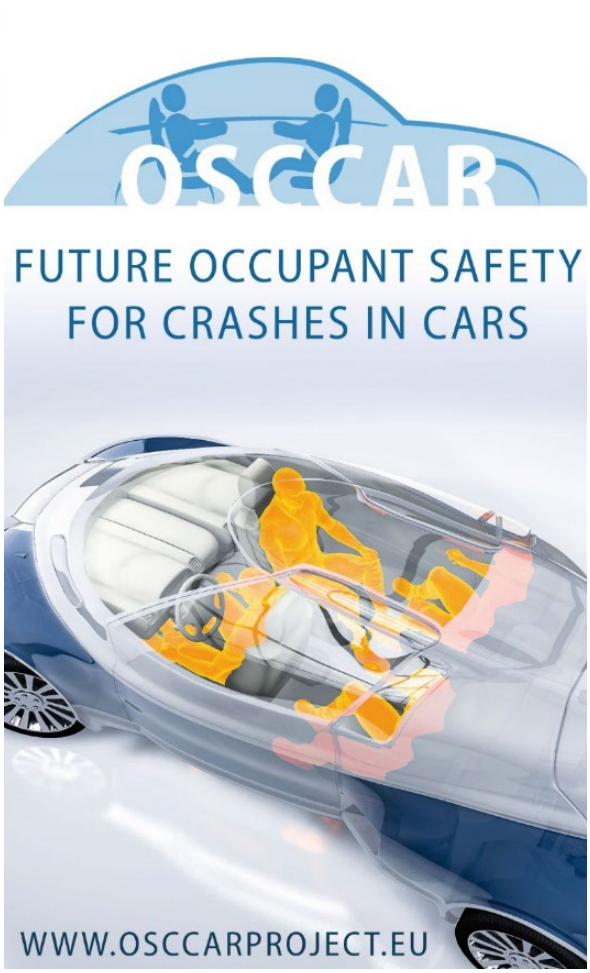
WELCOME TO OSCCAR NEWSLETTER!



Dear Readers,

A warm welcome to our Newsletter on EU-Project OSCCAR. Nearly two and a half years of research have passed, and OSCCAR is well on track to reach its research and innovation goals.

Time to give you a quick update on OSCCAR project! In addition to results, publications and news comprehensively documenting the work done in OSCCAR so far, this newsletter presents selected highlights and achievements from technical work packages from OSCCAR project.

NEWSLETTER CONTENT

HIGHLIGHTS AND ACHIEVEMENTS OF OSCCAR PROJECT

DETERMINATION OF FUTURE ACCIDENT SCENARIOS

lead by MERCEDES-BENZ AG

OSCCAR-WP1 addresses the key question: What will be the impact of automated vehicles onto road safety and, in particular, which future accident scenarios has an automated vehicle to face?

In WP1, we conducted an extensive study combining a simulation-based analysis with accident statistics in order to extract and extrapolate future remaining and relevant accident scenarios. For this study, WP1 focused on self-driving vehicles in highway situations and urban self-driving vehicles in crossing scenarios.

HIGHLIGHTS & ACHIEVEMENTS

The WP1 partners involved in the open-source activity “openPASS” (Mercedes Benz, Bosch, University of Stuttgart) focused on developing an open-source traffic model that comprises realistic surrounding traffic including human like behaviour leading to accidents. That allows to further investigate the potential accident situations an AD might encounter in mixed traffic. For this, multiple open-source tools were combined to create a fully functional software demonstrator to investigate these research questions.

BRIEF OUTLOOK

The WP1 partners will use the openPASS traffic model and run millions of kilometres of virtual simulations with and without a generic AD model to obtain enough “virtual accidents” to further analyse and provide results comparable to the approach based on accident statistics in the first project phase.

