OSCCAR

FUTURE OCCUPANT SAFETY FOR CRASHES IN CARS

OSCCAR results @ RCCADS
May 25h 2022

Werner Leitgeb
www.osccarproject.eu

OSCCAR has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 768947.

Result overview of the EU project OSCCAR

May 25, 2022

Time: ~ 20min

Speaker: Werner Leitgeb /OSCCAR coordinator (Virtual Vehicle Research)

Agenda

- Overall project presentation
  - Consortium
  - Goals
- Results
  - achievements, dissemination, open access results…

OSCCAR Project: June 2018 – Nov.2021

OSCCAR
FUTURE OCCUPANT SAFETY FOR CRASHES IN CARS

PROJECT PARTNERS

AUSTRIA
- TECHNISCHE UNIVERSITÄT GRAZ
- VIRTUAL VEHICLE RESEARCH GMBH

BELGIUM
- SIEMENS INDUSTRY SOFTWARE NV
- TOYOTA MOTOR EUROPE

CHINA
- TSINGHUA UNIVERSITY
- CHINA AUTOMOTIVE TECHNOLOGY AND RESEARCH CENTER

FRANCE
- ESI GROUP
- UNIVERSITE DE STRASBOURG

GERMANY
- BUNDESANSTALT FUER STRASSENWESEN
- ROBERT BOSCH GMBH
- LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN
- MERCEDES-BENZ AG
- RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN
- UNIVERSITAET STUTTGART
- VOLKSWAGEN AG
- ZF GROUP, PASSIVE SAFETY SYSTEMS, TRW AUTOMOTIVE GMBH

NETHERLANDS
- SIEMENS DIGITAL INDUSTRIES SOFTWARE

SPAIN
- IDIADA AUTOMOTIVE TECHNOLOGY SA

SWEDEN
- AUTOLIV DEVELOPMENT AB
- CHALMERS TEKNISKA HOEGSKOLA AB
- VOLVO PERSONVAGNAR AB

Mercedes-Benz TOYOTA VOLVO VOLKSWAGEN AKTIENGESELLSCHAFT SIEMENS Ingenuity for life ZF BOSCH Invented for life

Applus IDIADA Autoliv esi www.esi-group.com bast CATARC CHALMERS UNIVERSITÉ DE STRASBOURG LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

University of Stuttgart Germany ika RWTH AACHEN UNIVERSITY 清華大學 Tsinghua University TU Graz Graz University of Technology PROJECT COORDINATOR: virtual vehicle

PROJECT FACTS

PROJECT COORDINATOR: WERNER LEITGEB

INSTITUTION: VIRTUAL VEHICLE RESEARCH GMBH

EMAIL: OSCCAR@V2C2.AT

WEBSITE: WWW.OSCCARPROJECT.EU

START: JUNE 2018 **DURATION:** 42 months

PARTICIPATING ORGANISATIONS: 21

BUDGET: ~7,6 Mio€, EU Funding 6,98 Mio€

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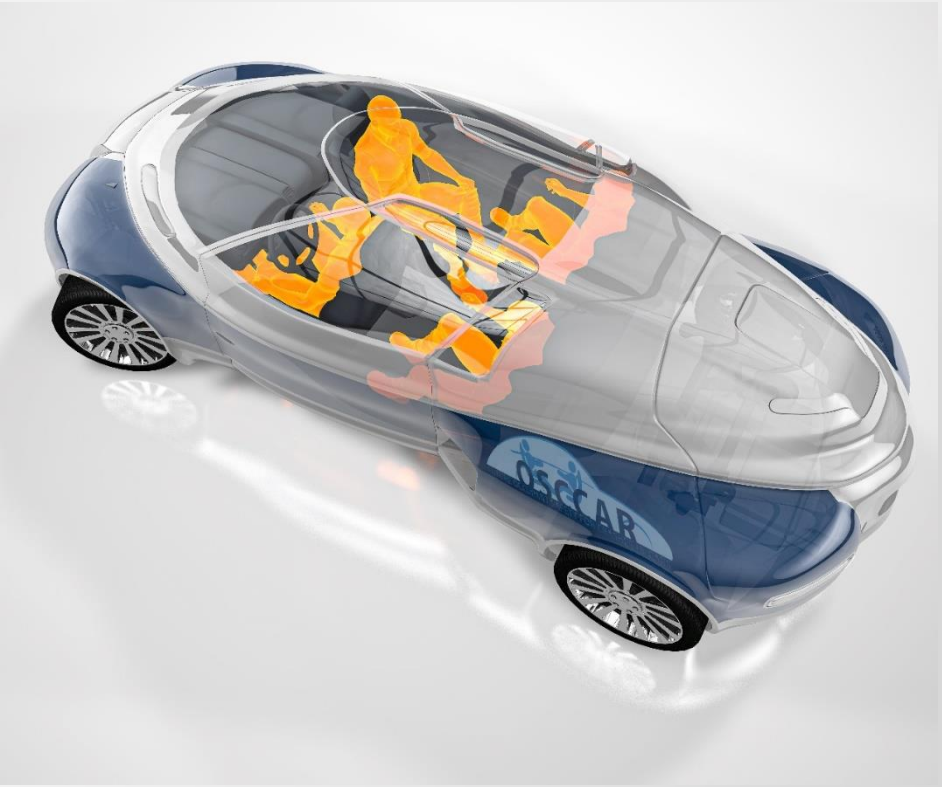
OSCCAR - Future Occupant Safety for Crashes in Cars



