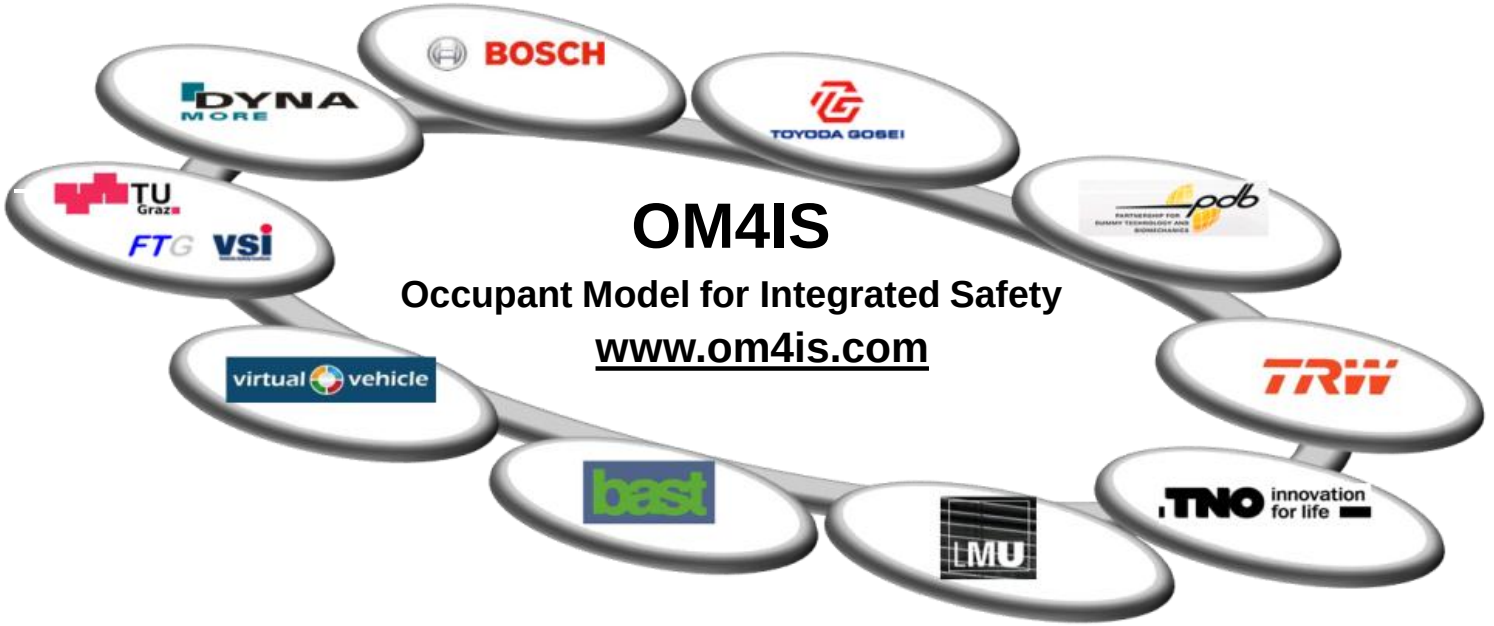
Validation data for reactive human body models in the pre-collision phase