DEVELOPMENT OF ADVANCED OCCUPANT PROTECTION PRINCIPLES

lead by ika/ RWTH & fka GmbH

WP2 deals with the virtual conception and investigation of several advanced occupant protection principles (PP) for sitting positions and postures related to automated driving. Both an adaptation of the restraint systems towards these new boundary conditions and a repositioning of the occupant into a conventional seating configuration prior to a crash are considered. The respective working groups are dealing with rotated seats, reclined seating positions, an advanced airbag design for a "living room" configuration (occupants facing each other) as well as occupant restraint in a future interior with regard to a side crash. In total six protection principles have been defined.

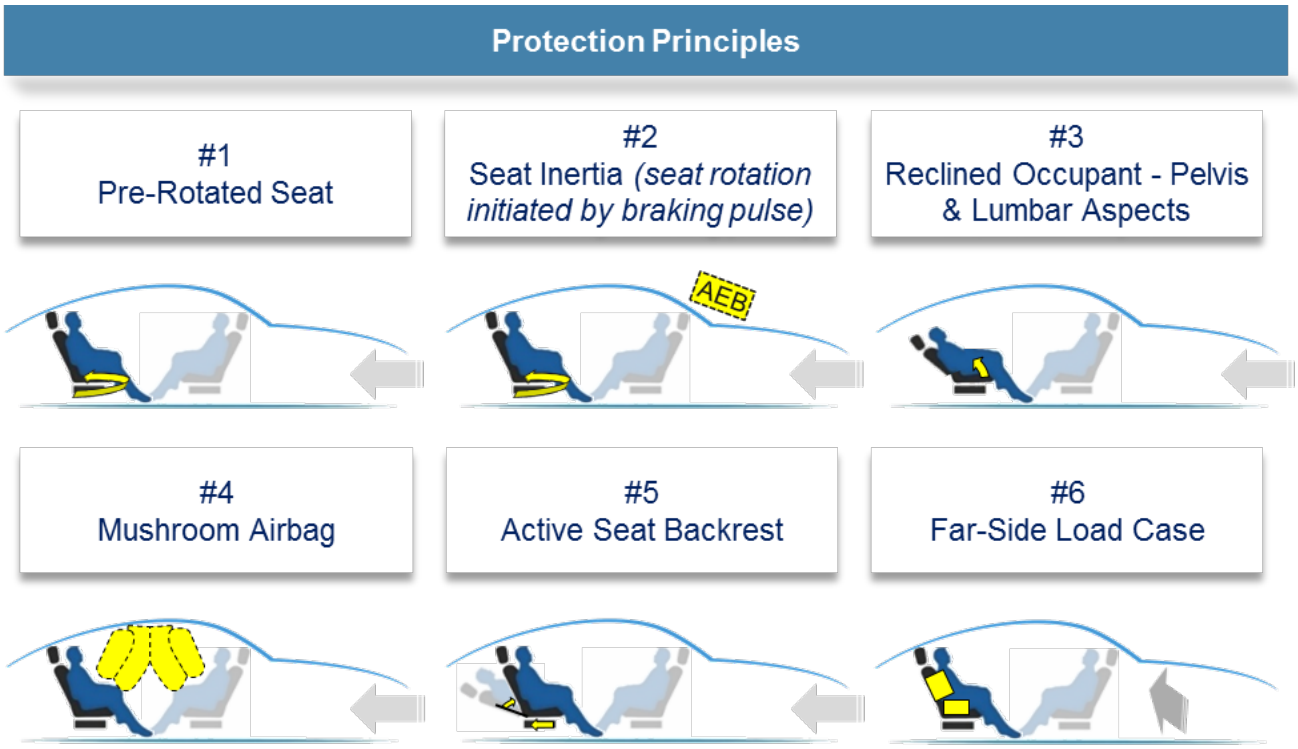


Figure 1 *Protection principles analysed in WP2*

Different hardware test series are performed in order to gain data for the validation of the respective simulation models and to demonstrate the functionality of selected protection principles.

