UNR157-07-13

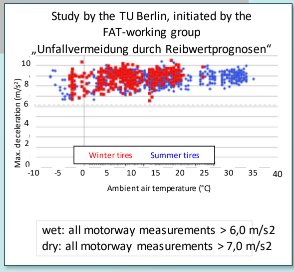
ALKS extension

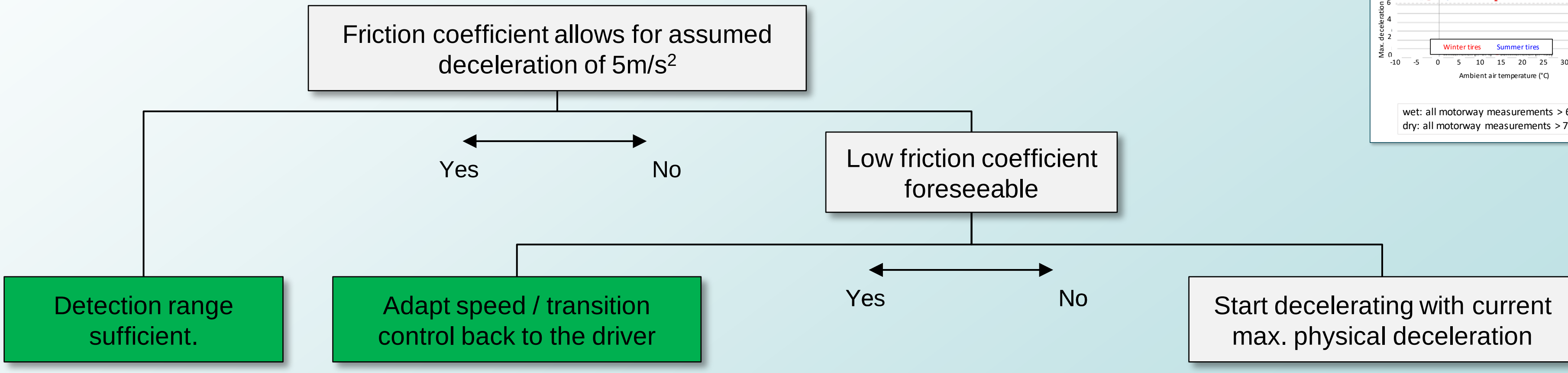
Reasonable assumptions when discussing Forward Detection Ranges

Alternative strategies for assumed deceleration values

Possible Situations

Minimum sensing requirements are derived from a worst case assumption for achievable deceleration, e.g. due to a stationary object in the lane. Research shows, that typical values for this assumed minimal deceleration are > 6.0m/s^2, even on winter tires and at temperatures sub zero (comp. GRVA-05-36, presented by BASt).
An assumed minimal deceleration of 5.0m/s^2 is in line with the ALKS requirements for emergency maneuvers (which in industry‘s view is justifyable for a suddenly appearing stationary object on a highway) and grants for an extra 20% headroom to the minimum deceleration values derived from research.



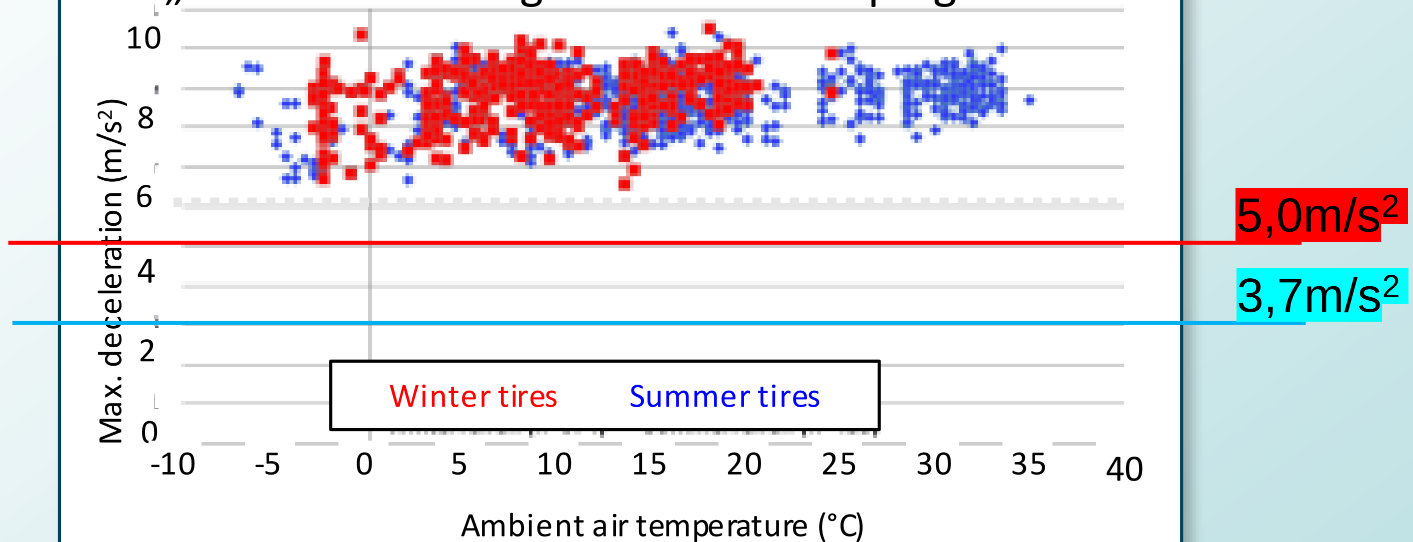


These situations are very rare. The majority of these events can safely be avoided by

