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2022 Annual Conference
& Innovation Awards

Numerical Simulation as a Complement to the Physical Testing of Road Safety Barriers

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Current situation & challenges

1. Road safety barriers are certified according to EN 1317
2. EN 1317 requires numerous crash tests, allows choice of vehicle acc. to required mass/size
3. Crash tests include measurements on vehicle (acceleration) to rate severity of impact – but no crash dummies

➔ (Biomechanical) occupant loadings when today's vehicles impact road safety barriers?

Effect of change in boundary conditions?

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Research agenda

1. Analysis of real-world accident data involving road safety barrier impacts
2. Conduct of 3 full-scale crash tests with instrumented Hybrid III crash test dummy
3. Build-up of numerical model of vehicle, vehicle interior with dummy and safety barrier
4. Validation of numerical model to complement physical tests and variation of boundary conditions to answer research questions

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Vehicles and safety barrier

- Compact car as representative of small car
  - Mass: 1,190 kg
  - Market introduction: 2005
- SUV as representative of large car w. higher center of gravity
  - Mass: 2,106 kg
  - Market introduction: 2001
- Road safety barrier
  - Single-rail steel safety barrier (ESP), certified acc. to EN 1317
  - Height: 0.75 m, distance between posts: 2 m

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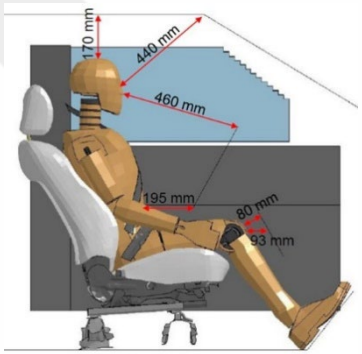
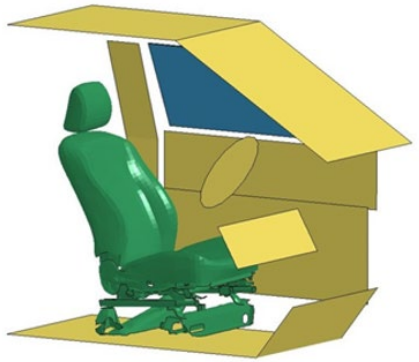
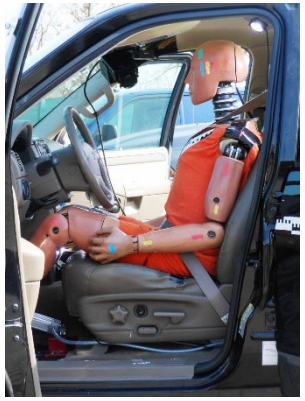
Numerical model

- Vehicle finite element models from NHTSA / GWU
- Seat belt, steering wheel etc. added by GDTech to interior of compact car
- Hybrid III dummy model positioned on driver seat
- Model of steel rail barrier provided by GDTech





- Similar driver environments in SUV and in compact car
  ➔„Box“ from compact car also applied to SUV



NHTSA National Highway Traffic Safety Agency
GWU George Washington University

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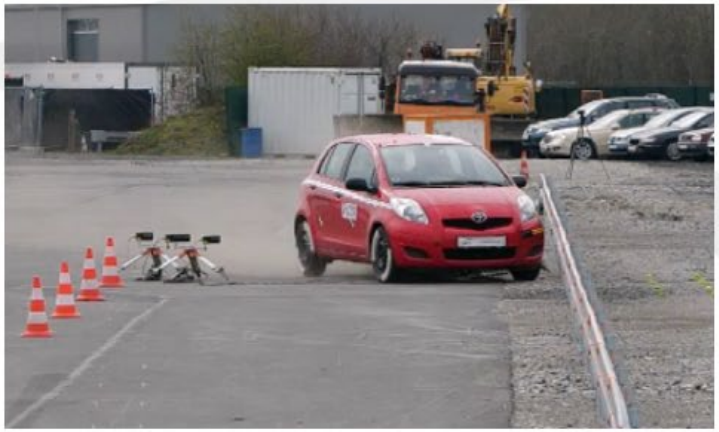
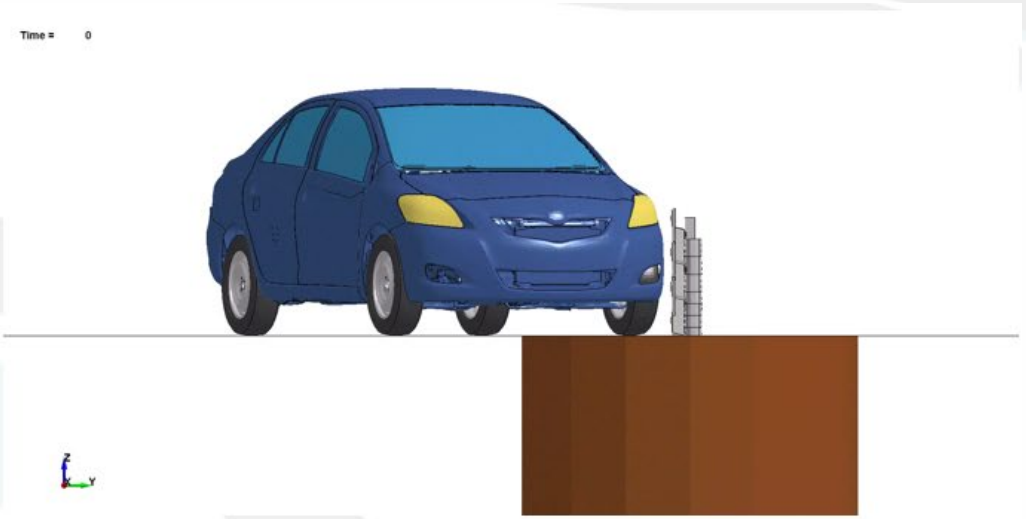
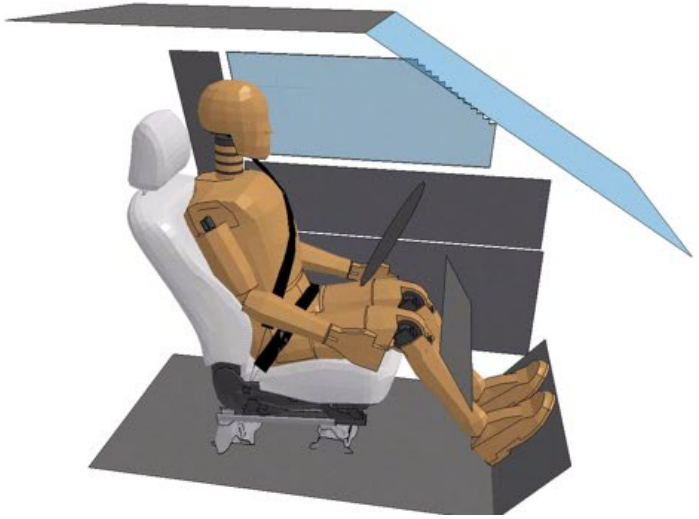
Numerical model vs. crash test