HIGHLIGHTS AND ACHIEVEMENTS

- Definition of Protection Principle 6 as an additional research focus.
- Main simulation studies on the different protection principles have been finished.
- A Protection Principles Workshop has been held.
- A sled test series regarding Protection Principle 6 with a side impact dummy considering different restraint system layouts as well as seat side supports has been conducted.

BRIEF OUTLOOK

- Preparation of Deliverable D2.4 - Final virtual design of advanced passenger protection principles.
- Loop 2 of the sled test series for the homologation demonstrator test case: The focus of this demonstrator test case is on a reclined seating position and the challenges for the restraint system and the testing devices associated with such a configuration.
- Sled test series in order to demonstrate an inertia-driven seat rotation for different types of occupants, i.e., the seat is not actively rotated but the rotation is initiated solely by an emergency braking prior to the crash. This is achieved due to an active release of the seat and a corresponding rotation axis.

HUMAN BODY MODELS FOR ASSESSMENT OF NEW SAFETY SYSTEMS IN FUTURE VEHICLES

lead by CHALMERS TEKNISKA HOEGSKOLA AB

A new open-source model of the human lumbar spine has been developed for inclusion in Finite Element Human Body Models (FE-HBMs). The model is designed with special attention on details that allow for morphing to different gender and large ranges in stature and BMI. The model is also designed to be suitable for injury prediction at tissue level for occupants in different seating postures compared to reference posture. The model has been meshed, material models selected, and properties assigned. Current status is that the model has been tuned based on reproduction of past test with lumbar spine units. Near future activities is validation of the model; first only the lumbar spine unit and thereafter the lumbar spine integrated in an intact FE-HBM. Thereafter, the model will be made available to other OSCCAR partners. The final work on this lumbar spine model will be carried out in the SAFE-UP project where injury risk criterion and risk functions will be identified and constructed, respectively.

Several HBMs with the capacity to predict humanlike response in pre-crash braking events have been developed or improved within the OSCCAR project. These models are currently being validated using the volunteer data made available by several OSCCAR partners. Some of these models have been fitted a new muscle controller that was developed early in the project. One of the advantages with this new muscle controller is that it greatly reduces calculation time while another is that experimentally derived spatial tuning patterns are not required. Other partners have developed and are currently evaluating spatial tuning patterns that work with more complex body motions; combined translational and rotational motions of a body relative another body.

HBMs are typically representative of an average male or small female and these have been successfully used in the design of safer vehicles. Next step towards superior safety for all vehicle occupants is to develop ranges of validated HBMs that are representative of the population at the highest risks. Several works on this topic have been carried out within the project. The works have mainly proceeded well, sex and anthropometry of those at high injury risk in typical car crashes have been identified, models have been morphed to suggested anthropometries while works also identified a lack of validation data.

Previously we have presented progress on skin, muscle and fat tissue material models and geometric adaptions that were developed for FE-HBMs and were being included in several different FE-HBMs. The evaluation of those adaptions is currently performed in OSCCAR homologation demonstrator load case. Recently, a numerically fast fat model is being developed.

DEVELOPMENT OF ROBUST AND EFFICIENT CRASH SIMULATION TOOLS FOR INTEGRATED ASSESSMENT & OVERALL IMPACT DEMONSTRATION

lead by VIRTUAL VEHICLE RESEARCH GMBH

Workpackage 4 develops the tools and methods to ensure a standardized, comparable virtual assessment including the use of human body models.

A harmonized workflow which ensures comparable occupant simulations involves several steps, which are shown in Figure 2.