Action points:

- Understand future mixed traffic accident scenarios
- Continuously address the complete accident phase
- Consider human heterogeneity requirements
- Derive suitable restraint principles for AV enabled seating
- Prepare for virtual testing & homologation in order to cope with the increased amount and variety of testing

OSCCAR – selected technical Highlights

- Prediction method, tool and results on **remaining future crashes** for the development of occupant protection in AD vehicles
- Research and demonstration of six **advanced protection principles** for AV seating using advanced HBMs for future relevant crashes
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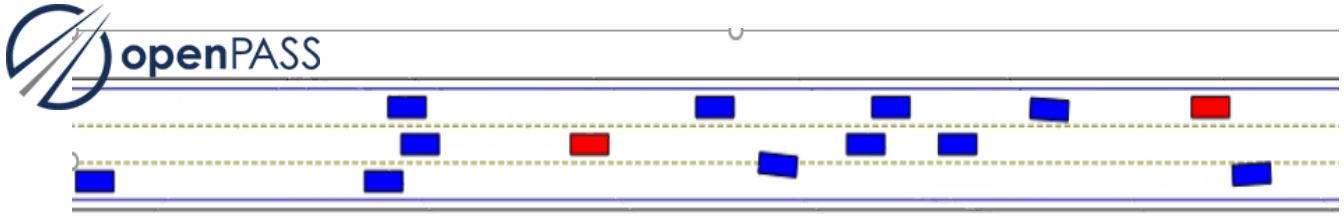
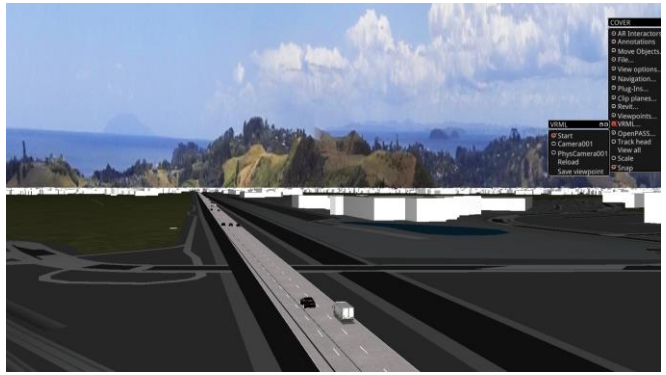
future accident scenarios

- **traffic scenario simulation** to predict crashes in mixed scenarios
  - „integrated assessment“: traffic accident simulation ➔ crash configurations ➔ CAE sim.
  - OSCCAR D1.2 „open source OSCCAR demo tool“ (based on COVISE & openPASS)
  - in OSCCAR D1.3: demo application of D1.2 tools in large-scale simulation study

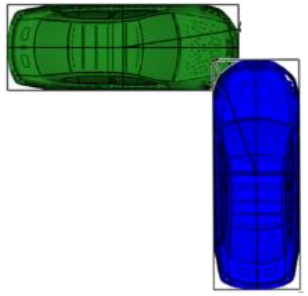


Virtual traffic volume (for OSCCAR demo):
~15 mio vehicles
~ 2.000 virtual crashes
OSCCAR Result: demonstration of a full tool chain using multi-agent stochastic traffic simulation for crash prediction – open source, hence easy to use in future research