OM4IS

Occupant Model for Integrated Safety

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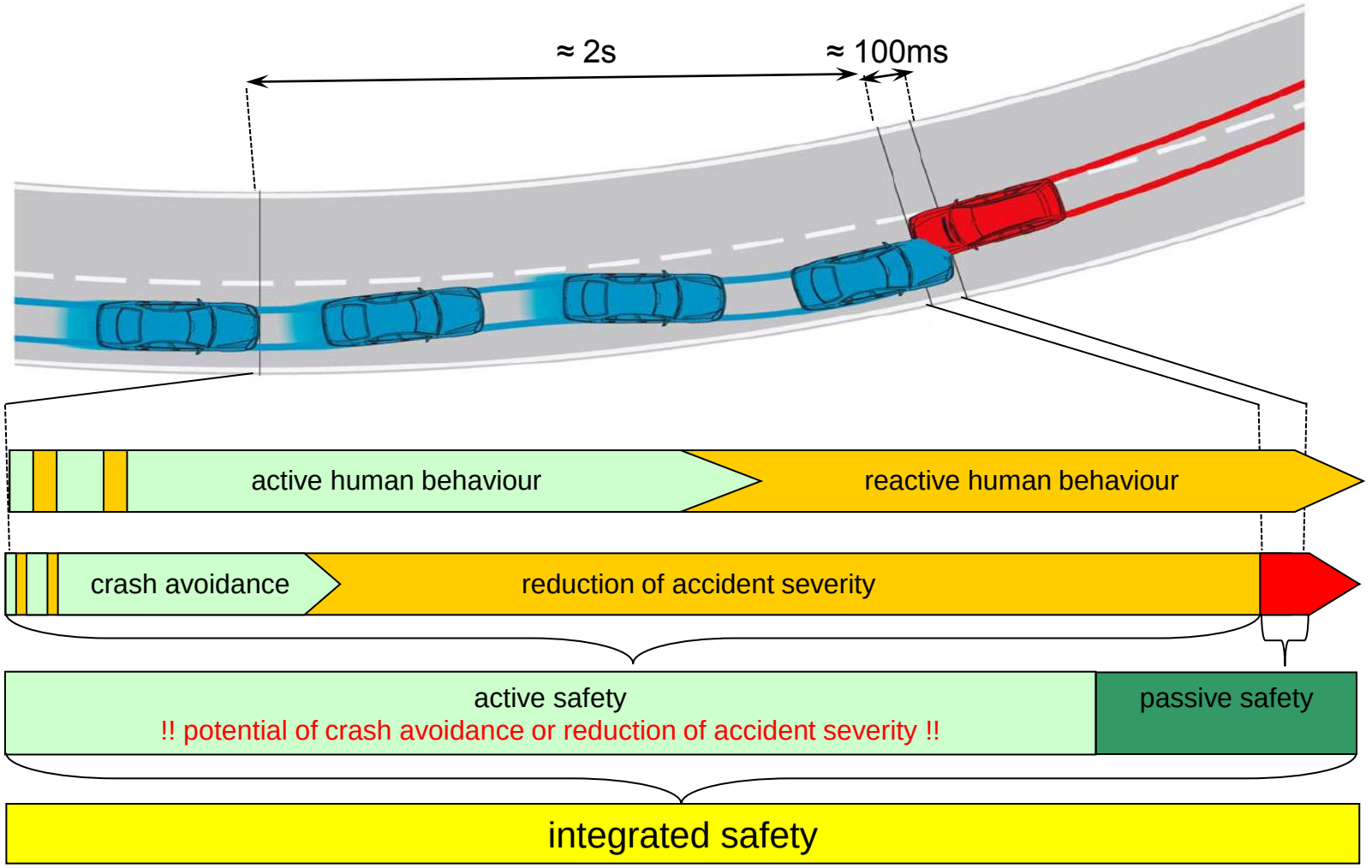
Content

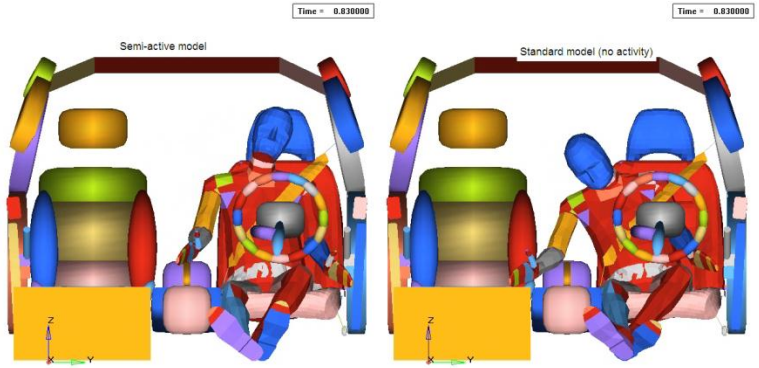
- General information
- Project task
- Testing
  - Sled tests
  - Vehicle tests
- Simulation
- Conclusions / Outlook

Strategic focus: Pre-crash time window (~2s) and reactive human patterns



Objectives

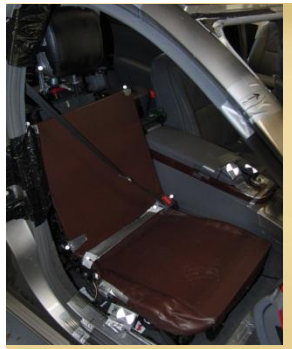
- **Testing:**
  - Different load cases
  - Significant number of volunteer
  - Accurate kinematic information
  - Danger for volunteer



