateral}$ [m]</th>
<th>$d_a$ [m]</th>
<th>$d_b$ [m]</th>
<th>$d_c$ [m]</th>
<th>$d_d$ [m]</th>
<th>$d_{bicycle}$ [m]</th>
<th>$l_{corridor}$ [m]</th>
<th>$d_{corridor}$ [m]</th>
<th>Impact Position [m]</th>
<th>Turn Radius [m]</th>
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For information only (not influencing test parameters)

- Vehicle width + 1 m

Add. Assumption: Signal activated before outside swerve (since that's not tested, as requested by Industry)
## Original pass-fail criteria, including turning

<table>
<thead>
<tr>
<th>New Test Case</th>
<th>$r_{\text{turn}}$</th>
<th>$v_{\text{vehicle}}$ [km/h]</th>
<th>$v_{\text{Bicycle}}$ [km/h]</th>
<th>$d_{\text{lateral}}$ [m]</th>
<th>$d_c$ [m]</th>
<th>$d_{\text{bicycle}}$ [m]</th>
<th>$l_{\text{corridor}}$ [m]</th>
<th>$d_{\text{corridor}}$ [m]</th>
<th>$d_{\text{corridor,outer}}$ [m]</th>
<th>Include cone to account for initial swerving?</th>
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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 application** 5 m/s²

**Vehicle stopped before crossing trajectory**

**Total stopping distance**
Vehicle Speed and Information Signal Timing

Radius corresponds to total stopping distance from left diagram.
Paradigm Change: Require requirements

**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?
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 flexibility 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)