SCHIMMELPFENNIG BECKE

Insassenbelastung unter Airbagbeteiligung bei verschiedenen Crashszenarien und Sitzhaltungen

Comparison of occupant stress in frontal collisions with varying degrees of seat belt use

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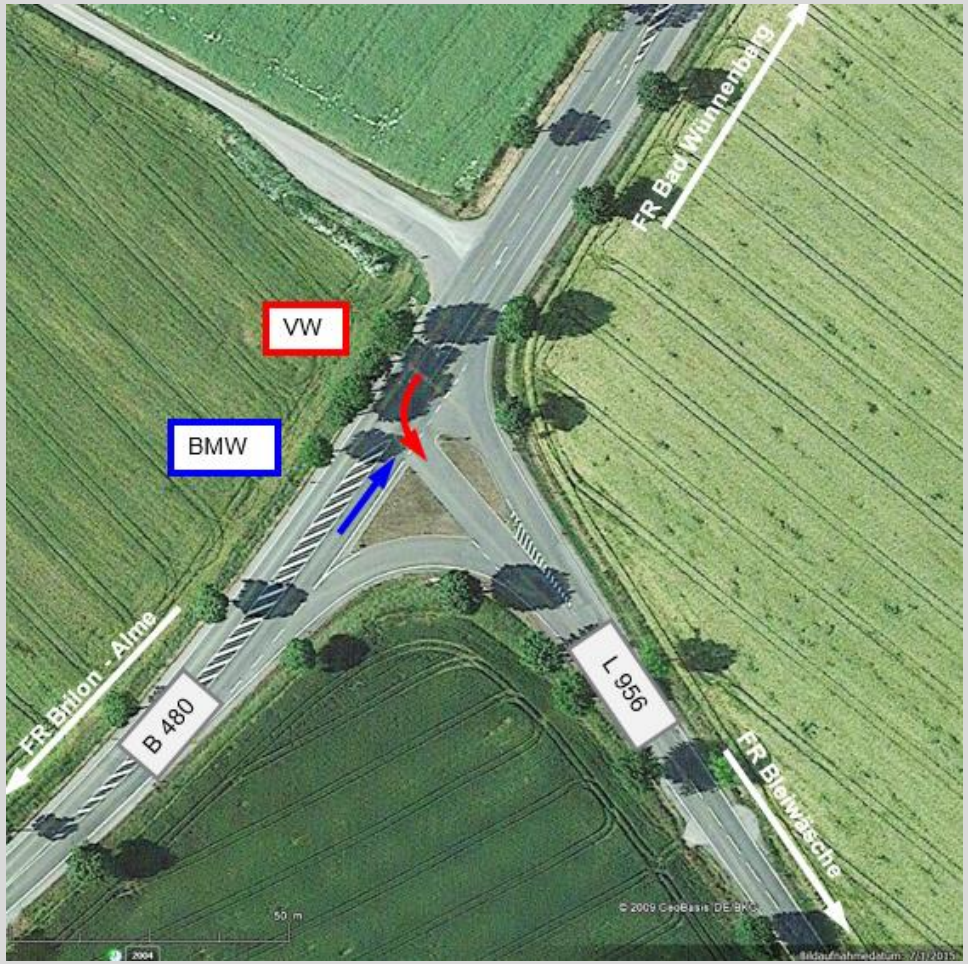
DUMMY. CRASHTEST. KONFERENZ. – 30.September - 01.Oktober 2020

Court case

- Opposing traffic collision on country road with slowly turning vehicle

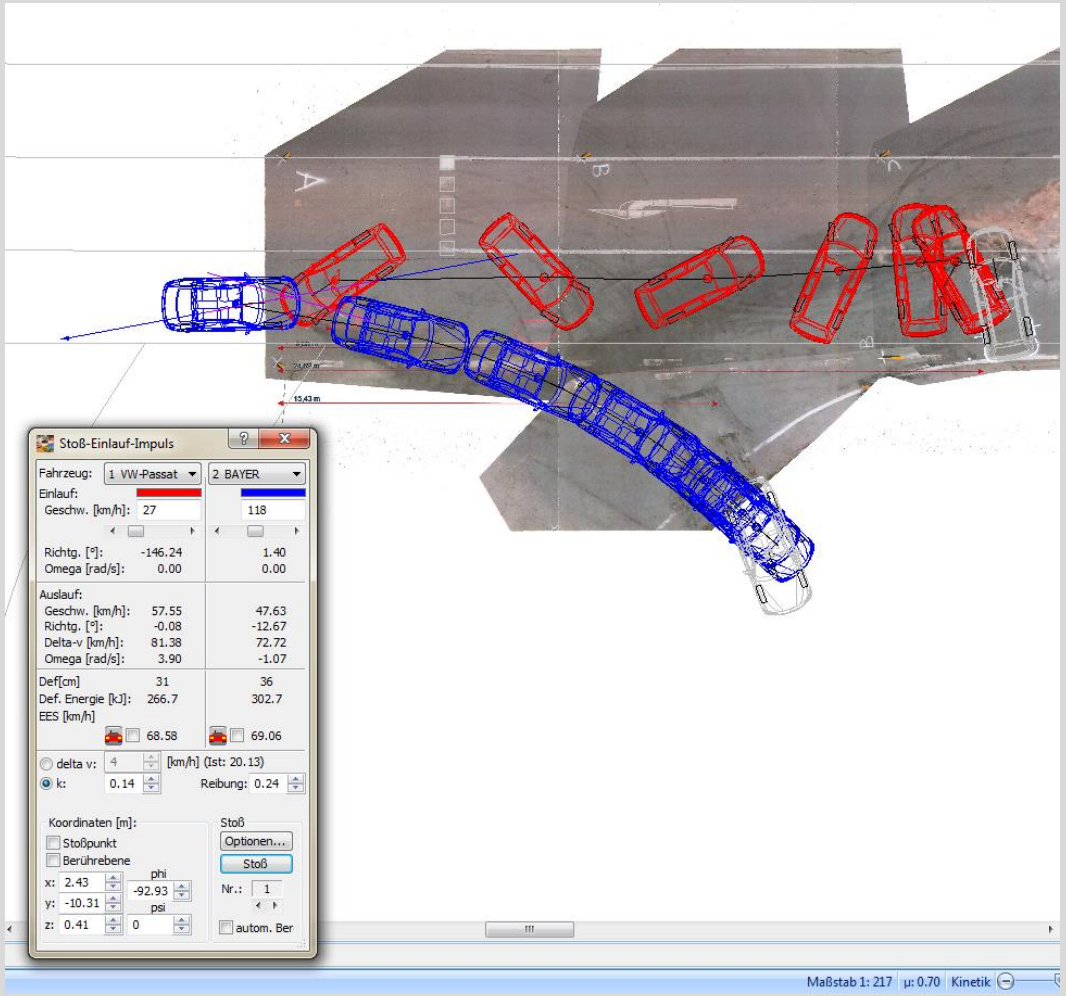


Court case

- Questions: Was the passenger wearing the seat belt properly? If not, which injuries still would have been suffered had the occupant been wearing their seat belt properly?

Court case

- Evaluation of impact velocities upon vehicle damages and rest positions



$V_{BMW} \approx 120$ kph, $V_{VW} \approx 30$ kph

- Biomechanical stress on the occupant (BMW):

  $\Delta v \approx 80$ kph

Acutal occupant injuries:

- Thorax contusion (right side)
- Knee contusion (right side)
- Complicated fracture of foot skeleton, of tarsal bone and metatarsal joint

„What is the difference in the occupants‘ biomechanical stress level?“

Structure of the series of experiments

- Three crash tests with same collision parameters, velocities and vehicle types
- Head on collision into a tree
- **All tests with airbag deployment**
- A PRIMUS breakable dummy with triaxial accelerometers in head/chest and hip
- Level of seat belt usage:

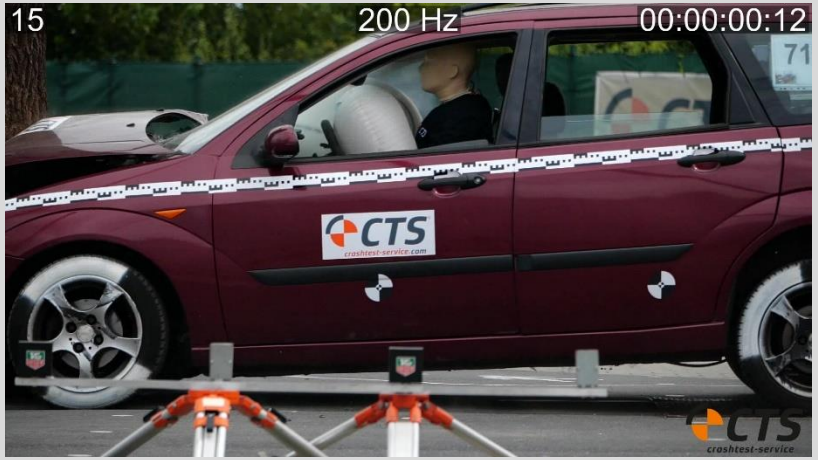
  seat belt fitted properly, seat belt worn under the left shoulder,

  not wearing a seat belt
- Autopsy of the primus dummy was conducted after each test