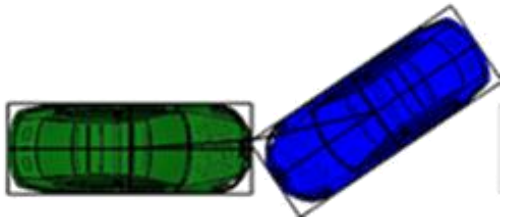


future accident scenarios

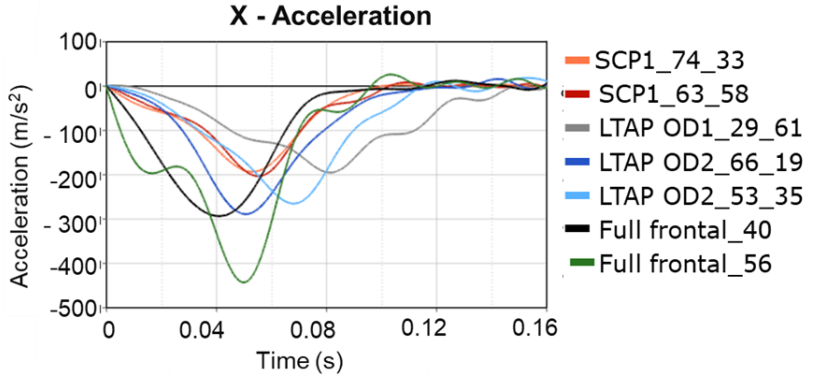
- The number of crashes are expected to be reduced with high implementation of ADAS and/or introduction of AD vehicles
- However, crashes will still occur in mixed traffic, but will be different
- **For AD vehicles in urban areas, two especially relevant crash configurations were identified**
- **Generic pulses were derived and are publicly available**
  - Straight Crossing Path (SCP):
    - Critical metrics: Head excursion, rib fracture risk, Slipping out-of-belt
  - Left Turn Across Path Opposite Direction (LTAP OD)
    - Critical metrics: Head excursion, rib fracture risk, Slipping out-of-belt, Lumbar spine compression, Pelvis ASIS (reclined seating)



SCP 63_58 km/h



LTAP OD 66_19km/h



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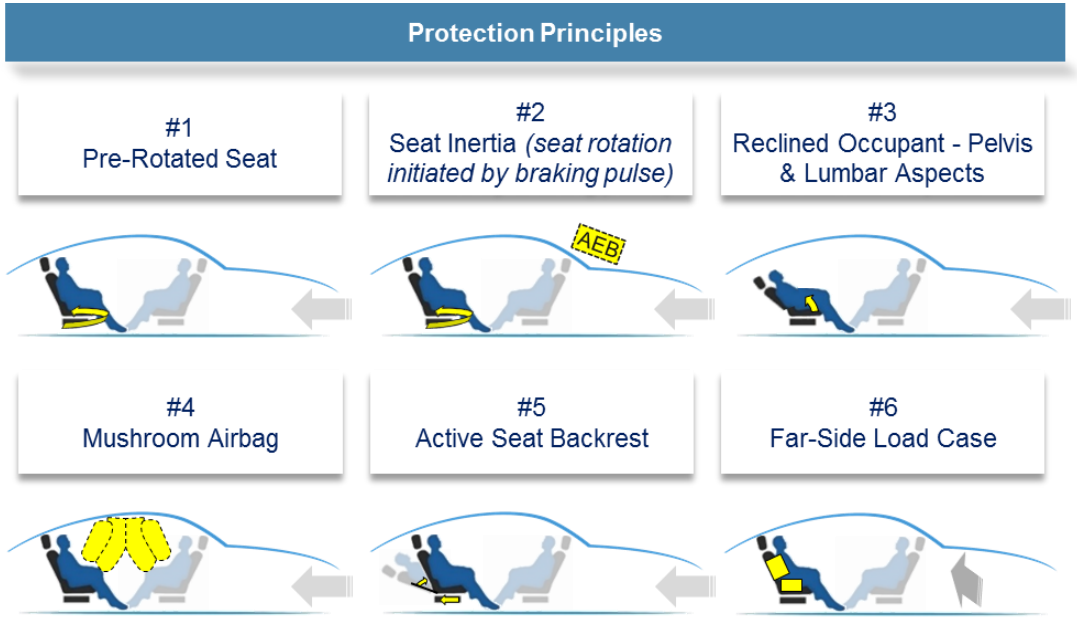
advanced protection principles

- Occupant Protection Principles:
  - The Working Groups investigated various research questions related to rotated seats, reclined seating positions, an advanced airbag design as well as future occupant restraint with regard to a side crash
  - All studies have shown that each Protection Principle has significant potential to increase occupant safety with regard to new future seating configurations