- **Simulation: Several FE/MBS models on the market**
  - Marginal possibility to modify the control system of the existing models
  - Marginal information about the validation of the models

- **<u>Project tasks</u>**
  - Development and improvement of models and methods for the representation of reactive behavior in **numeric human body models**
  - Characterization of **reactive behavior** in low load **pre-crash phase**
  - Specification of behavior patterns based on existing and new **experimental methods** and integration into a numeric human body model

Sled test set up



Reference seat
(only lap belt)

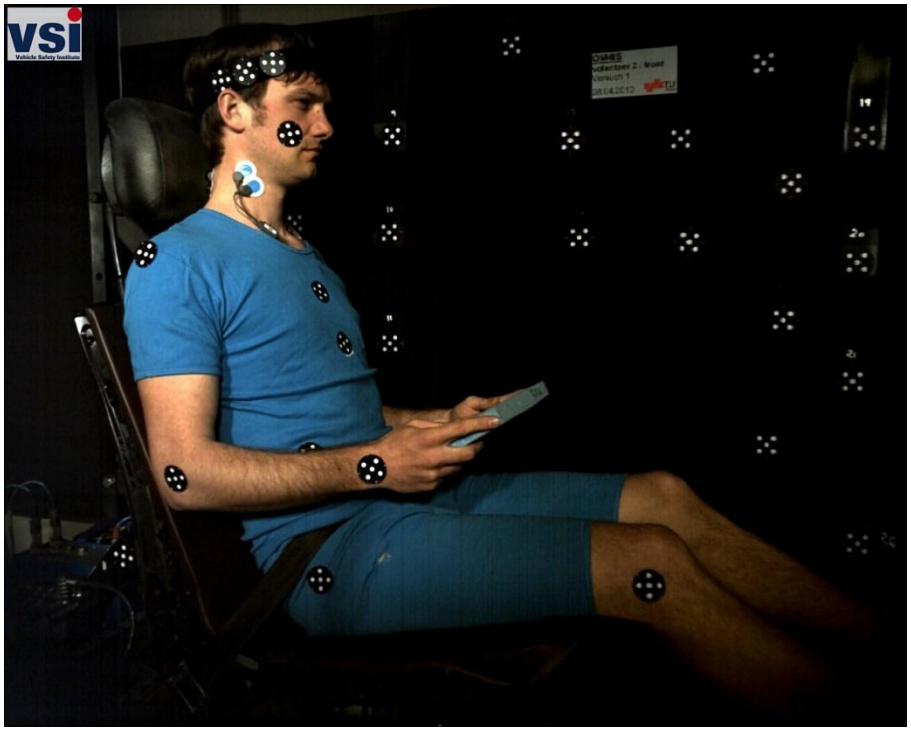
VICON
Camera system

Brake operating cylinder