Unbelted dummy

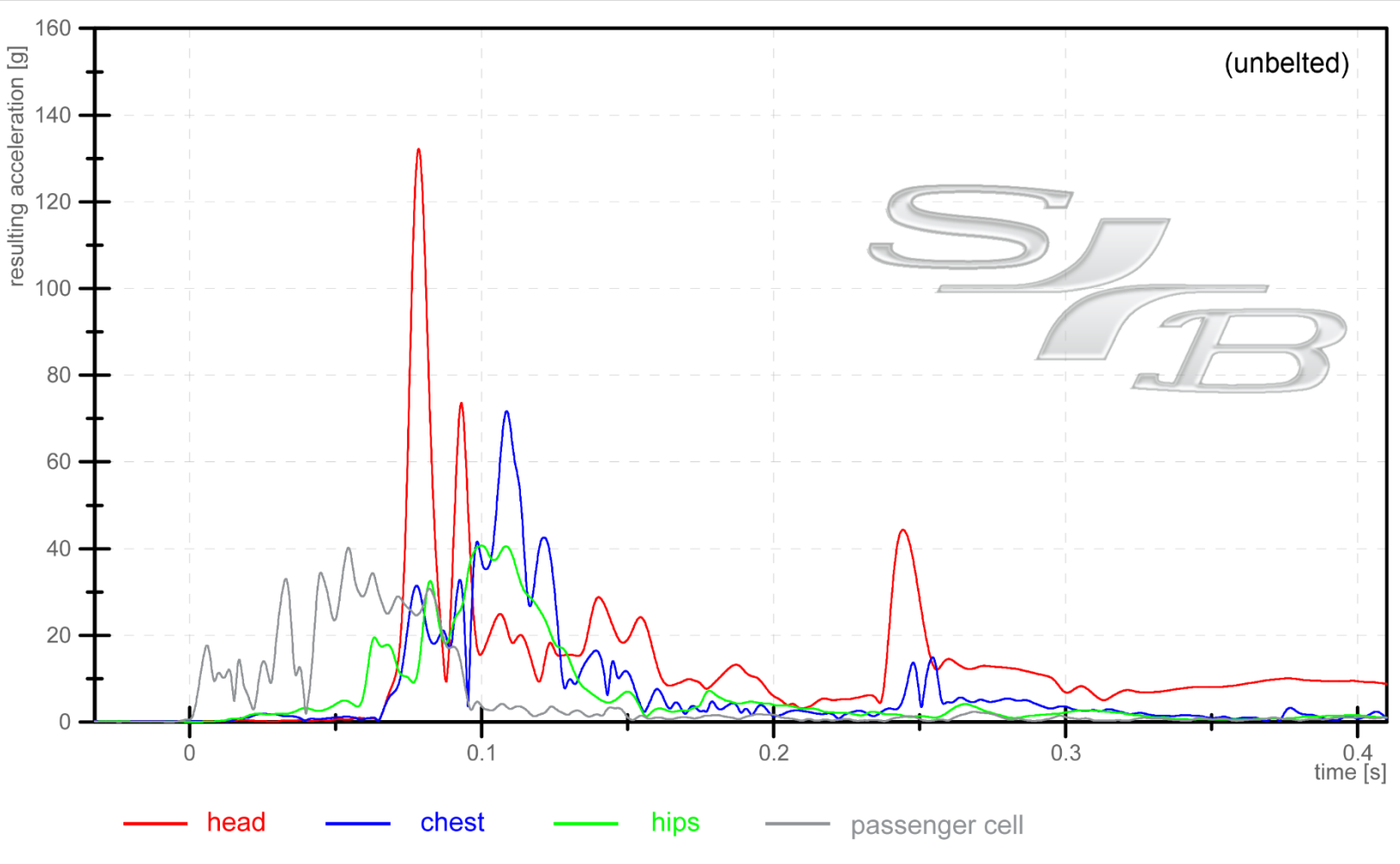
Unbelted dummy

- Motion sequence of the occupant



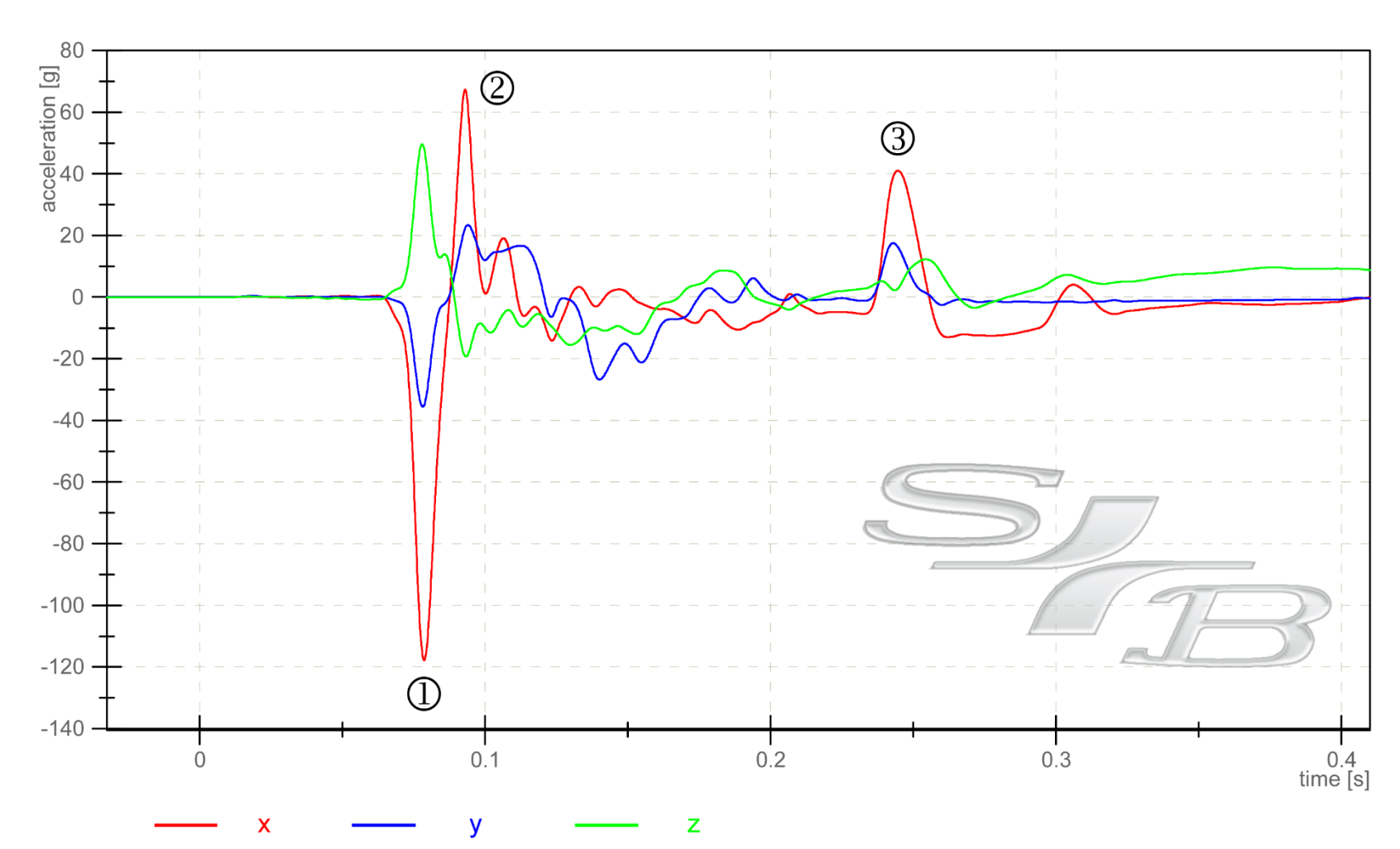
Unbelted dummy

- Resulting accelerations (CFC60 filtered)



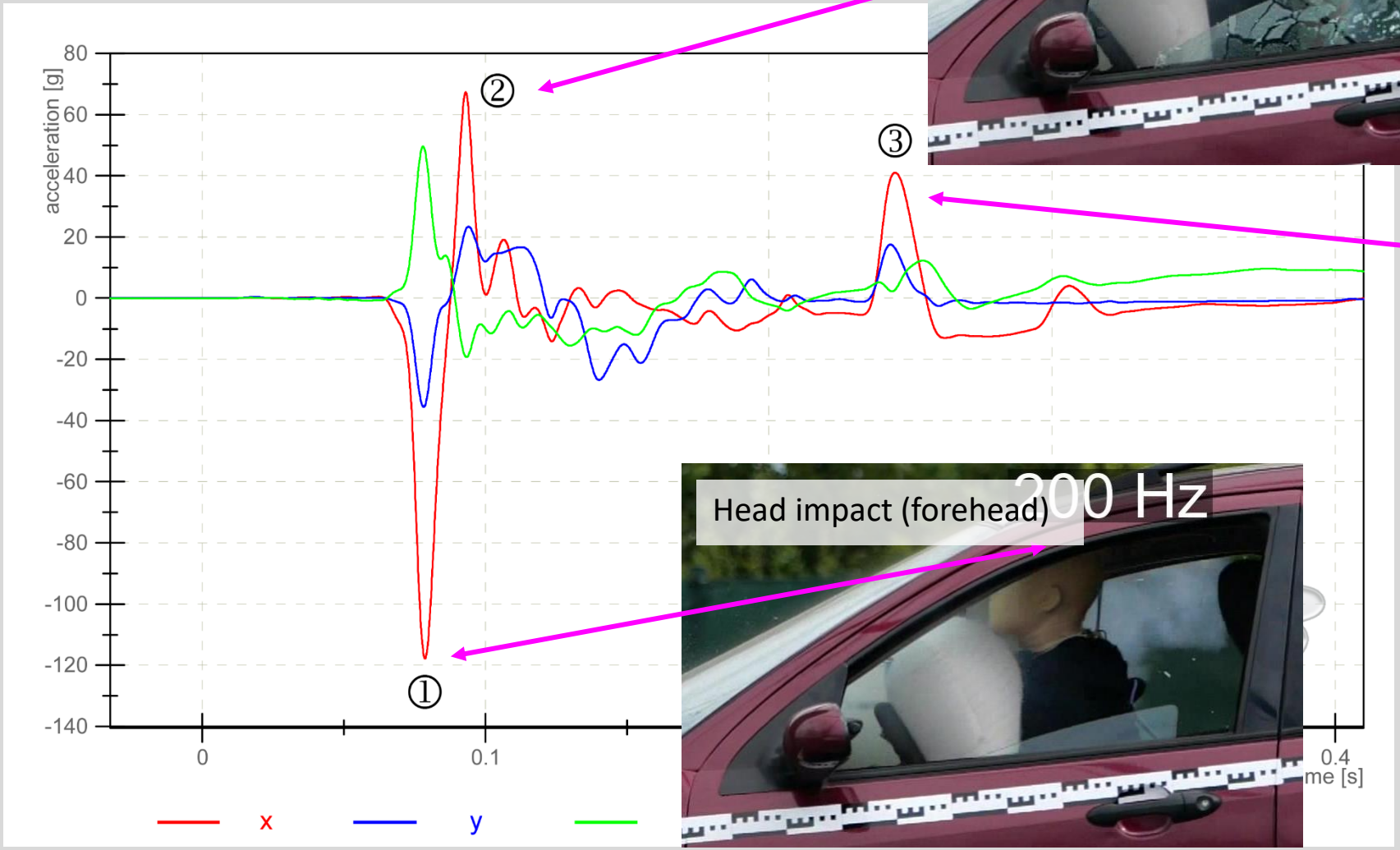
Unbelted dummy

- Head accelerations (x,y,z)