  - A general proof of functionality and effectiveness was provided for all Protection Principles
  - Both pre-crash activation and adaptation as well as in-crash protection were considered
  - By the use of human body models the kinematic boundary conditions, e.g. the risk of submarining, and the related injury mechanisms for selected test cases could be analysed qualitatively well
  - A combination of single Protection Principles is reasonable and may lead to additional benefits

advanced protection principles

#1 Pre-Rotated Seat	#2 Seat Inertia *(seat rotation initiated by braking pulse)*	#3 Reclined Occupant - Pelvis & Lumbar Aspects	#4 Mushroom Airbag	#5 Active Seat Backrest	#6 Far-Side Load Case

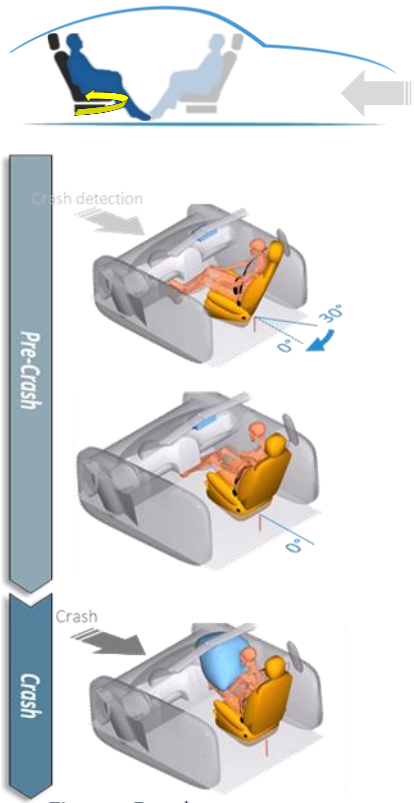
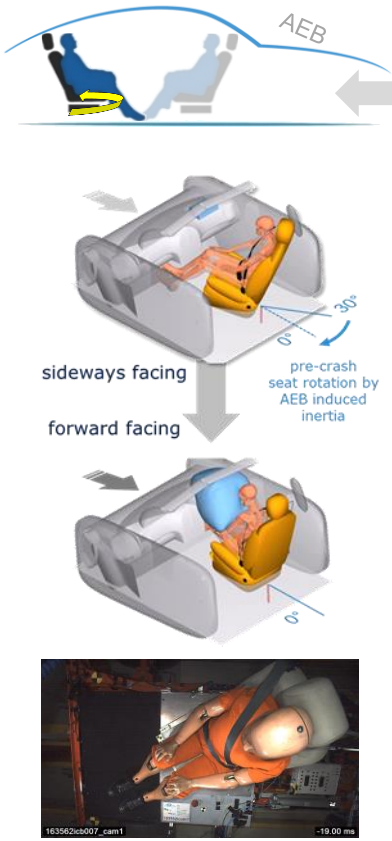


Figure: Bosch



Figures: ika / fka

Figure: Mercedes-Benz

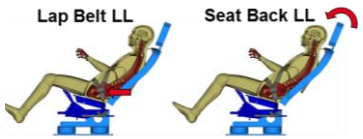


Figure: Autoliv

Figure: Volvo Cars

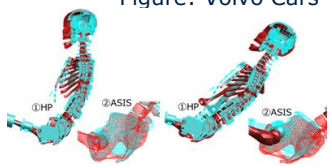
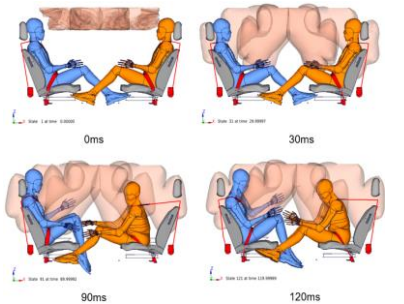


Figure: Toyota



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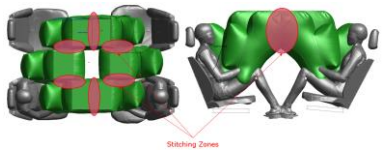

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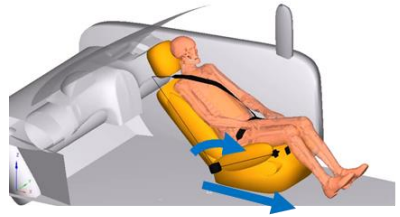