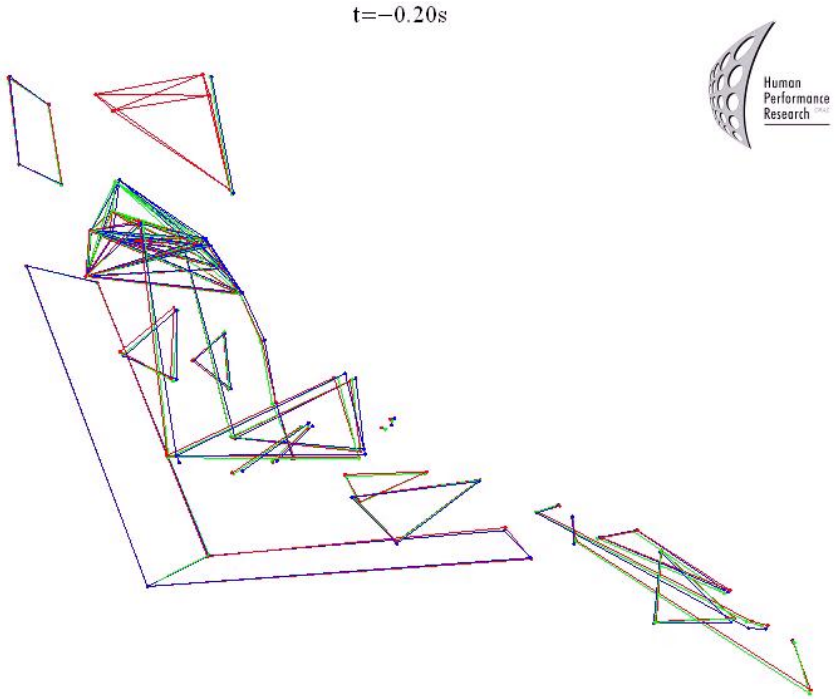
Crash track

Cable guided sled

Video high speed camera



Video infrared camera

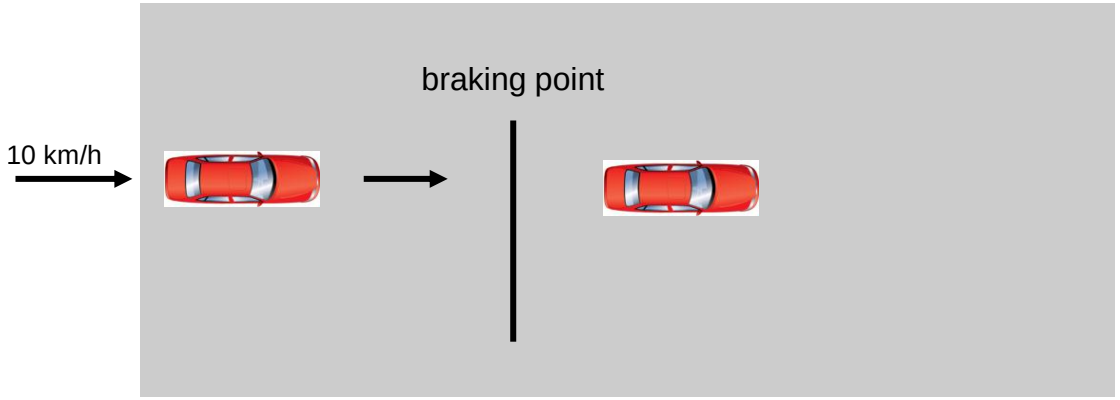


For detailed information refer to:
Detailed Analysis of 3D Occupant Kinematics and Muscle Activity during the Pre-crash Phase as Basis for Human Modeling Based on sled tests
13.06.2011 ESV Washington DC

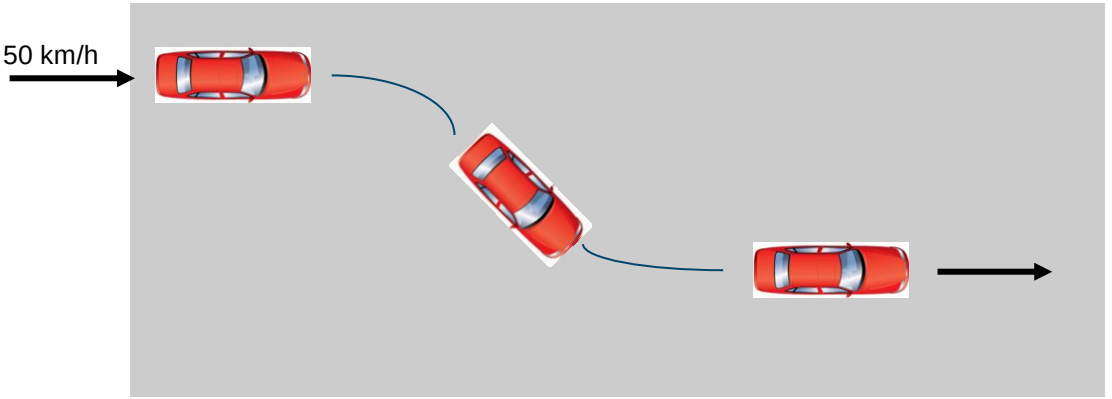
Analyses:

- Large inter-subject variability
- Large intra-subject variability (less movement upon repeated trial)

1. Case: Front braking maneuver 10 km/h



2. Case: Lane change 50 km/h



➢ Two different seats

I. Production-model seat
II. Reference seat OM4IS

➢ 3 possibilities for belt system (front and side):