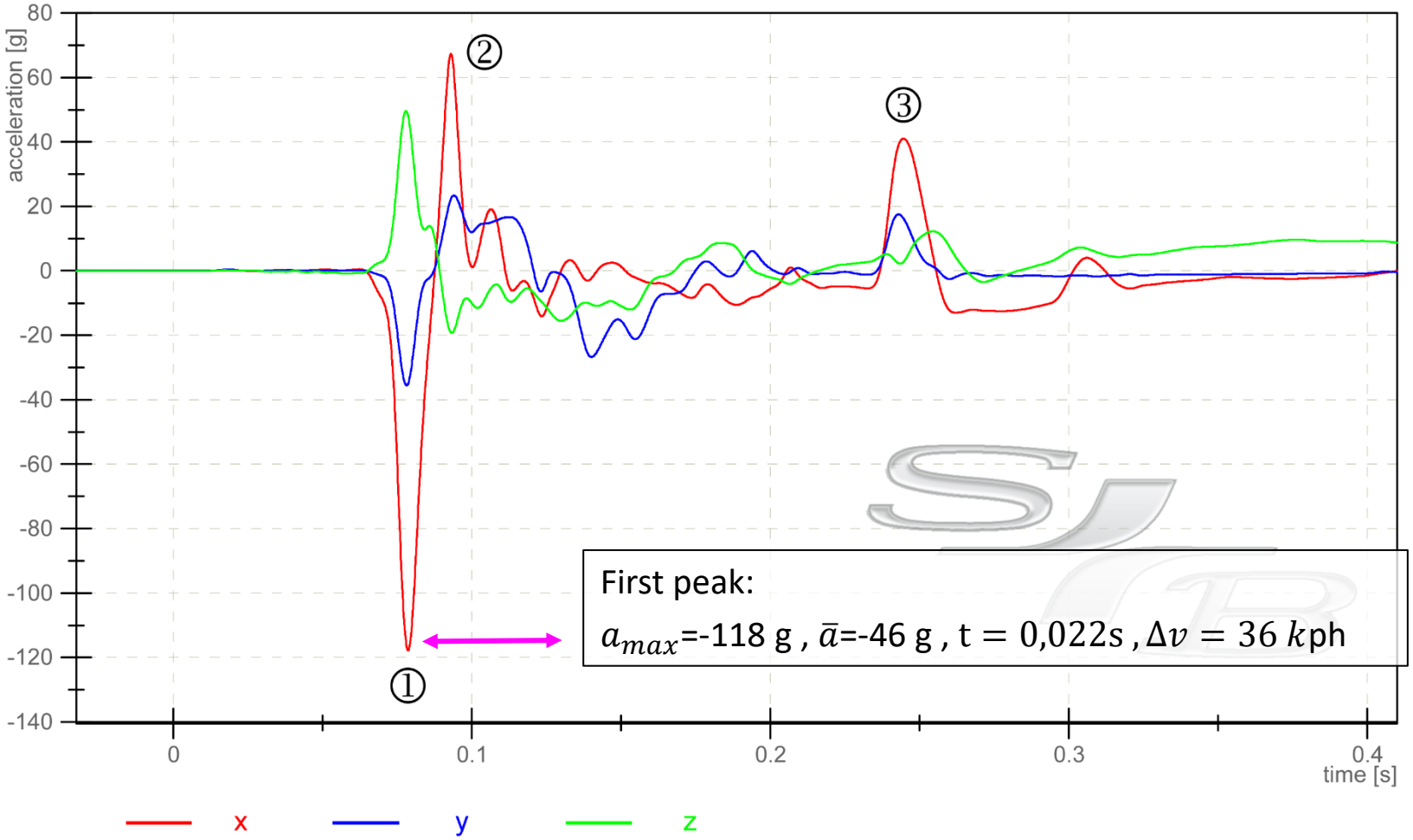
Unbelted dummy

- Head accelerations (x,y,z)



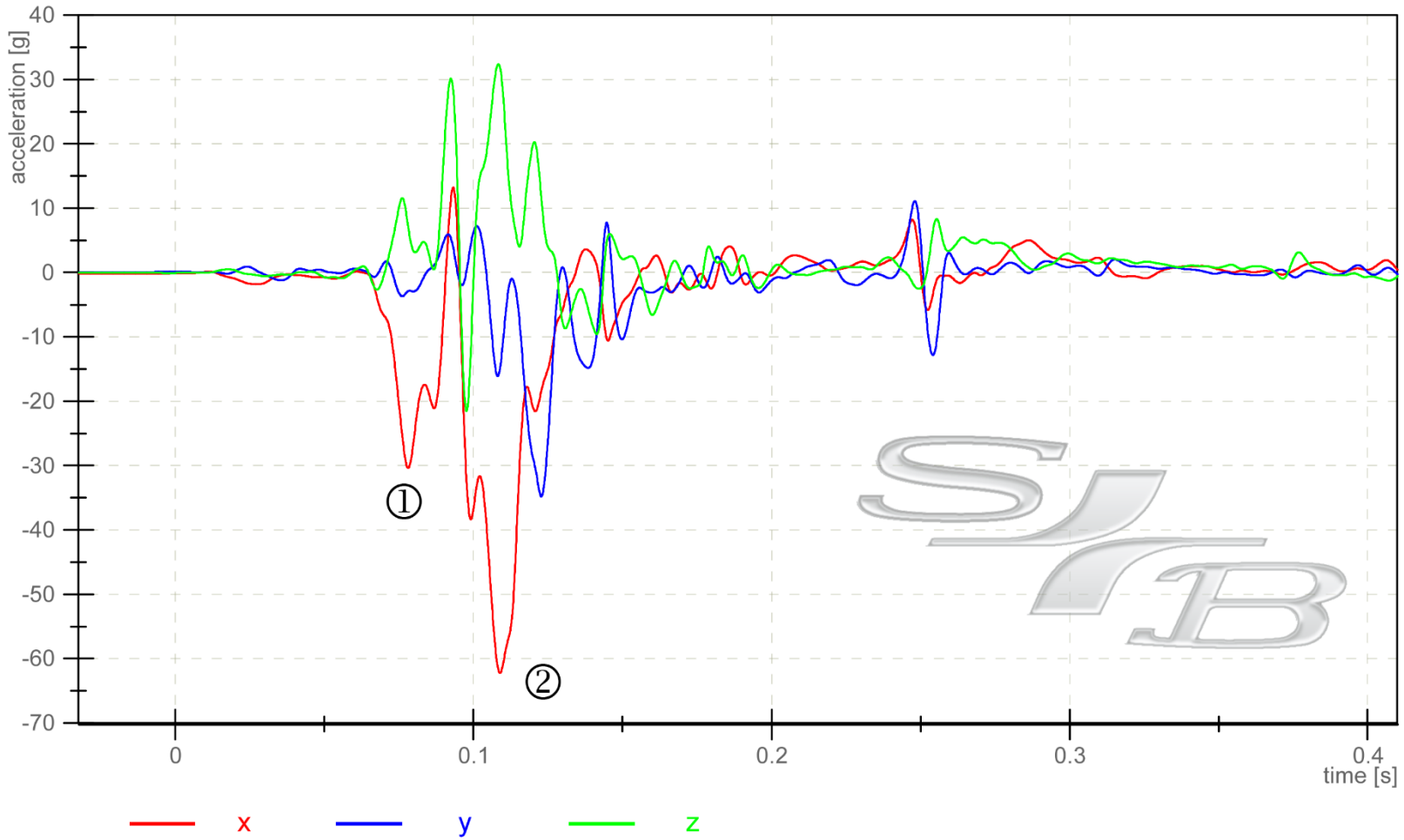
Unbelted dummy

- Head accelerations (x,y,z)