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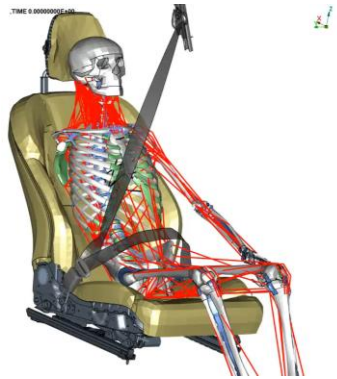
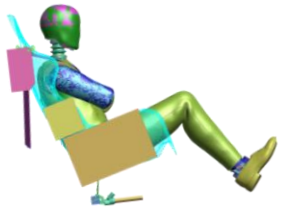
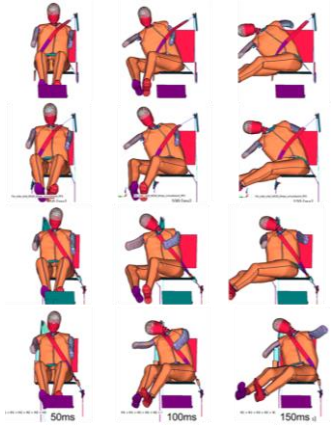


Figure: Volvo Cars



Figures: IDIADA



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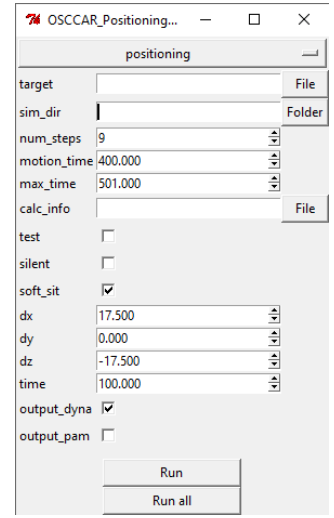
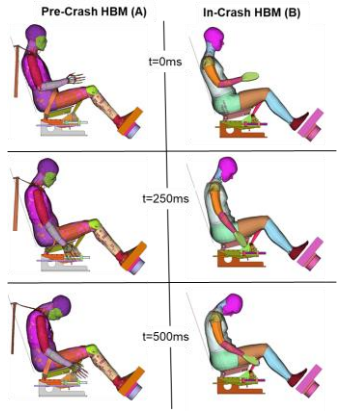
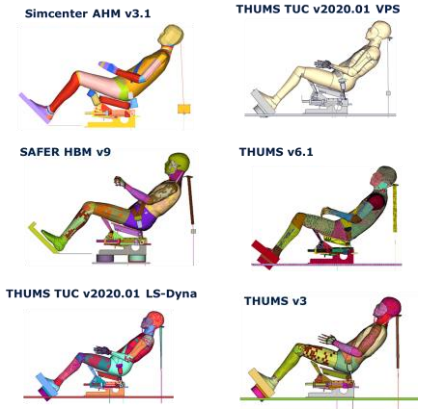
Comparable, continuous occupant assessment

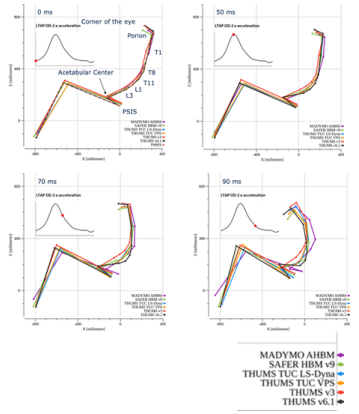
- OSCCAR HBM simulation based positioning tool
  - Open source tool (https://openvt.eu/groups/osccar/positioning)
- Kinematic transition method for Pre- and in-crash phase
  - Continuous simulation with different active and passive HBMs
  - Multi Body and Finite Element Method HBM transition capability
- Homologation Test case comparison
  - Comparison method
  - 3 Solvers, 6 HBMs,
  - 2 scenarios, pre+ in-crash
  - Environment models and data publicly available for future use
  - Kinematic and injury level analysis







Figures: VIF



Homologation testcase: shared data “post OSCCAR”

- **Environment**
  - Environment models and validation repository @ TUC (Thums User Community) https://tuc-project.org/frontal-sled-reclined/
  - Validation data from sled tests (Deliverable 2.5 +BAST / Autoliv sled test data available on request: please contact schiessler@bast.de)
- **Pulses**
  - OSCCAR generic crash pulses for future crashes @ TU Graz repository (https://repository.tugraz.at/) DOI:10.3217/datacite.2400t-cxv49
- **Tools**
  - Open source tool for positioning (https://virtual.openvt.eu/osccar/positioning)
  - Assessment: Dynasaur (https://gitlab.com/VSI-TUGraz/Dynasaur)
- **Results:** Simulation results of HBM simulations (Deliverable 4.3)