A.) Belt …. 3 point safety belt
B.) Active belt …. belt retractor
C.) Lap belt ….only lap belt

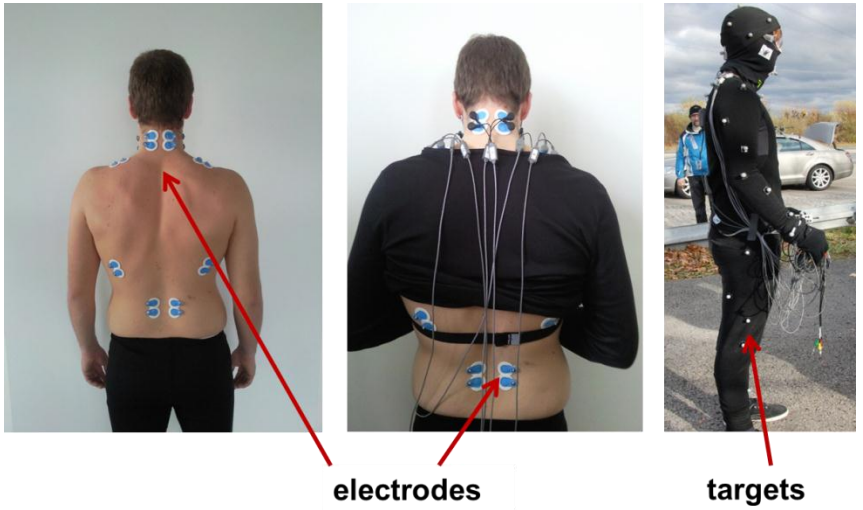
➢ Six different maneuvers

1a.) Front **unaware**: the volunteer does not know the maneuver or the location
1b.) Front **anticipated**: the volunteer can anticipate the maneuver and the location
1c.) Front **informed**: the volunteer is told where and when the maneuver happens
2a.) Side **unaware**: the volunteer does not know the maneuver or the location
2b.) Side **anticipated**: the volunteer can anticipate the maneuver and location
2c.) Side **informed**: the volunteer is told where and when the maneuver happens

30 volunteers according to
50% male HIII dummy

Measurement systems

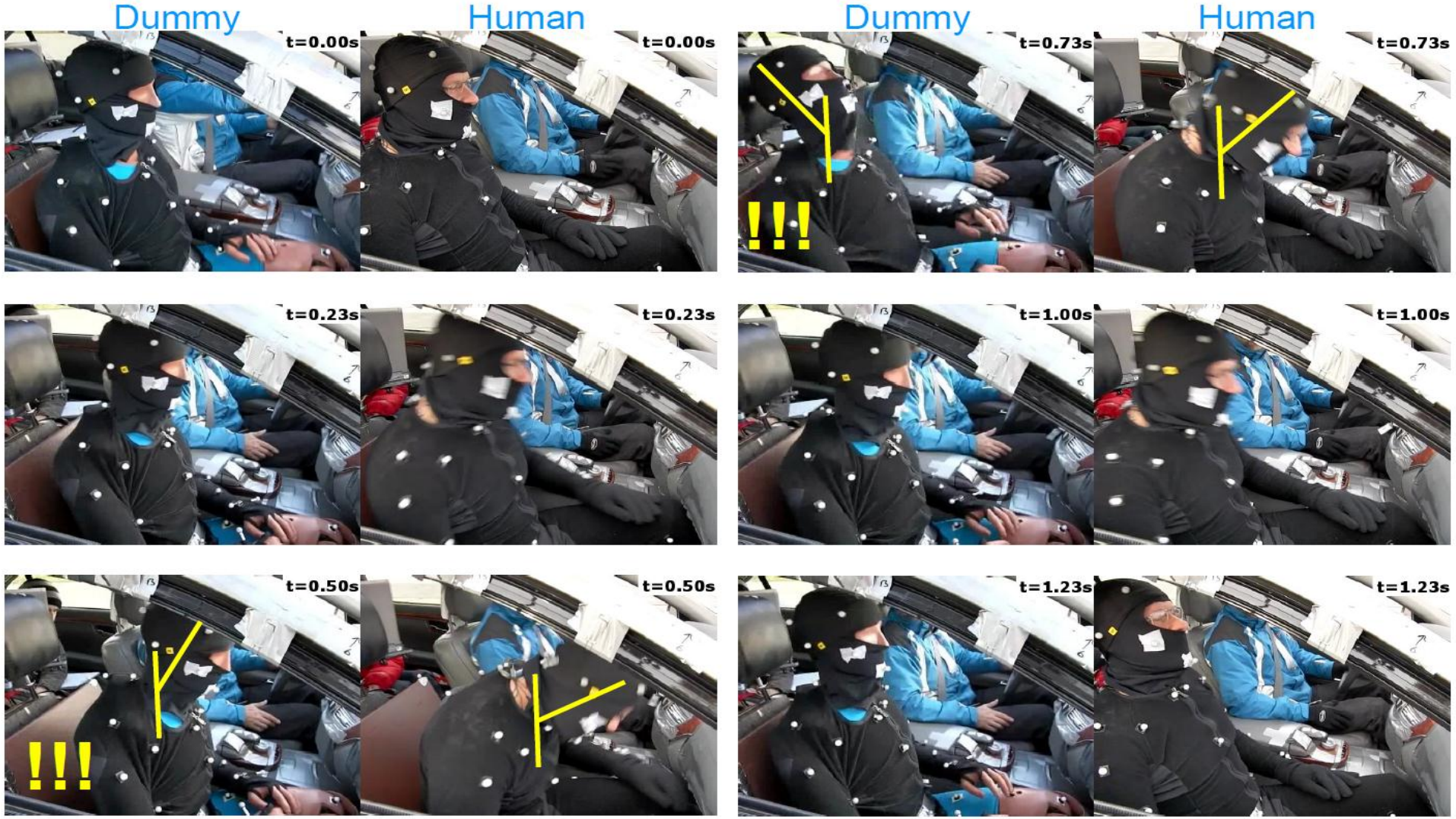
- Vehicle data
- Kinematic volunteer (Vicon)
- Surface EMG