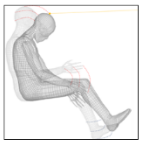
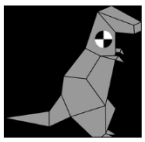
	Quality check	Positioning	Pre-Crash Phase	Transition	In-Crash Phase	Assessment
						
OSSCAR activity	Check list / tool **Task 4.1**	Positioning tool & method **Task 4.2.1**	Active models Task 3.3	Transition tool **Task 4.2.2**	Enhanced HBMs Task 3.2	Harmonized assessment based on DynaSaur tool **Task 4.2.3**

Figure 2 *Transition of kinematics from pre-to incrashmodels and finally the assessment of the simulation*

The workflow starts which a quality check, which monitors mainly the output settings of the simulation deck. Following a positioning process (see **OSCCAR Newsletter June 2020**) is conducted. Next the pre-crash phase is simulated. To hand over the kinematic information of the occupant from a pre-crash to an in-crash model, a transition method was developed in OSCCAR. This method will be described in more detail in this newsletter below. With this pre-conditioned model, the in-crash simulation is carried out. Finally, the simulations are assessed by using the open-source software Dynasaur, which is also enhanced in the OSCCAR project.

HIGHLIGHTS AND ACHIEVEMENTS

To hand over kinematic information between the pre-crash and the in-crash model, several methods are possible. Mapping methods which project the kinematic information (position, velocity) from the final pre-crash simulation step to the initial state of the in-crash simulation are one possibility to solve this task. Another method is, to repeat the pre-crash model motion with the in-crash model by guiding it along the pre-crash models trajectory.

That approach was chosen and adapted for the needs in the OSCCAR project. Among handing over the kinematic information from the pre- to the in-crash model the method needs to be applicable for unidentical occupant models. Different versions of Finite Element HBMs (with the same percentile) as well as combination of multibody models (pre-crash) and FE models (in-crash) needs to be covered by the OSCCAR method.

The basis of this transition method is the description of the human model anthropometry with a vector structure.

The vectors of the pre-crash model simulation are scaled to the in-crash model vector structure for every timestep in order to consider anthropometric differences. The coordinates of the vectors describe the trajectories which lead the in-crash model through the pre-crash phase, as shown in Figure 2. Doing so guarantees not only the transition of position information but also of velocity. After the final pre-crash timestep, the model is released, and the in-crash phase is initialized.

Figure 3 *OSCCAR kinematic transition method*

Figure 4 shows exemplarily the pre-crash kinematic transition from MB to FE (Madymo AHM 50% male to THUMS v3 AM50).

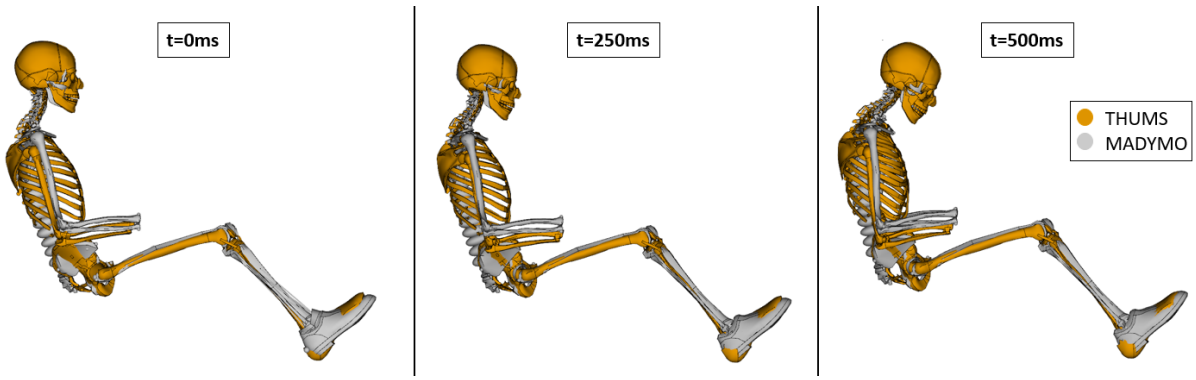


Figure 4 *Kinematic transition from a Madymo AHM to THUMS v3 AM 50*

BRIEF OUTLOOK

- Application of the developed methods in a “Homologation test case” with several OSCCAR partners
- Impact demonstration of Human Body Models for the use in occupant protection simulations

STANDARDIZATION OF VIRTUAL TESTING

lead by LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN

HIGHLIGHTS AND ACHIEVEMENTS

Within WP5 the work on the first of the three deliverables has been completed. Deliverable 5.1 "Standardised procedure for validating a vehicle environment for VT" summarises existing work and experience in the context of Virtual Testing in vehicle safety assessment.

