



Informal document No. **GRSP-41-27**  
(41<sup>st</sup> GRSP, 7-11 May 2007,  
agenda item 3.1.)



# GTR Head Restraints Triggering of active systems in sled test

Peter Horn, Mercedes-Benz  
04.05.2007

# Dynamic Test of GTR / FMVSS 202a



Test conditions in GTR / FMVSS 202a:

- Complete vehicle (without tires, fluids, unsecured components)
- Vehicle fixed rigidly on test sled
- Positioning of seats and dummy (...)
- Acceleration of test platform (corridor, approx. 17 km/h, 9 g, 90 ms)

Missing definitions in GTR / FMVSS 202a:

- Triggering of active head restraints (external, internal, status of ignition, ...)
- Measuring method of head – torso angle (sensors, calculation method, ...)

# Test pulse for dynamic test

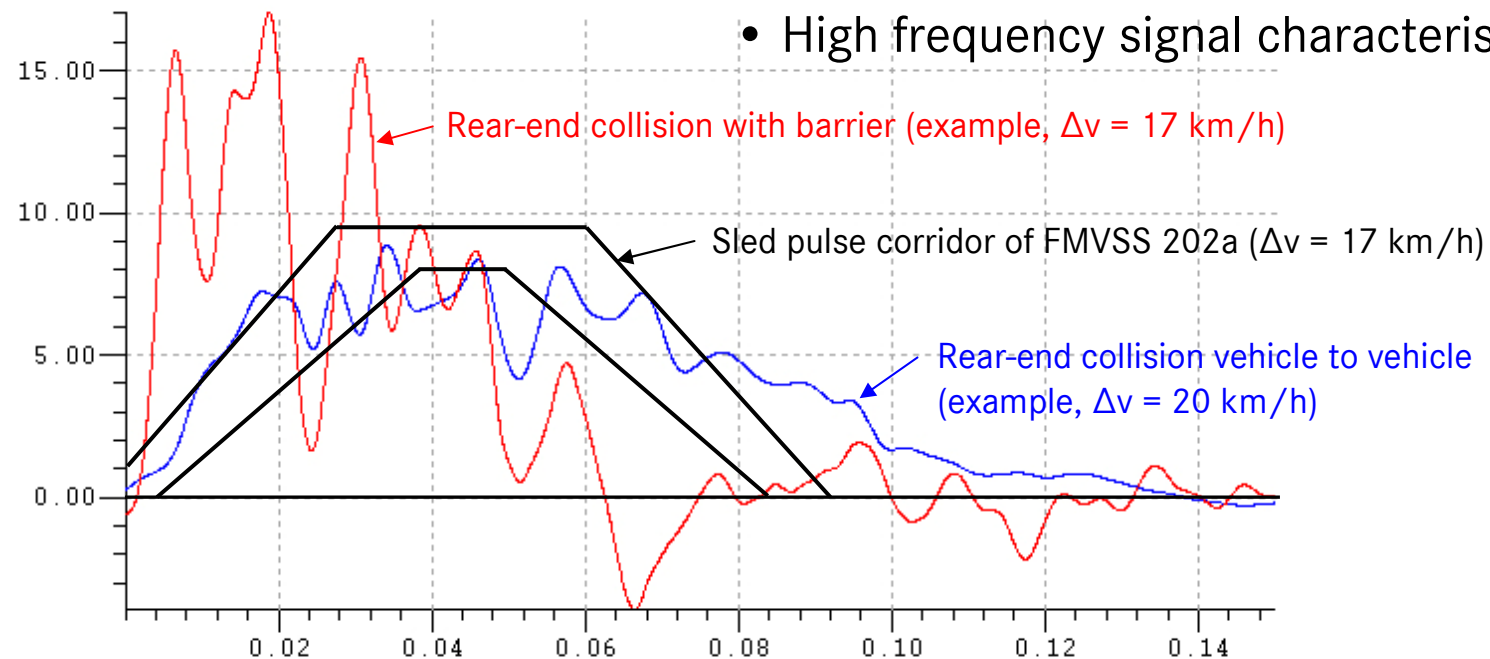


Test pulse of GTR / 202a:

- Synthetic puls, sinus form

Crash test and real world pulses:

- High gradient of acceleration at beginning
- Vehicle specific characteristics of acceleration curve
- High frequency signal characteristics