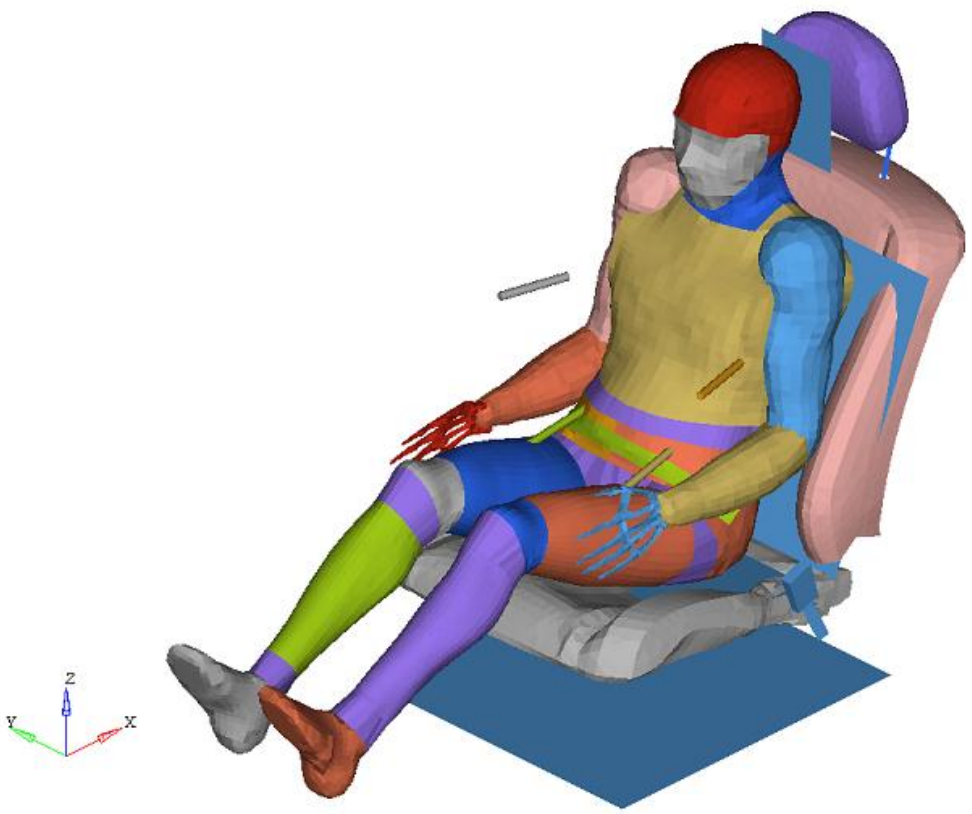


Video Front **unaware** ~10km/h, peak acceleration ~ 1g

Video Front **unaware** ~10km/h, peak acceleration ~ 1g

Comparison Front Braking Maneuver

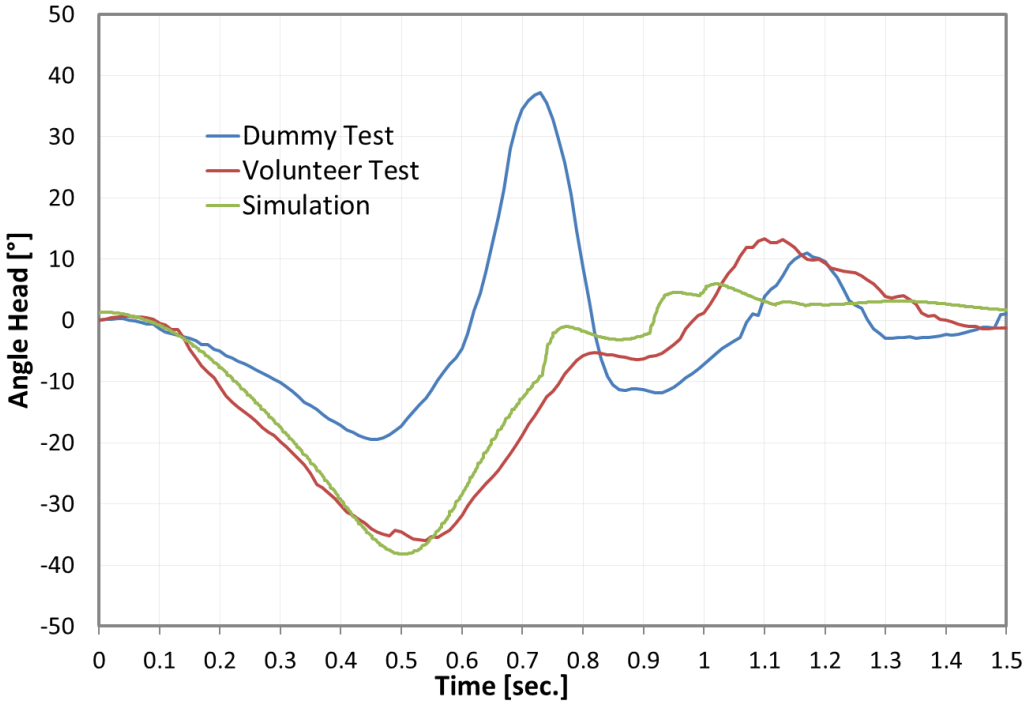