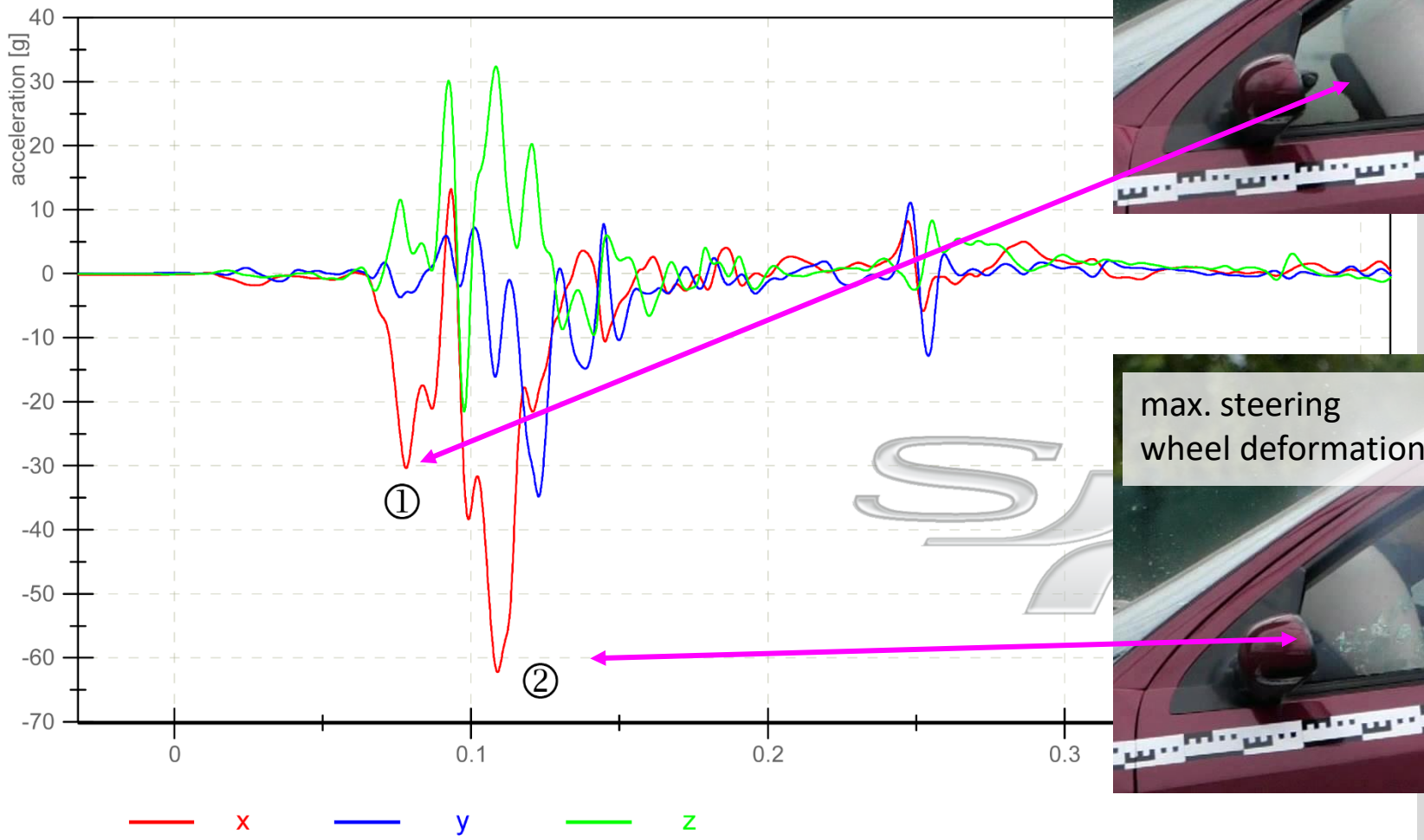
Unbelted dummy

- Chest accelerations (x,y,z)



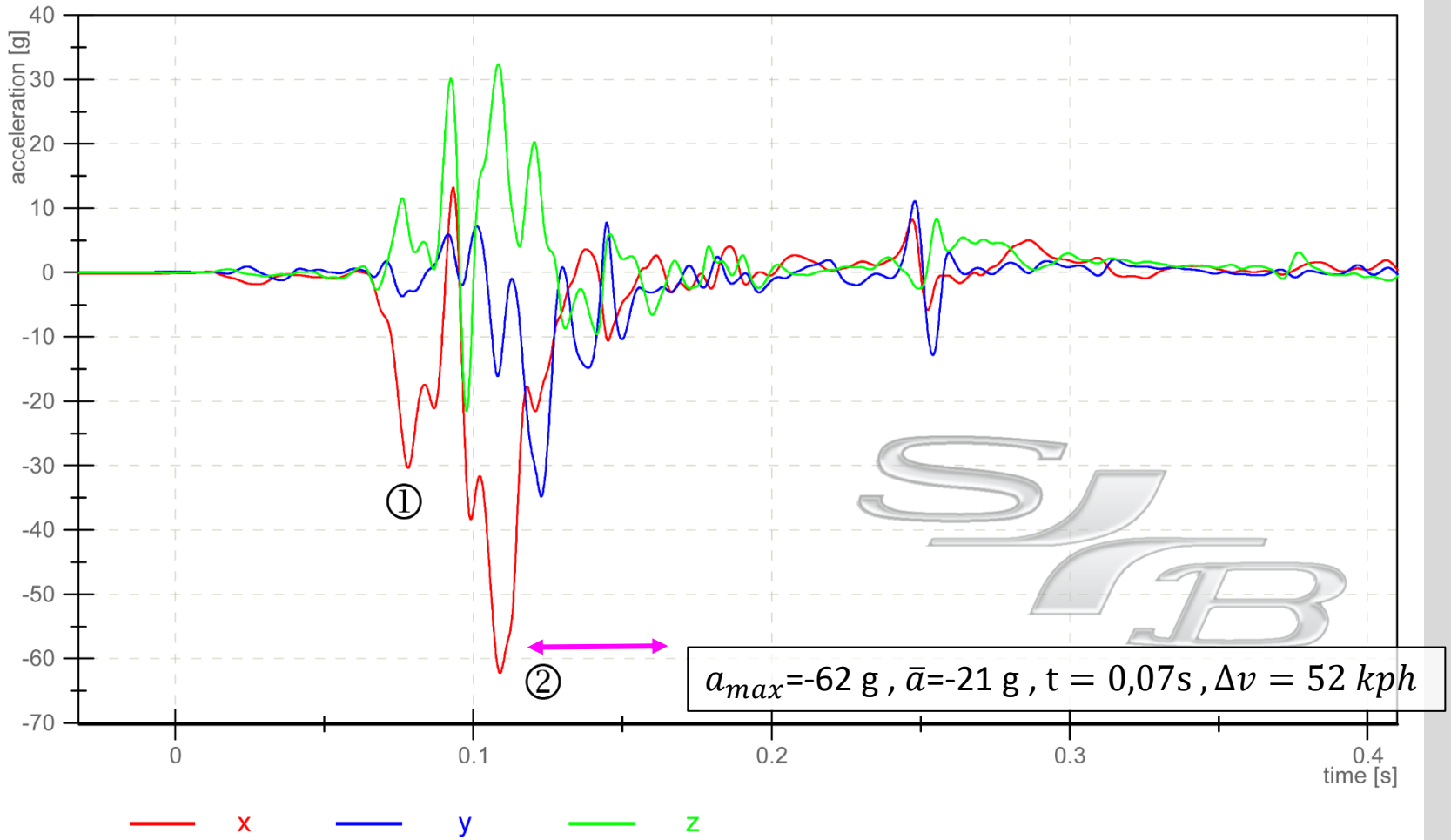
Unbelted dummy

- Chest accelerations (x,y,z)



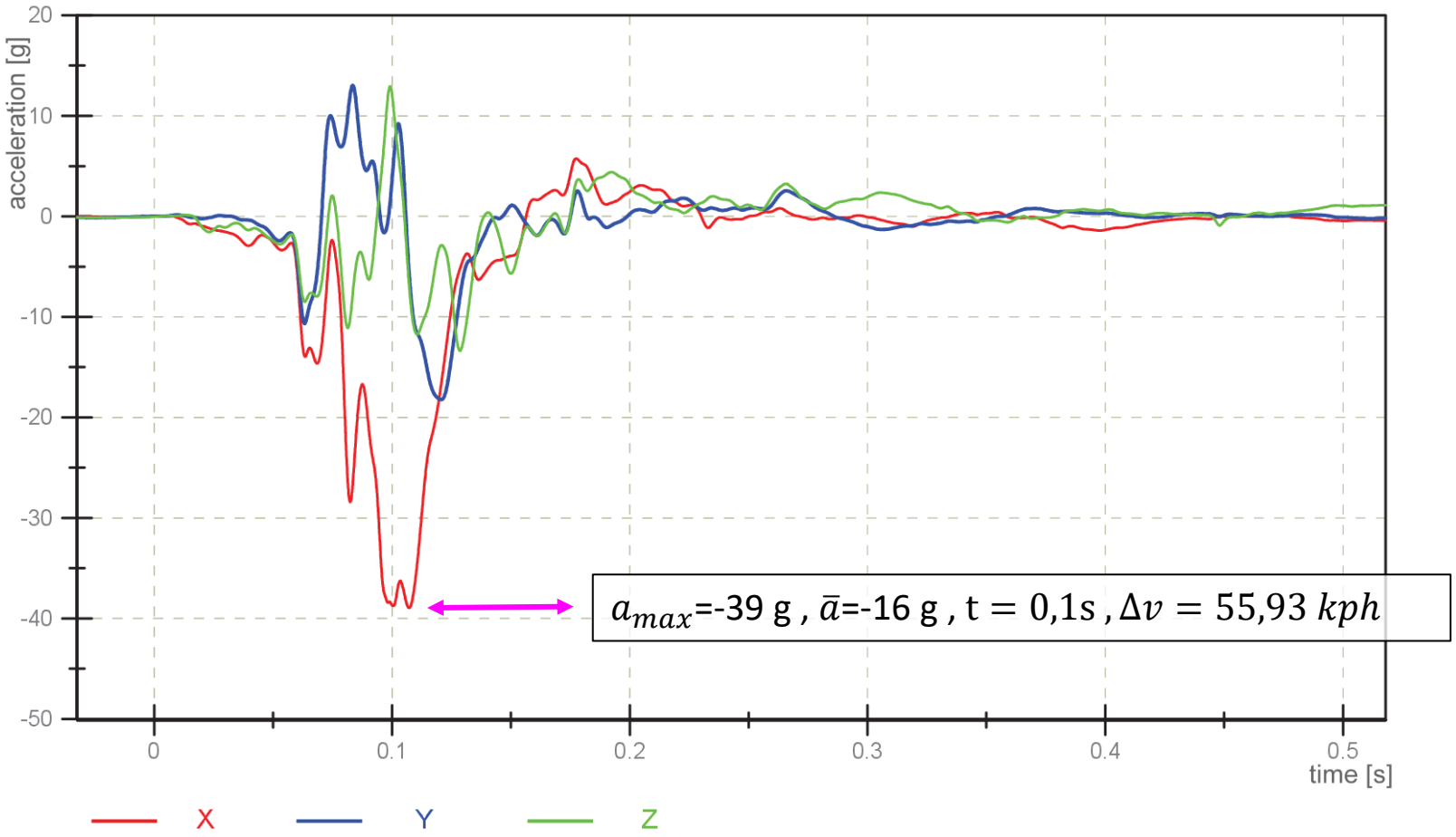
Unbelted dummy

- Chest accelerations (x,y,z)