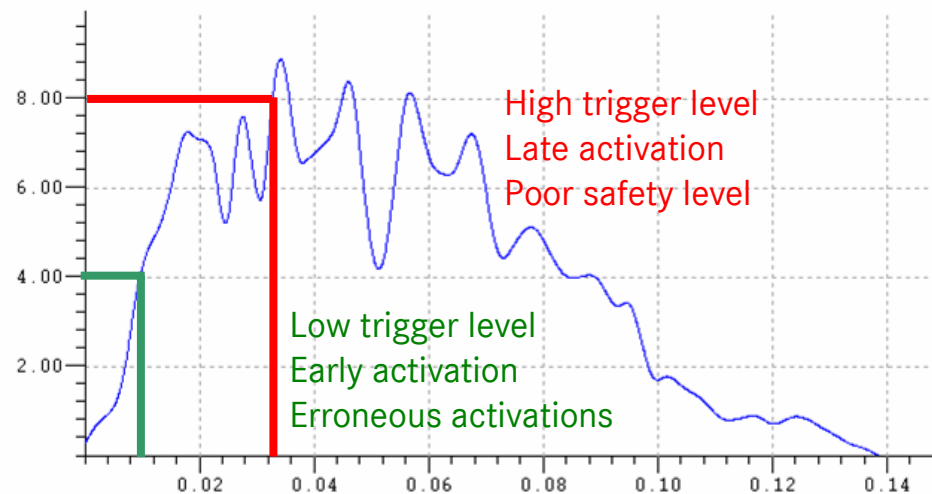


# Criteria for triggering active Systems



Acceleration:

- Acceleration currently only criteria considered by FMVSS 202a / GTR
- High triggering level leads to late deployment / poor safety level
- Low triggering level leads to fast deployment / good safety level but many erroneous system activations



Not considered in GTR:

- Vehicle weight
- Plausibility checks
- Pulse form
- Mis-use

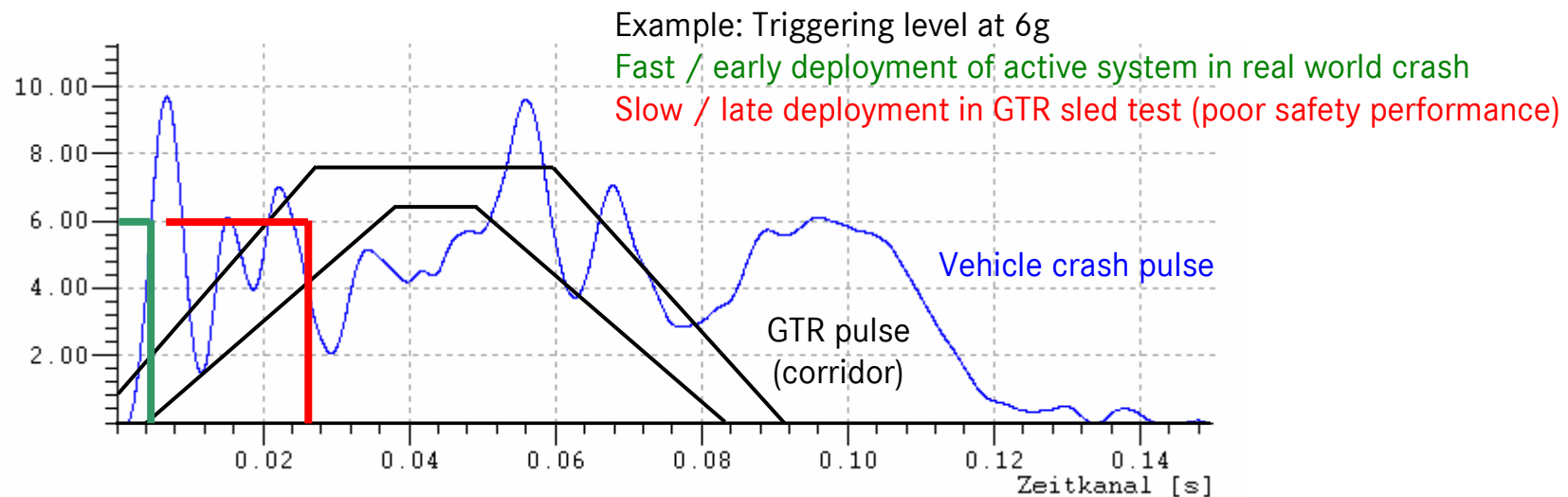
=> Active systems, designed for real world crash, may not be activated in GTR sled test

# Criteria for triggering active Systems



Vehicle weight:

- Acceleration level in rear end crash depending on vehicle weight
- Different layout of triggering algorithm necessary
- Triggering with GTR sinus pulse can lead to different / wrong triggering times in sled test compared to real world crash.



# Criteria for triggering active Systems



Plausibility checks:

Additional criteria is checked in vehicle sensor system to verify crash situation

- lateral acceleration (is typical for real world crash)
- check of additional sensors (typical time delay in signals, because acceleration is „running“ through vehicle from rear end to front end)

Additional criteria is needed to avoid erroneous system activations

These additional criteria are not available on sled (rigidly fixed vehicle has no lateral acceleration and no time delay between different sensor signals)

=> active systems (designed for real world crash) may not be activated in sled test