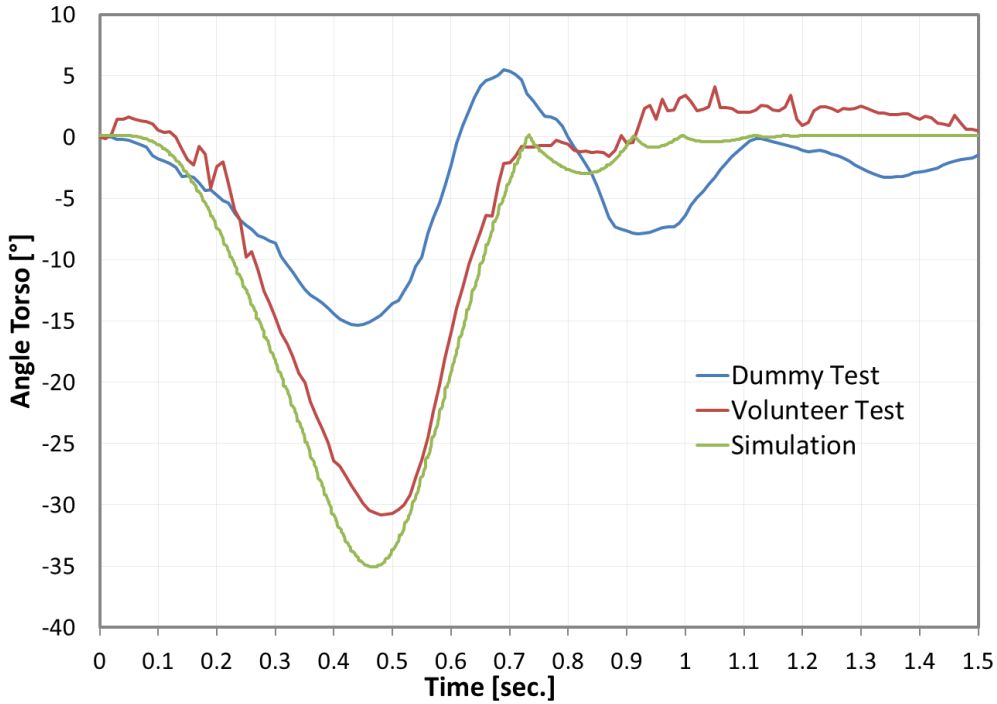
- Code-independent controller
- Simulation method independent controller (suitable for MBS and FE)
- Model is able to cover full range of subject movement