Public available data independent from OSCCAR

- **Positioning data** for HBMs in 48° reclined seated position: https://virginia.app.box.com/s/kpnt7v960a9fm7lsts5pa8hcfz4ojex1

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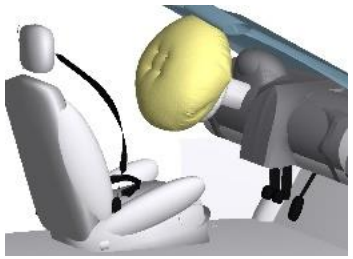
Virtual Testing Procedures

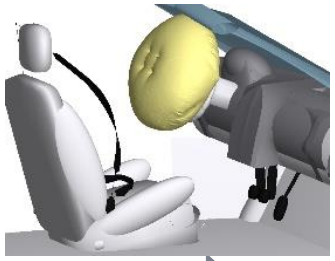
Phase 1: Vehicle Model Development

Vehicle Environment Simulation Model development by OEM)



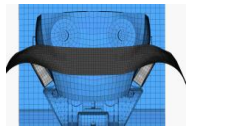
Code-specific **quality requirements** (numerical correctness, discretisation, convergence, element quality, control settings etc.)

Model calibration/validation based on previous models, data (e.g. material data base) and validation tests



Calibrated Vehicle Environment Model – status frozen (ready for VT)

Phase 2: Vehicle Model Certification (Validation check)



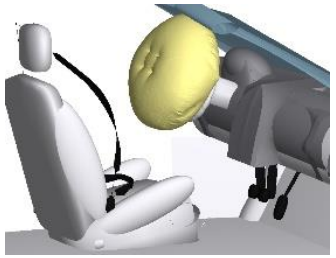
Validation Simulations performed by (OEM)

Simulation data

Objective correlation procedure

Test data

Hardware Validation Tests (performed or witnessed by NCAP/Technical Service)

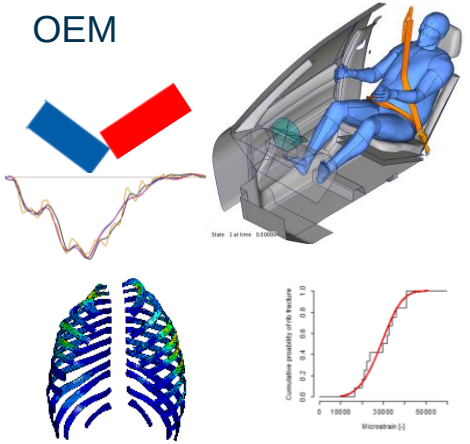


Officially Admitted/ Certified Vehicle Environment Model

Phase 3: Homologation / Assessment

Full Virtual Testing with HBM in new load case:

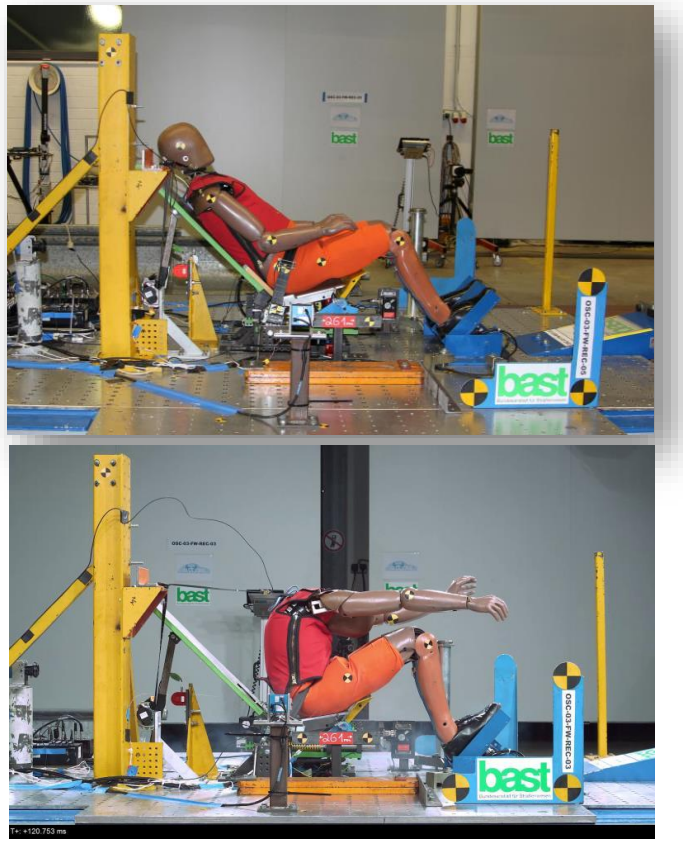
- Simulations performed by OEM



- Test tool: HBM certified for new load case
- Standardised virtual test procedure (Occupant positioning, belt installation,...)
- HBM based assessment criteria (kinematics/injury)