# Criteria for triggering active Systems



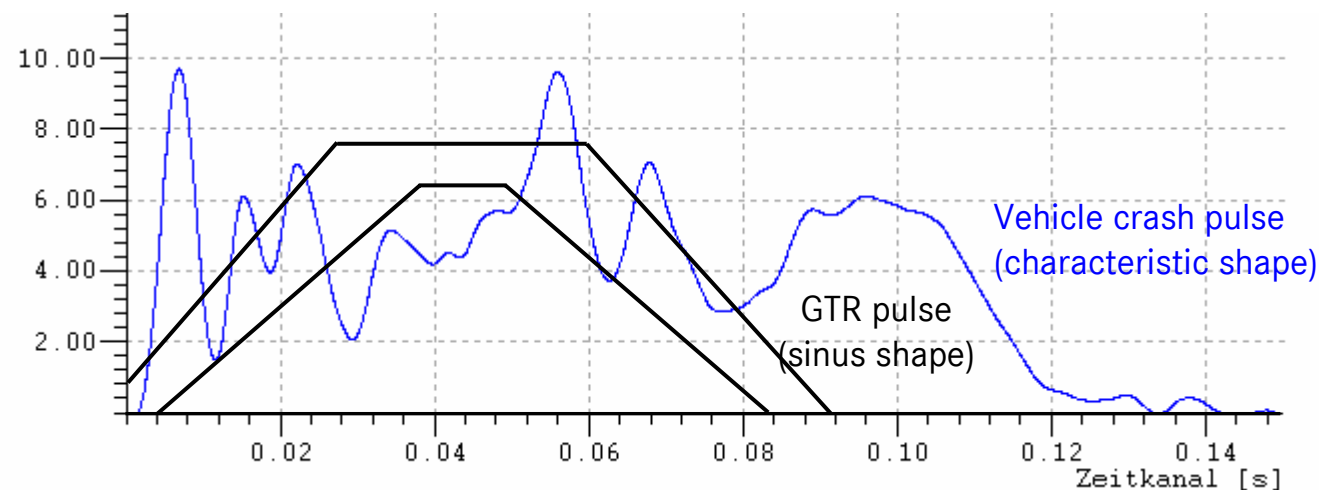
Analysis of pulse form:

Vehicle crash pulse has a typical / vehicle specific form / characteristic

- Puls form / characteristic is used for verification of crash situation
- Puls form / charecteristic can be used to get faster triggering

(puls form can be recognized before a certain acceleration level is achieved)

=> Sinus pulse of sled test may lead to late triggering time of active system



# Criteria for triggering active Systems



Avoidance of erroneous system activations:

All additional criteria (vehicle weight, plausibility checks, pulse form) are needed to get an assured deployment of the active system and to avoid erroneous activations and activations in mis-use situations like:

- Road holes
- Kerbstone
- Driving over beam
- Door strike
- Gravel trap
- Stone impact
- Rough road
- Parking minicrash
- etc.

All these criteria are not available in a FMVSS 202a / GTR sled test

Design of vehicle sensor system according to sinus sled pulse will lead to wrong triggering times, non-activations and erroneous activations of active head restraints in real world. In consequence this means a decrease of safety level and customer satisfaction.



# Summary of triggering criteria



Criteria	Explanation	Can be considered in GTR/202a test	Available in real world accident
Acceleration	<ul style="list-style-type: none"> <li>• High trigger level leads to slow / late triggering and poor safety level of active system</li> <li>• Low trigger level leads to fast /early triggering and good safety level, but also to many erroneous system activations</li> </ul>	yes	yes
Vehicle weight	<ul style="list-style-type: none"> <li>• Lower acceleration trigger level needed for heavy vehicles, higher for light vehicles to get same triggering time</li> <li>• Sinus pulse leads to different trigger times in different vehicles</li> </ul>	no	yes
Plausibility check	<ul style="list-style-type: none"> <li>• Check of simultaneous lateral acceleration (vibration of vehicle body is typical for real world crash)</li> <li>• Check of additional sensor signals (typical time delay between different sensors does not exist on sled)</li> </ul>	no rigid fixation of vehicle on sled, no deformations	yes
Pulse form	<ul style="list-style-type: none"> <li>• Evaluation of pulse characteristics (vehicle specific, steep rise, oscillations) for faster recognition and triggering</li> </ul>	no sinus pulse	yes
Mis-use	Plausibility checks and evaluation of pulse characteristics necessary to prevent mis-use and erroneous activations like: Road hole / kerbstone / door strike / gravel trap / driving over beam / stone impact / rough road / parking minicrash ...	no not possible (missing criteria)	yes

## Summary



For good safety level of active head restraints in real world accident a fast and early triggering is necessary, erroneous activations should be prevented

=> additional triggering criteria are needed (acceleration not sufficient)

These additional criteria are not available in sled test with synthetic test pulse

=> active systems may not be activated in GTR / FMVSS 202a sled test

=> Adaptation of sensor system to GTR / 202a sled test would lead to many erroneous activations of active system in real world (will not be accepted by customer, may lead to extra costs for customer)

## Conclusions:

- External triggering of active head restraints in GTR / 202a test is needed
- External triggering is already allowed in FMVSS (see FMVSS 208, S13.1)
- The vehicle specific triggering time can be obtained in a suitable rear-end crash test (to be defined)