Comparison Dummy Test - Volunteer Test - Simulation

Head



Torso



Conclusions:

- Differences in kinematic behavior between volunteer and Dummy
- Large inter-subject variability
- Good agreement between simulation and volunteer kinematics

Outlook:

- EMG analyses
- Movement patterns
- Movement controller optimization

Thank you for your attention

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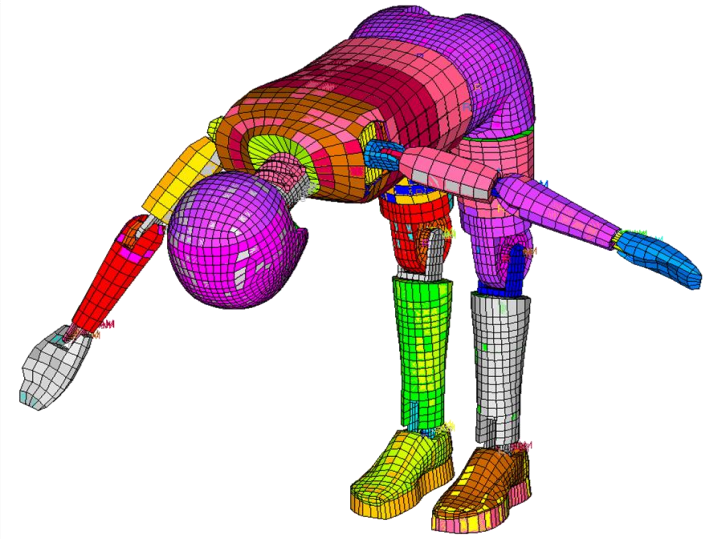
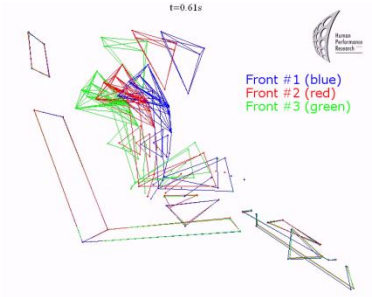


bmvit Bundesministerium für Verkehr, Innovation und Technologie
bmwfj Bundesministerium für Wirtschaft, Familie und Jugend
FFG COMET
Das Land Steiermark
SFG Im Auftrag des Wirtschaftslandesrates
TU Graz Graz University of Technology

Appendix - Sled Testing

- 11 volunteers analogue 50% male dummy (average weight 78 kg, average height 175 cm)
- 3 frontal tests per volunteer (0,8 g acceleration / 10 km/h velocity)
- 3 lateral tests per volunteer (0,4 g acceleration / 8 km/h velocity)
- 2 different camera systems (Vicon infrared / Weinberger highspeed)
- Measurement of 8 different muscles (left and right bodypart ➔ 16 muscles)



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- Volunteer 1-30
  - **1.) frontal passive/unaware**
  - **2.) lane change passive/unaware**
  - **3.) frontal passive/anticipated**
  - **4.) lane change passive/anticipated**
  - **5.) frontal active/informed**
  - **6.) lane change active/informed**

- Summary
  - **30 volunteers**
  - **90 frontal tests**
  - **90 lane change maneuver**