Tests referring to TB32 specs. (110 kph, 20° angle)

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Numerical model vs. crash test

	Small car crash	Small car simulation	SUV crash	SUV simulation	TB 32 requirement
Impact speed	112.5	110	113.8	110	**110**
Vehicle mass [kg]	1,100	1,100	2,100	2,100	**1,500** (pass. car)
ASI [-]	0.73	0.85	0.54	0.58	**≤ 1.0** (for level A)
THIV [kph]	22.6	23.4	19.4	18.5	**≤ 33**
HIC 15 [-]	131	213	23	21	**< 700**
3ms accel. head [g]	51.2	61.1	23.7	20.1	**< 80**
3ms accel. chest [g]	20.8	16.7	9.3	13.8	**< 60**
3ms accel. pelvis [g]	11.7	12.4	8.3	16	**< 60**

Examples of use cases

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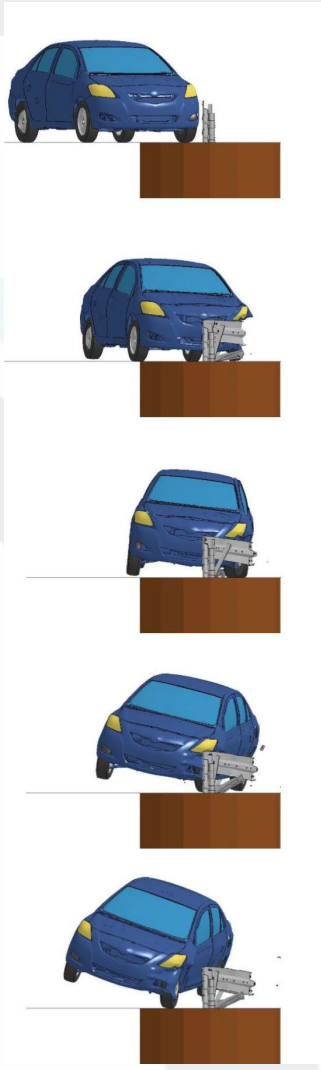
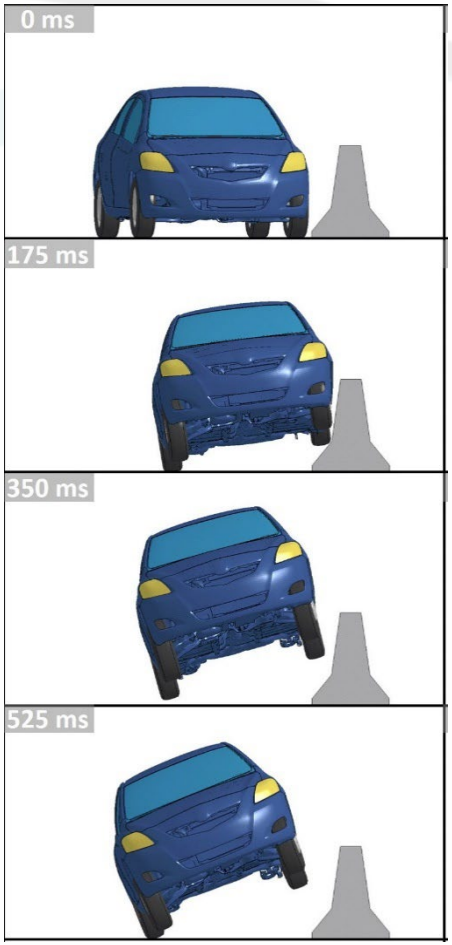
- Variation of models based on validated scenarios against steel and concrete barrier (110 kph, 20°)
- Determine effect on vehicle kinematics

a. if steel barrier mounted too low

b. if impact against concrete barrier occurs under smaller angle



a.



b.

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The way ahead

1. Road safety barriers are effective means to mitigate injuries for car occupants!
2. Shown approach intended to complement physical testing, requires further discussion and development
3. Method offers « testing » of road safety barriers under wider array of impact conditions
4. Might be starting point to replace (some) certification crash tests in the future
5. Numerical model quality and validation are crucial

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THANK YOU FOR YOUR ATTENTION

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