Virtual Testing Procedures

- Concept Demonstration & Validation:
  - Virtual Testing concept
  - Homologation Demonstrator for Virtual Testing
  - Harmonisation of Injury Risk Assessment



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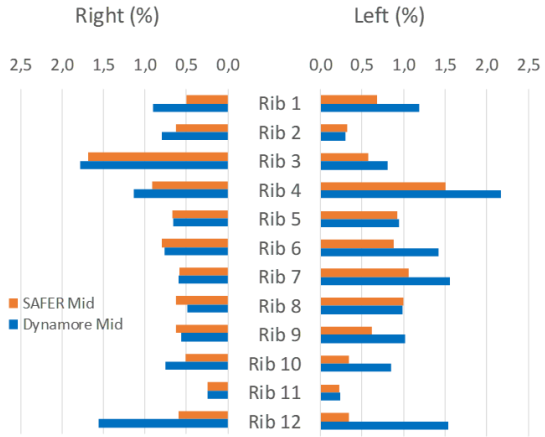

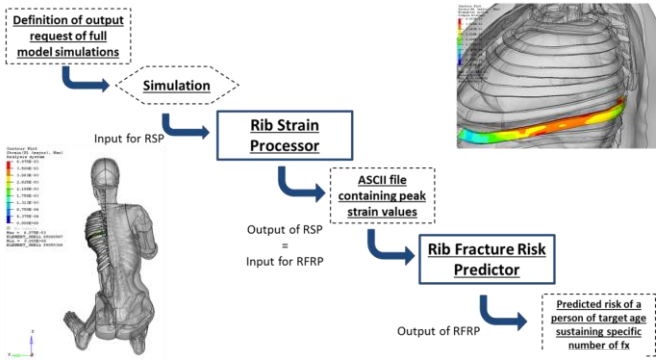

Example TUC tool

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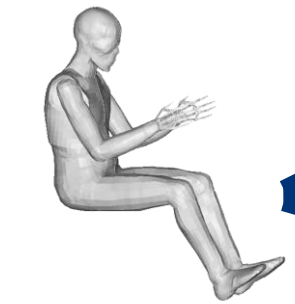
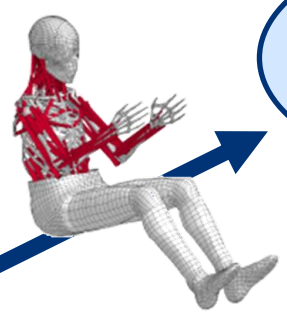
➢ diverse, omnidirectional, biofidelic and robust **HBMs**

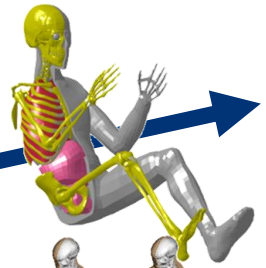


State of the Art HBM

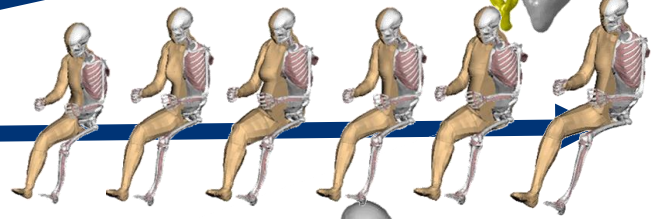
Active HBMs for pre-crash phase modeling



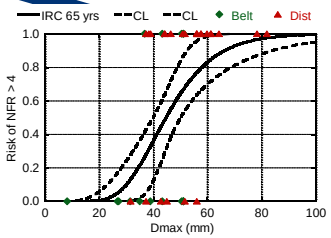
Representation of separate muscle, skin and fat tissues