Unbelted dummy

- Hip accelerations (x,y,z)



„poorly belted“ dummy (seat belt under the shoulder)

- Examples of poorly belted occupants

"poorly belted" dummy

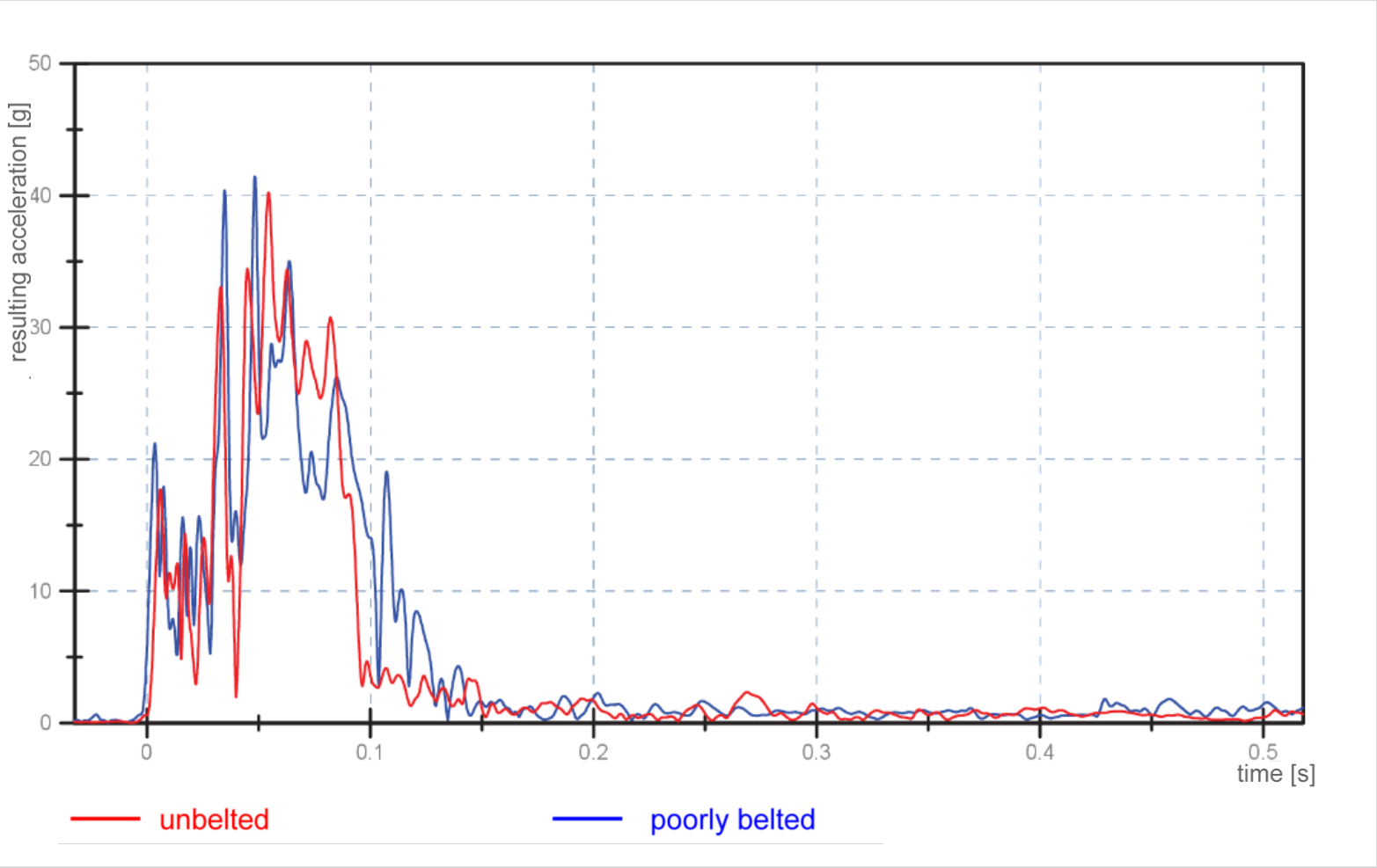
"poorly belted" dummy

- Motion sequence of the occupant

„What is the difference in the acceleration values of the occupant?“

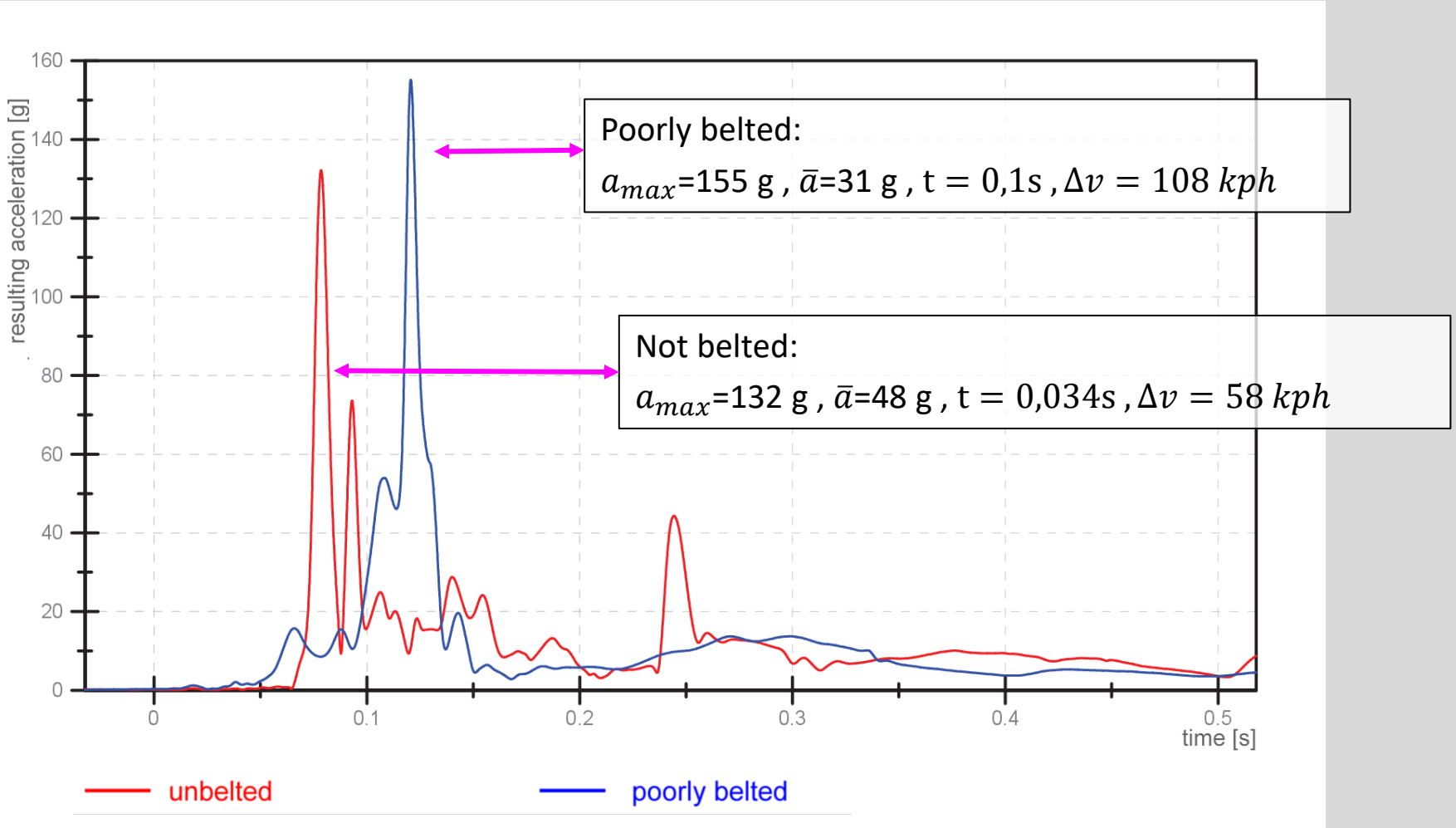
Comparision not belted /"poorly belted" dummy

- Comparision of different crashtests is admissible due to similar acceleration levels