In particular the processes outlined in the IMVITER project were used to create a flowchart and the description on how future Virtual Testing procedures could look like, in this first deliverable focusing on the occupant's environment, i.e. seat, belt, airbag, interior components etc... The results of that work and the content of the deliverable were presented and discussed in an OSCCAR-internal workshop with 26 participants.

BRIEF OUTLOOK

Following the overall objectives of the OSCCAR project, Virtual Testing is described as the complementation of existing protection assessment for load cases, in which there is no other option. That means in particular, that no physical testing as fallback is available, which creates particular demands on simulations used.

Validation of FE models of the occupant's environment thus require specific testing, being representative for the later Virtual Testing application. The use of a Validation Device (VD) is proposed here. This is not to be confused with the use and purpose of an Anthropomorphic Test Device (ATD), but an ATD can however serve as VD to a certain extent. A Validation Device does not serve for injury risk assessment.

The process of validation as entry requirement for subsequent Virtual Testing is creating challenges at the administrative side as well as in technical aspects. Proof of validation can potentially be given in existing testing but options for obtaining further proof as necessary need to be foreseen. Scatter of the mechanical response of components of the occupant's environment are essential to be considered as they are potentially largely influencing whether such proof can be obtained or not.

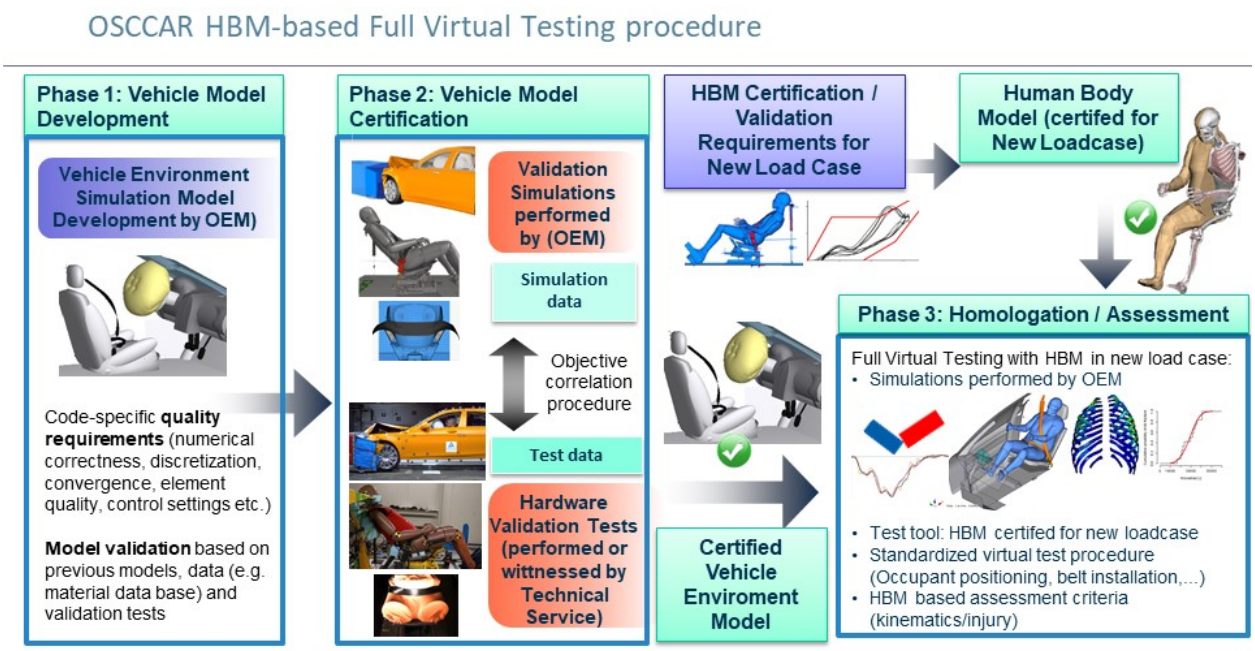


Figure 5 *Flowchart virtual testing*

OSCCAR OUTLOOK

The OSCCAR project is set to run until November 2021. During this time, the openPASS traffic model will be used to run millions of kilometers of virtual simulations to have sufficient "virtual accidents" to provide comprehensive results. Furthermore, the virtual design of the respective advanced passenger protection principles and the corresponding hardware testing will be finalised. Next step toward superior safety for all vehicle occupants is to develop ranges of validated HBMS that represent the population at the highest risk. Progress has also been made on skin, muscle and fat tissue material models and geometric adaptions that were developed for FE-HBMS. These adaptions are now evaluated. Recently, a numerically fast fat model is being developed.

The efforts from all OSCCAR partners in intensive joint work will lay the foundation for future harmonized virtual testing of advanced vehicle protection systems and the homologation of future sitting positions.

Selected results and articles/publications from OSCCAR project with the according links can be found below.

