



Protective Braking for ACSF



Protective braking for ACSF

(indispensably needed for category E, perhaps as well for other categories)

Aim:

No collision with other road users, road furniture or other objects while using ACSF

Rationale:

- ACSF may encourage driver to carry out secondary tasks so that he is distracted or loses situation awareness
- Driver activity control may fail to detect this

Solution:

Protective Braking for ACSF



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Functionalities of ACSF protective braking:

- a) Protective braking shall ensure correct safety distances to other road users if
 - driver is not intended to control this himself
 - driver fails to control this himself

⇒ braking to adjust EGO-vehicle speed to other traffic
-> see tests EM1A and EM1B

- b) Emergency braking by the EGO-vehicle itself in case of sudden unexpected events since the time for safe transition of driving task to driver would be too short
 - ⇒ ACSF protective braking must be able to deliver full braking force to achieve maximum deceleration possible
-> see test EM2



Protective braking for ACSF

Overwriting of ACSF Protective Braking

Example situation:

- System initiates a protective braking to prevent a collision with the car in front
- Driver was inattentive, scared and intuitively grasps the steering wheel
- Driver is not aware of the current traffic situation yet, but the system may think, that the driver wants to override the function and stops the protective braking
- After the driver realized the traffic situation, the time may be too short for a manual braking ==> **accident**

Conclusion:

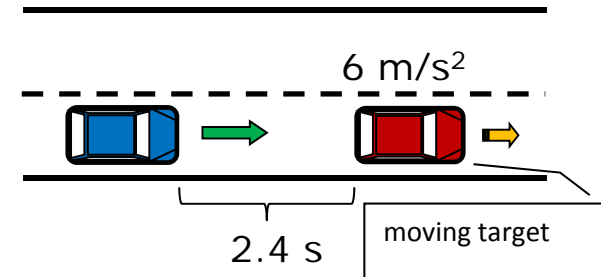
Requirements necessary to prevent unintended overwriting/stopping of the protective braking function



Protective braking for ACSF

Advantage:

- Protective Braking is independent from drivers intention. So considerations about driver reaction time are not necessary.
 - ACSF protective braking is thus not comparable to the philosophy of conventional AEB (automatic emergency braking), which brakes only at the latest possible point in time.
- > ACSF protective braking should be regulated in R 79
- > AEB(S) is regulated for trucks and buses in R 131 and might be later regulated for cars in R131 or a new Regulation



Tests for ACSF Protective Braking EM 1A (Approaching behind lead vehicle)

Basic automatic collision avoidance capability (without a lane change) if lead vehicle suddenly decelerates sharply

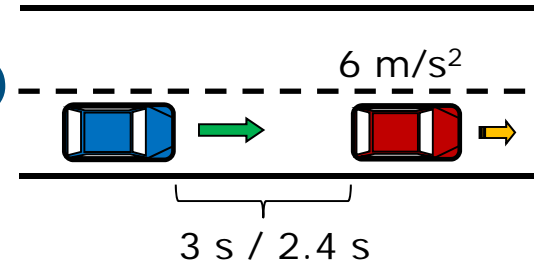
- Test speed of both vehicles “only” 80 km/h or 10 km/h below v_{smax} whatever is lower (since target allows 80 km/h driving)
- Initial time gap 2.4 s (@ 80 km/h)
- Lead vehicle deceleration 6 m/s², mean jerk 6 m/s³



Test is passed: No collision and no steering around the obstacle



EM 1A (Approaching behind lead vehicle)



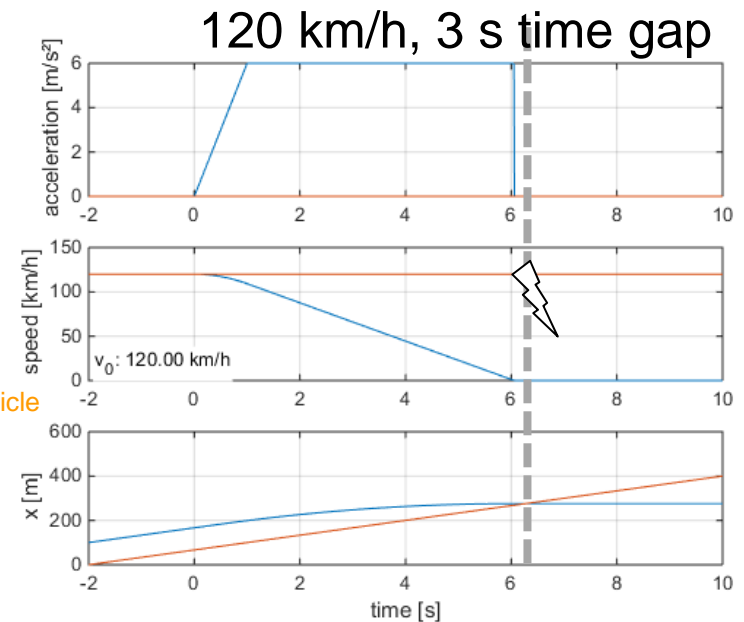
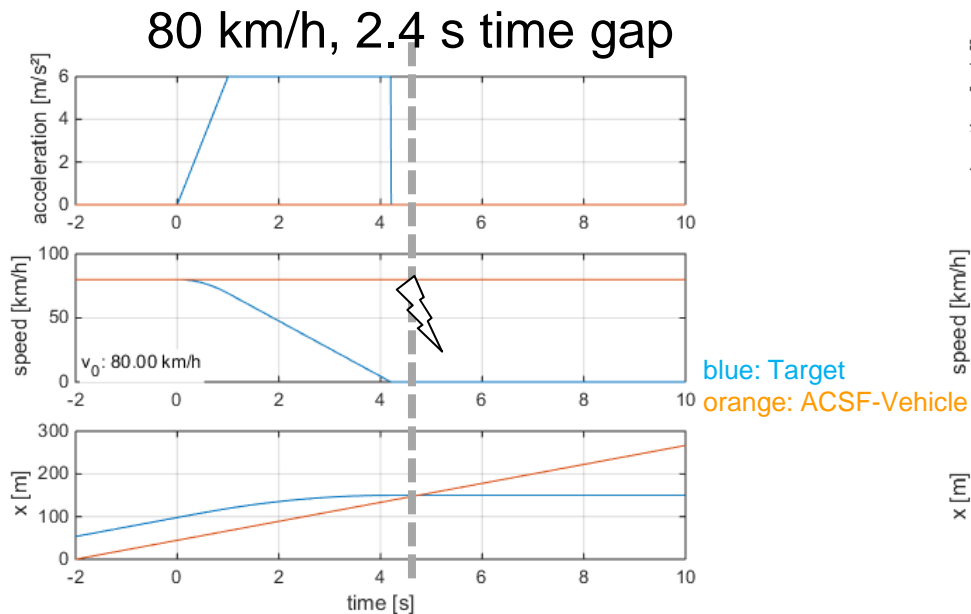
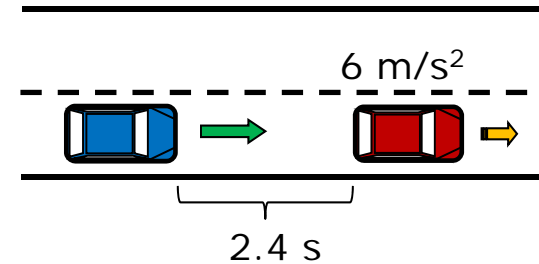
Justification