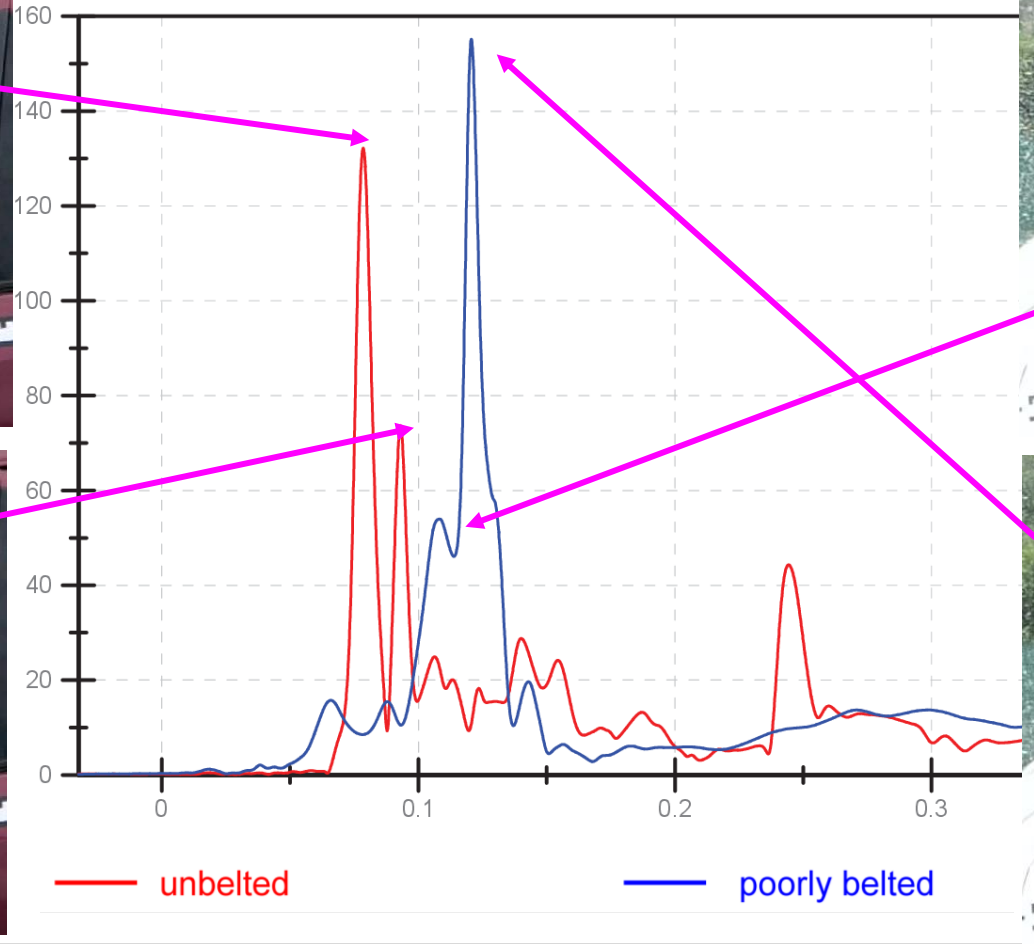
Comparision not belted /"poorly belted" dummy

- Head accelerations (resultant)



Comparision not belted /"poorly belted" dummy

- Head accelerations (resultant)