OSCCAR RESULTS AVAILABLE ON THE OSCCAR WEBSITE

Public OSCCAR deliverables

Definition of terms in context of virtual testing (OSCCAR cooperation with THUMS user community)

AD ready: future occupant protection

Knowledge transfer webinars to facilitate synergies between innovation projects

Joint VIRTUAL – OSCCAR workshop: Progress in Virtual Testing for automotive applications – available on YouTube

New publications out of OSCCAR since the last newsletter

- **Comparison of Controller Strategies for Active Human Body Models at the Example of Different Muscle Materials,** Isabell Wochner, Carola A. Endler, Syn Schmitt, Oleksandr V. Martynenko, IRCOBI – International Research Council on the Biomechanics of Injury Europe Conference, Florence, Italy

- **Effect of seat and seat belt characteristics on the lumbar spine and pelvis responses of the SAFER human body model in reclined posture,** Krystoffer Mroz, Martin Östling, et al., IRCOBI – International Research Council on the Biomechanics of Injury Europe Conference, Florence, Italy

- **Evaluation of Kinematics and Restraint Interaction when Repositioning a Driver from a Reclined to Upright Position Prior to Frontal Impact using Active Human Body Model Simulations,** Jonas Östh, Katarina Bohman, Lotta Jakobsson, IRCOBI – International Research Council on the Biomechanics of Injury Europe Conference, online 2020

- **Occupant Safety in Highly Automated Vehicles – Challenges of Rotating Seats in Future Crash Scenarios,** Julian Becker (RWTH), Gian Antonio D'Addetta, Maja Wolkenstein (BOSCH), Freerk Bosma, Ruud Verhoeve (SISS), Swen Schaub, Michael Sprenger (ZF), Michael Hamacher (fka), IRCOBI – International Research Council on the Biomechanics of Injury Europe Conference, online 2020

- **A method for predicting crash configurations using counterfactual simulations and real-world data,** Alexandros Leledakis, Magdalena Lindman, Jonas Östh, Linus Wågström, Johan Davidsson, Lotta Jakobsson, Accident Analysis & Prevention, Volume 150, February 2021

GENERAL PROJECT INFORMATION

More information on OSCCAR is available on our website: www.osccarproject.eu.

Our latest news are also available on Twitter and Linkedin:

Follow us on Twitter: https://twitter.com/OsccarProject

Follow us on LinkedIn: https://www.linkedIn.com/groups/13655575

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

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

Follow us on Twitter
https://twitter.com/OsccarProject

Become OSCCAR member on LinkedIn
https://www.linkedin.com/groups/13655575/

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

WWW.OSCCARPROJECT.EU

Acknowledgement

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

This document reflects only the author's view, the Innovation and Networks Executive Agency (INEA) is not responsible for any use that may be made of the information it contains.