- Initial aim: Test for basic automatic collision avoidance capability (without a lane change) @ 120 km/h if lead vehicle suddenly decelerates sharply and driver is inattentive
- With 3 s initial time gap there is no time criticality for the system for detection or decision and the test would be valid for a basic braking function in this scenario
- But there is no target available for testing with 120 km/h
- For tests with 80 km/h a target would be available
- With a time gap of 3 s @ 120 km/h the target would be always at standstill before the ACSF car would reach the target.
- For a comparable criticality @ 80 km/h (Target always at standstill, even for no ACSF reaction) the initial time gap should therefore be 2.4 s (s. next page).
- Alternatively with 1.8 s initial time gap there is more time criticality for the system for detection and decision (1.8 s = recommended safety distance in Germany) and the test would be more demanding



EM 1A (Approaching behind lead vehicle)

- **Target available**
- Same criticality (Target always at standstill, even for no ACSF reaction)
- Additional EM 1B test for full speed range

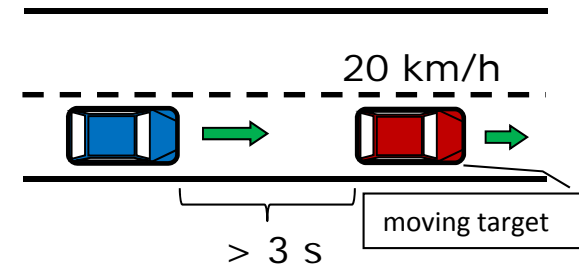




EM 1B (Approaching behind slower lead vehicle)

Basic automatic collision avoidance capability if slower lead vehicle appears and lane change is not possible

- Test speeds 10 km/h and 30 km/h below v_{smax}
- Initial time gap > 3 s
- Lead vehicle speed 20 km/h (traffic jam)



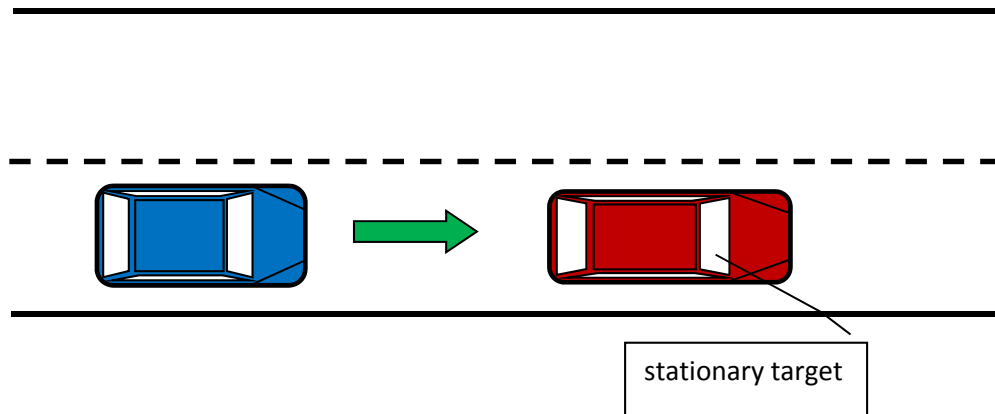
Test is passed: No collision and no steering around the obstacle



EM 2 (Approaching behind stationary car (M1) or motorcycle (L3))

Basic automatic collision avoidance capability on objects standing stationary in the lane

- Test speed 10 km/h below v_{smax}
- Initial time gap $\gg 3$ s
- M1 representative stands centered in the lane



Test is passed: No collision and no steering around the obstacle