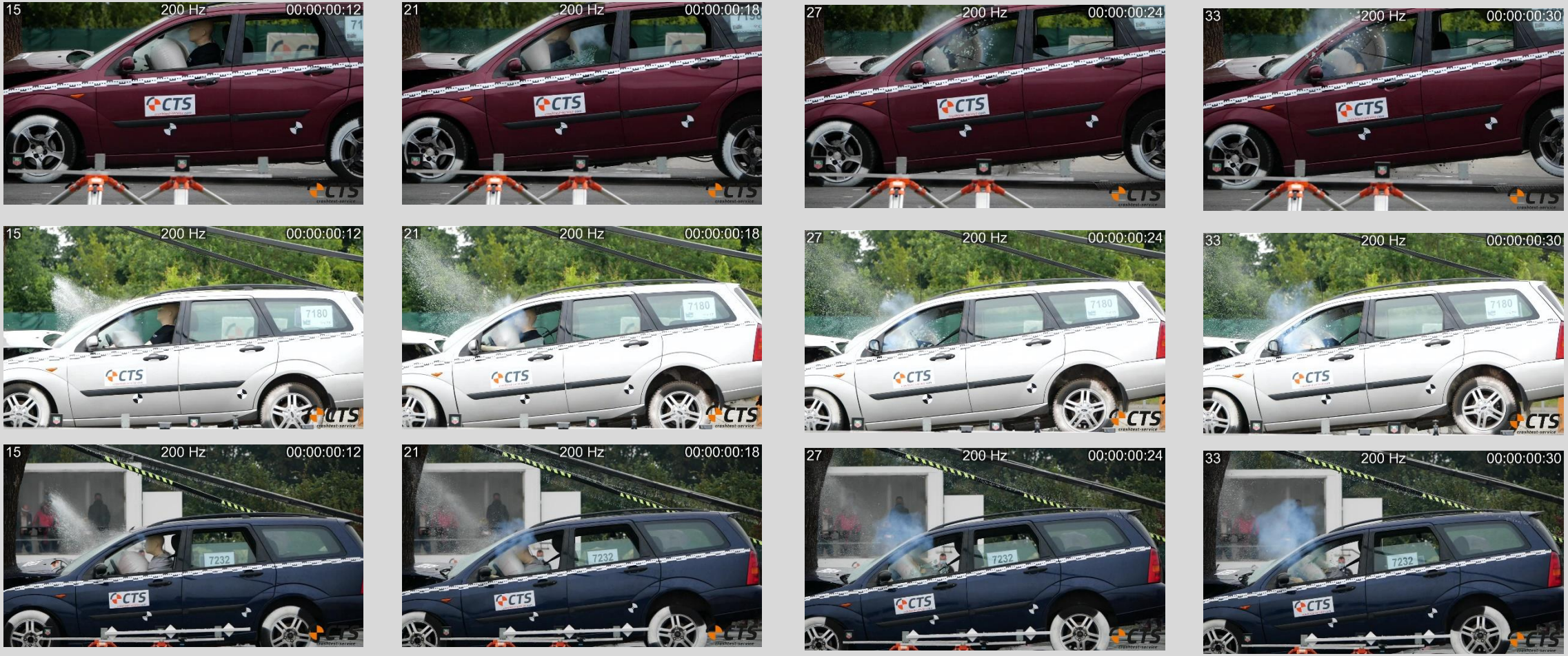


Propery belted occupant

- Motion sequence of the occupant

Comparison of motion sequences

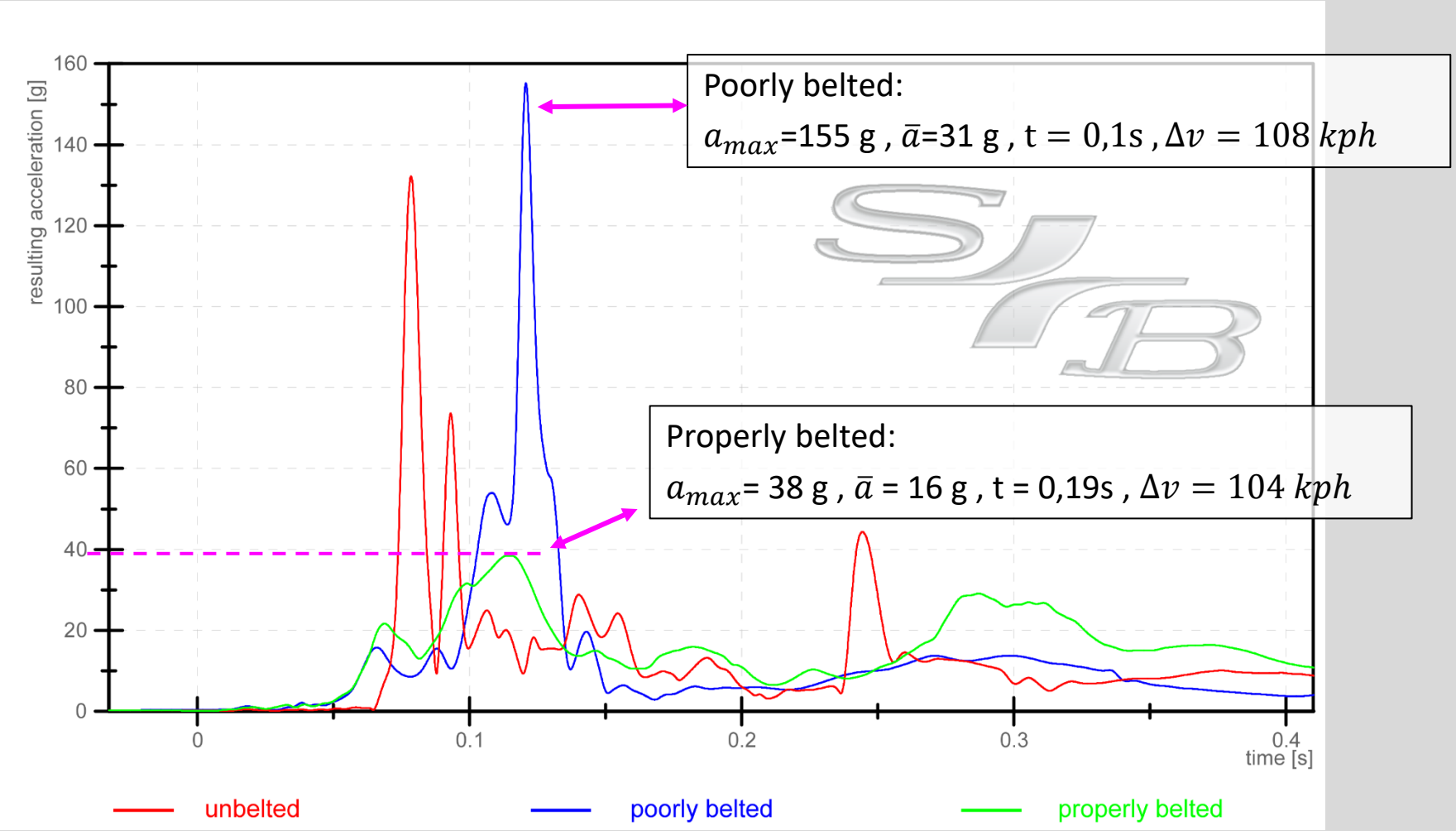
- Motion sequence of the occupant



Comparision of the biomechanical stress for all three crash test scenarios

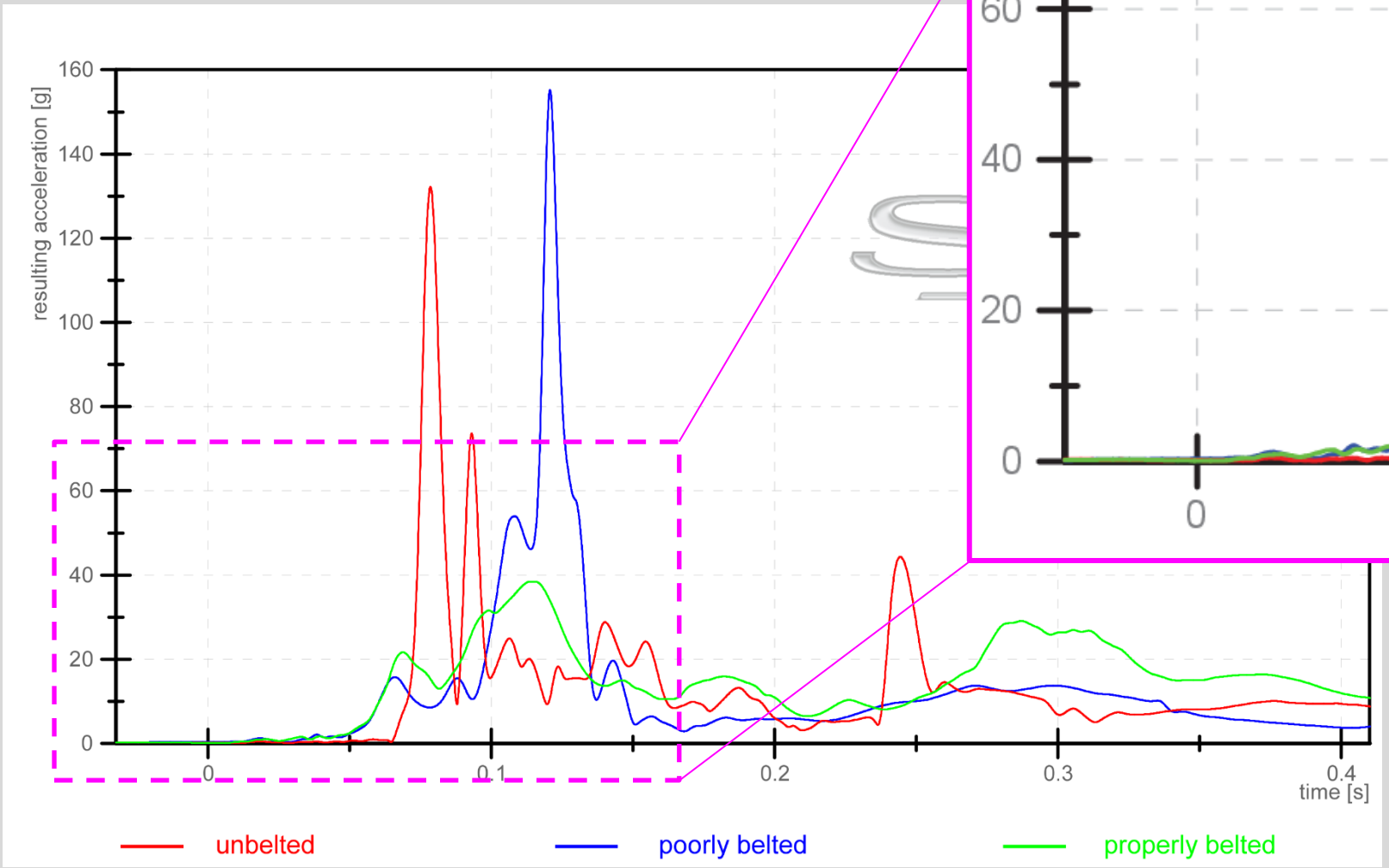
Comparision of the biomechanical stress for all tests

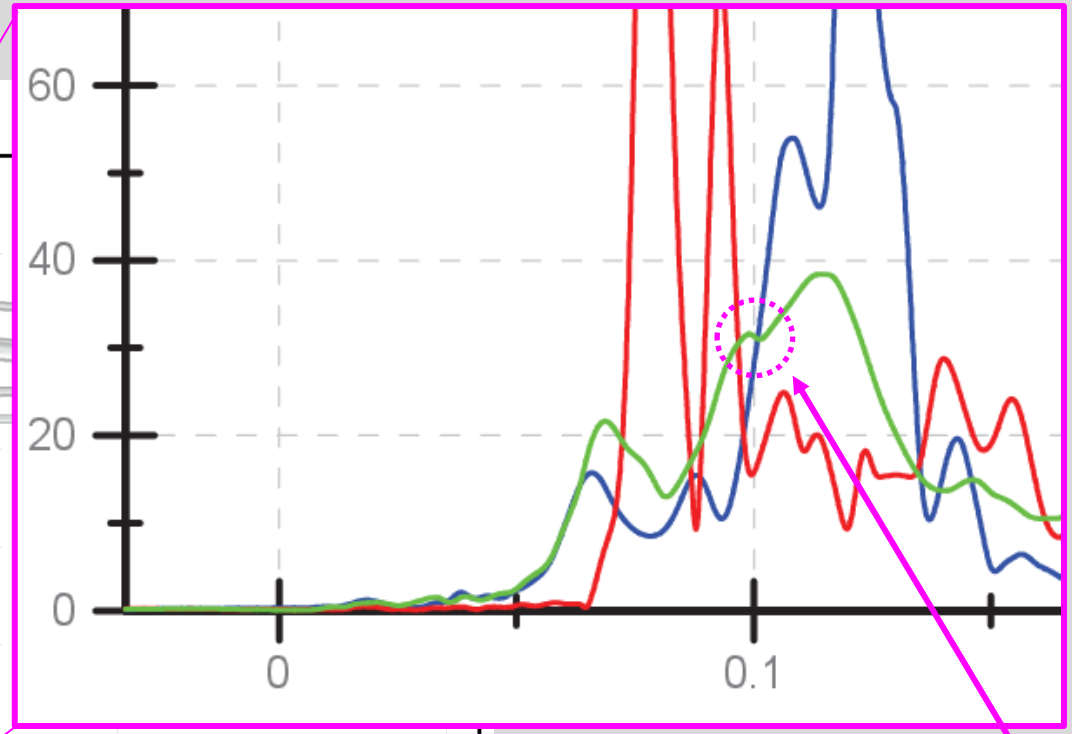
- Head accelerations (resultant)



Comparision of the biomechanical stress for all tests

- Head accelerations (resultant)





Seat belt and airbag lead to soft decelleration of the occupants head

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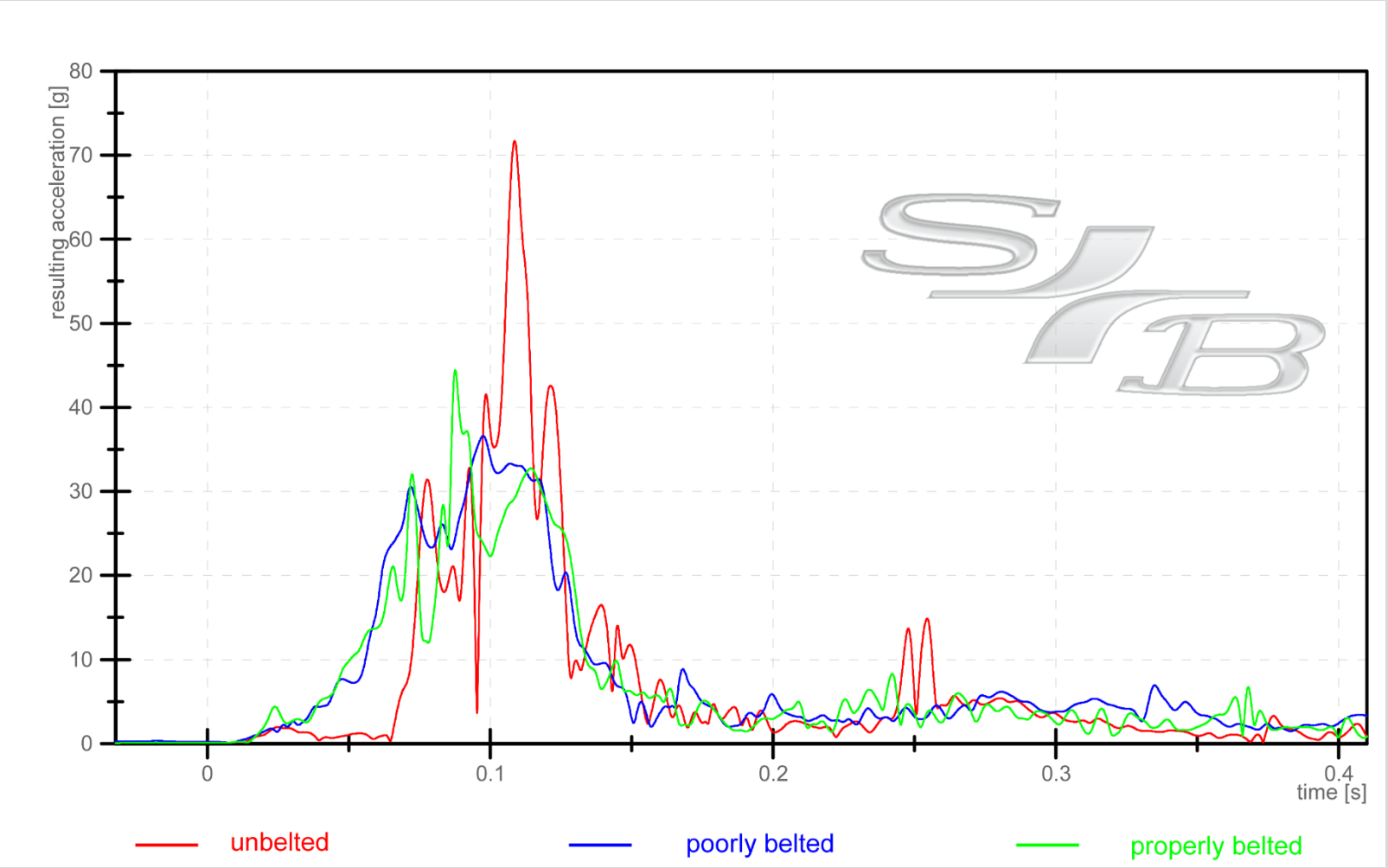
With airbag only, the biomechanical stress is increased significantly