Population heterogeneity aspects included



Multidirectional biofidelity for new sitting positions

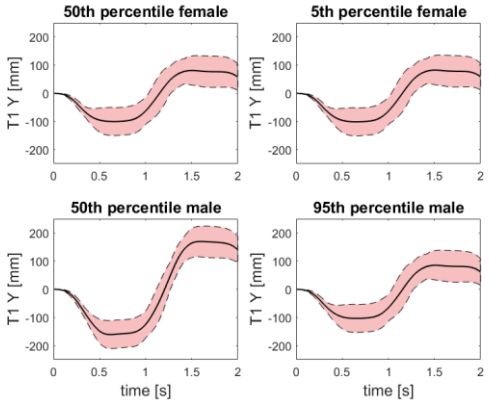


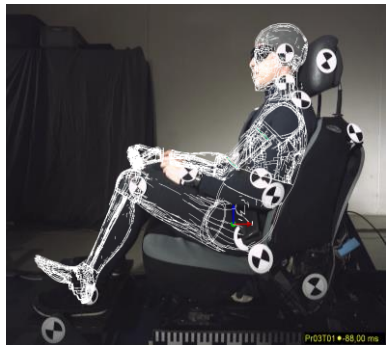
Improved and standardized injury criteria

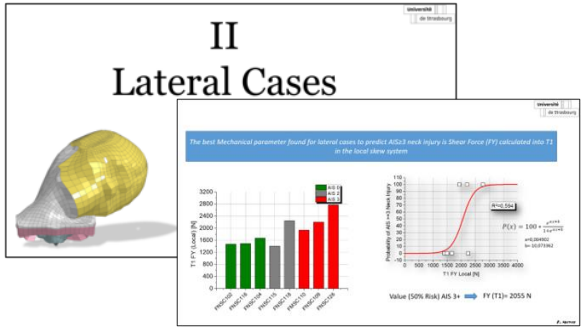
Improved HBMs for injury risk prediction

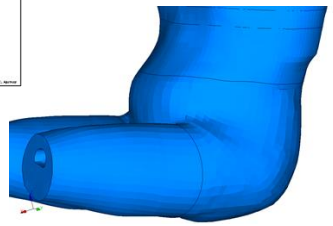
- Representation of diversity using HBMs
  - Morphed HBMs to match Age, Sex, Stature and Weight
- Specific HBMs for selected markets
- Public validation data catalogue for Active HBMs
- Injury Criteria for
  - Rib fracture analysis harmonization
  - Neck injury
  - Muscle injury
- Soft tissue modelling
- Neck modelling
- Lumbar spine and IVD modelling

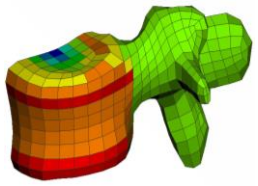
THUMS V4 Asian 50th Male

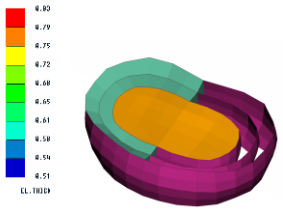












OSCCAR – Results – to be continuously updated

- Publications https://www.osccarproject.eu/media/publications/
- 20+ public OSCCAR Deliverables to be found here http://www.osccarproject.eu/media/deliverables/
- OSCCAR is on Social Media – Follow us for the latest news and updates! LinkedIn, Twitter
- Data, models, tools for further, post OSCCAR, open access use

All links to be found on OSCCAR webpage https://www.osccarproject.eu/media/

- Covise/ openPass OSCCAR extension of traffic simulation software
  - Installer hosted by USTUTT (COVISE/HLRS): COVISE: COVISE Download (hlrs.de)
  - Source code zu openPASS (customized for OSCCAR/COVISE) https://gitlab.eclipse.org/eclipse/simopenpass/simopenpass/-/tree/hlrs
- Environment models and validation repository @ TUC (Thums User Community) https://tuc-project.org/frontal-sled-reclined/
- Volunteer pre-crash behaviour validation catalogue data @ Zenodo /Openaire (https://zenodo.org/) https://zenodo.org/record/5747370; https://zenodo.org/record/5786677; https://zenodo.org/record/5774088; https://zenodo.org/record/5784240
- Pre-crash FE Seat models for validation catalogue data @OpenVT platform https://openvt.eu/osccar/precrash_seat_models
- OSCCAR HBM positioning tool @OpenVT platform https://openvt.eu/osccar/positioning
- OSCCAR generic crash pulses for future crashes @ TU Graz repository (https://doi.org/10.3217/datacite.2400t-cxv49

OSCCAR

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virtual vehicle

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