- Swerving or changing lanes
- Decelerating stronger as soon as friction allows for it (a sudden drop of µ due to e.g. oil spill is typically spacially limited)
- The object disappearing itself due to pulling over, accelerating

Research on friction on highways

Study by the TU Berlin, initiated by the FAT-working group „Unfallvermeidung durch Reibwertprognosen“



wet: all motorway measurements > 6,0 m/s2
dry: all motorway measurements > 7,0 m/s2

Possible strategies in foreseeable situations

Alternative strategies with regards to sensor ranges (in case the assumed deceleration cannot be realized)

- ➢ Reduce speed based on rain sensors, temperature sensors, weather forecast.
- ➢ Dynamic locking of routes based on traffic data (construction sites, oil spill, …)
- ➢ Adapting speeds based on traffic density information (RTTI data)
- ➢ Transition control back to the driver

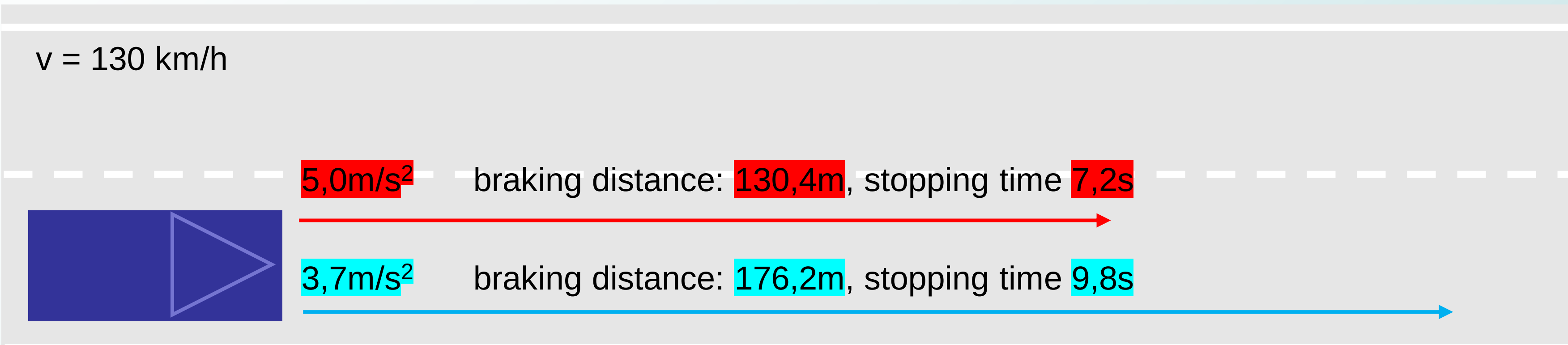
✓ **Already reflected in the ALKS regulation by some other paragraphs e.g.:**

5.2.3.2.
The activated system shall adapt the vehicle speed to infrastructural and environmental conditions (e.g. narrow curve radii, inclement weather).

7.1.3:
The ALKS shall implement strategies to detect and compensate for environmental conditions that reduce the detection range, e.g. prevent enabling the system, disabling the system and transferring the control back to the driver, reducing the speed when visibility is too low. These strategies shall be described by the manufacturer and assessed according to Annex 4.

Possible strategies in unforseeable situations

Calculation example



Time to reach 130,4m @ 3,7m/s²: 4,8s
→ 4,8s to react to the situation by adapting system strategies, e.g.

Changing lanes
Comparison Cat C lanechange maneuver commences within 3s-5s

Swerving around object
A lateral evasive maneuver of 2m with an assumed lateral acceleration of 3m/s² lasts 1,15s

Regaining better grip and decelerating stronger
In the example above, an assumed deceleration of 3,7m/s² for 2s could be compensated by braking with 6,3m/s² for the rest of the distance

Or simply the object disappearing

Other points of consideration

„looking forward“ – collision avoidance with obstacle

- Probability of detection and system response at greater distance is not a step function
- A proper assessment of the situation and deduction of an appropriate reaction pattern might not be feasible at >180m to ensure braking of 3,7m/s^2 is justified. Example scenarios: slow vehicle exiting the highway. Road maintenance clearing debris.

„looking backwards“ – controllability for rearward traffic

- A following vehicle has other available strategies than to decelerate (slide 3)
- The following vehicle is required to adapt its distance when it has poor braking capability