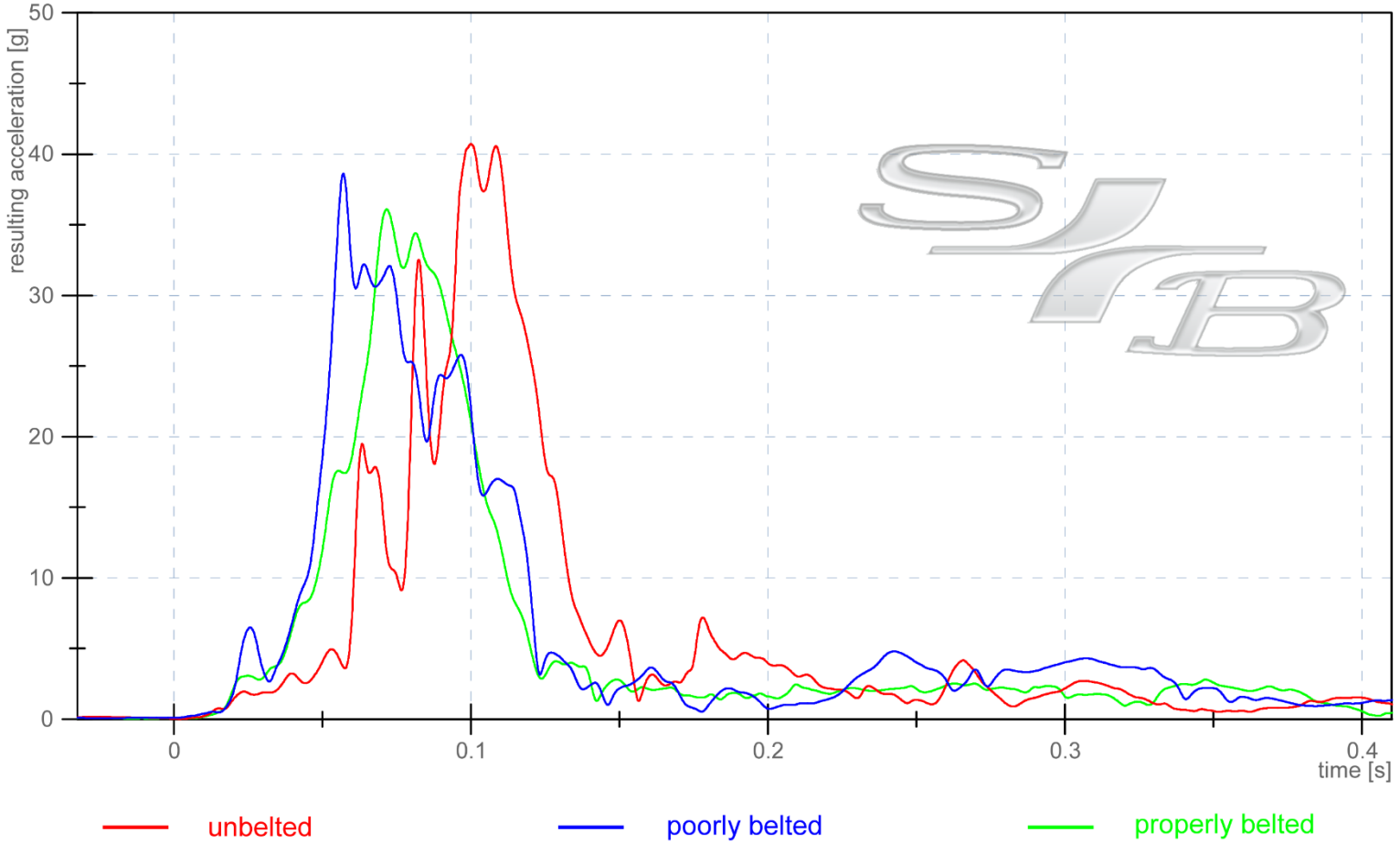
Comparision of the biomechanical stress for all tests

- Chest accelerations (resulant)



Comparision of the biomechanical stress for all tests

- Hip accelerations (resultant)

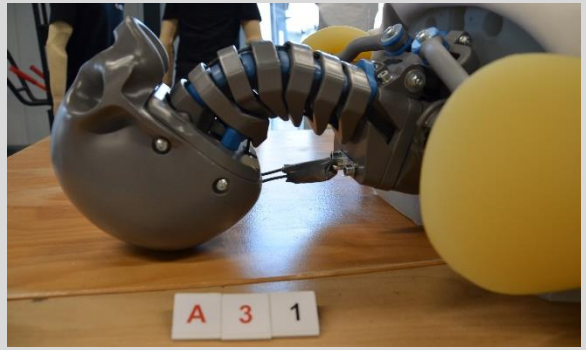


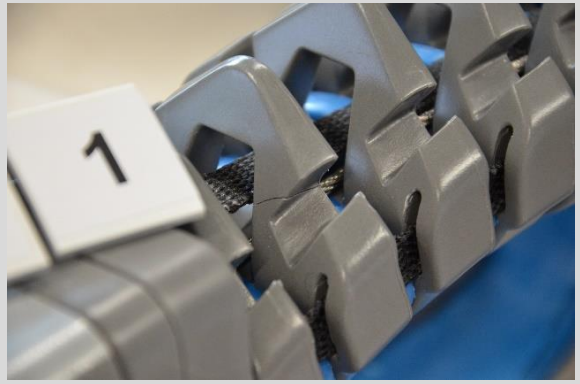
Comparison of injuries

- Not belted

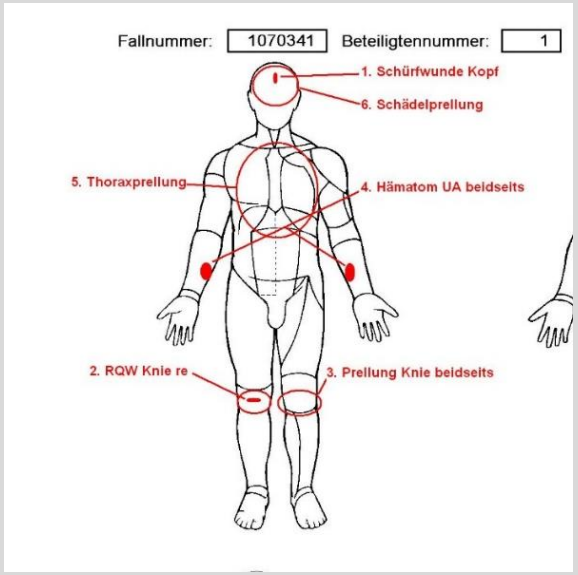
heavy overexpansion of cervical spine

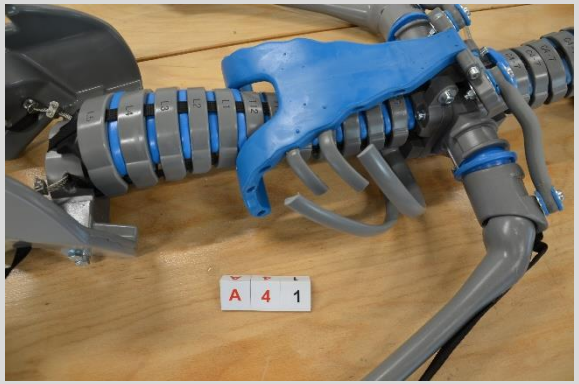
vertebral fracture





- „poorly belted“

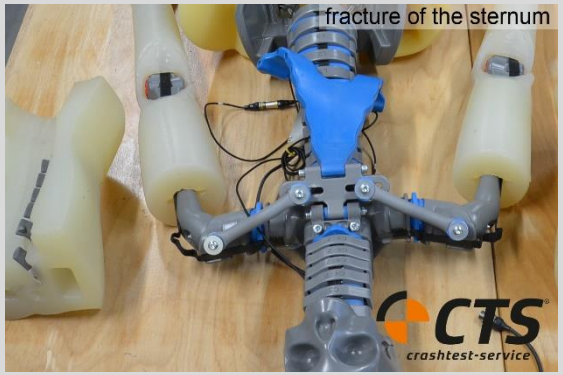




- Properly belted

Two broken ribs left side

Sternum fracture



Conclusion

- Significant results from the head on collisions onto a tree with 50 kph
  → not belted: double head impact, compression of cervical, chest impact on steering wheel
  → „poorly belted“: head impact on the steering wheel, heavy deformation of the steering wheel
  → properly belted: no impact on steering wheel, long decelleration phase with airbag

- Similarities of the occupant motion
  → hip accelerations similar in all crash tests regarding amplitude and characteristics
  → chest accelerations similar with poorly belted and properly belted dummy (no impact)
  → head impact similar without belt and poorly belted (regarding peak intensities)

- Where the seat belt is worn correctly, **in combination with the airbag** the acceleration values decrease significantly and are averaged over a longer time period

The protective effect of the airbag helps in combination to the seat belt only.

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Thank you for your attention!