WELCOME TO THE OSCCAR NEWSLETTER!

Dear Readers,

A warm welcome and thank you for reading our Newsletter on the EU-Project OSCCAR. Over three years of research have passed, and OSCCAR is in its final stage, with the official project end in November 2021. The project is well on track to reach its research and innovation goals.

It is very unfortunate that the consortium hasn't met face-to-face for a long time, but there is a small glimpse of hope to see each other personally for the **final consortium meeting** scheduled for 29-30 November. We are looking forward to presenting the results and achievements of the project on the 30th of November from 09:00 – 12:00. **If you want join us online please register via this link.**

Now it is time to give you one more update on the OSCCAR project! We hope that the selected highlights at the beginning will inspire you and give you a deep insight into results and achievements within the OSCCAR project. Additionally, you'll find publications and news comprehensively documenting the work done in OSCCAR so far and selected highlights and achievements from technical work packages from the OSCCAR project. Enjoy reading!

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OSCCAR project featured in Crash Test Technology International

Read this very interesting and comprehensive **article** (page 30-34).

How we create a safe driving experience using human body models

Bosch Research blog article about challenges of new vehicle interiors and the pre-studies of Bosch colleagues carried out within **OSCCAR**.

Enjoy reading: **Your automated driving trip – how we create a really safe trip using human body models**

How does a self-driving car protect itself in a collision?

Nice story about "How does a self-driving car protect itself in a collision?"

Article in Hungarian: **Köszönöm szépen!**
Find an automatic translated version by **Google translate**.

Podcast about the OSCCAR project

You like podcasts? Then listen to this **very interesting podcast about the OSCCAR project** from our colleagues from fka.

HIGHLIGHTS AND ACHIEVEMENTS OF THE OSCCAR PROJECT

DETERMINATION OF FUTURE ACCIDENT SCENARIOS

lead by MERCEDES-BENZ AG

The objective of Work Package 1 (WP1) within OSCCAR is to predict future traffic scenarios as well as future crash configurations for automated vehicles based on current crash data. Human error in terms of performance limits, lack of attention or lack of obeying traffic rules is estimated to contribute to the majority of road crashes. Since automated vehicles are expected not to show human imperfections, they are expected to be involved in considerably fewer crashes. Yet, automated vehicles are expected to be involved in unavoidable collisions within their Operational Design Domain (ODD). The crash configurations as well as the crash pulses derived from those remaining road crashes serve as an input for occupant protection measures in other OSCCAR work packages.

HIGHLIGHTS & ACHIEVEMENTS

A first analysis of future crash configurations of automated vehicles was reported in OSCCAR WP1 deliverable **D1.1 Accident data analysis – remaining accidents and crash configurations of automated vehicles in mixed traffic**. By assuming some crashes linked to, e. g., violation of traffic rules, and an inherent avoidance of those crashes by automated vehicles on the one hand and performing pre-crash simulations with a conceptual collision avoidance function on the other hand, remaining crashes for urban intersections and motorways were identified. Out of these remaining crashes, representative test-scenarios were derived by cluster analysis and presented as final results of **D1.1**.

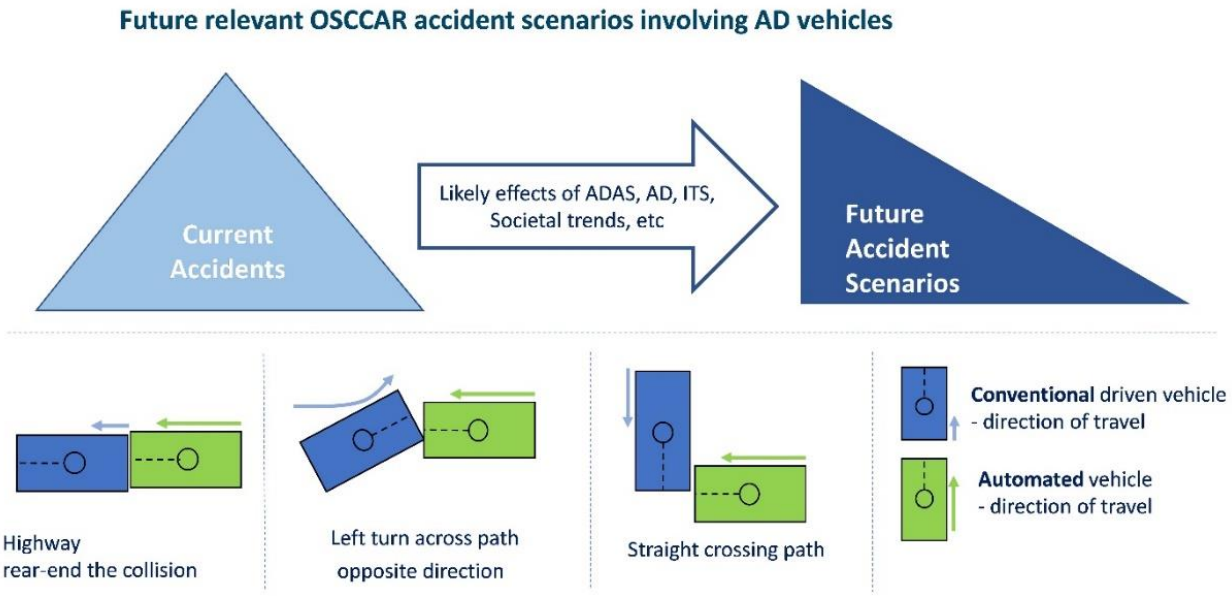

Figure 1 *Future relevant OSCCAR accident scenarios involving AD vehicles*

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. 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. This is clearly described in detail in the public deliverable **D1.2 openPASS framework for integrated safety assessment**, soon available on the OSCCAR webpage.

The OSCCAR WP1 deliverable **D1.3 Future collision type matrix** marked the end of WP1. It provided a comprehensive outlook from accident research perspective on potential challenges for occupant safety of automated vehicles beyond the state-of-the-art. It covers the substantial work on crash pulses – selecting them from predicted crash configurations and transferring them into useful acceleration time series data for occupant simulation.

By using openPASS, a novel traffic model is used to amend the initial D1.1 findings on potentially remaining crashes of automated vehicles where traditional crash data is limited. Finally, the EU weighting completes the new methodology and provides EU figures based on the local and national results.

Based on the results of this work, the **other OSCCAR work packages received a basis for evaluating future interior use cases with virtual assessment methods** focusing on the use of active human body models. Connecting different domains of safety assessment led to a new methodology for integrated virtual safety assessment within the entire OSCCAR project. This allows to manage the complexity arising with automated vehicles in terms of, e. g., new crash configurations, pre-crash behavior, and new seating positions.

DEVELOPMENT OF ADVANCED OCCUPANT PROTECTION PRINCIPLES

lead by ika/ RWTH & fka GmbH

WP2 deals with the conception and investigation of advanced occupant protection principles for high and fully automated vehicles. Since future interiors will offer more degrees of freedom for passengers, e.g. rotated or reclined seating positions, the restraint systems like belts or airbags have to be adapted towards these new boundary conditions. Furthermore, a repositioning of the occupant into a safe seating configuration prior to a crash is considered.

The main objective of WP2 is the virtual conception and investigation of several advanced occupant protection principles addressing different future seating configurations and vehicle automation levels respectively. Various hardware test series were performed in order to gain data for the validation of the respective simulation models and to demonstrate the functionality of selected protection principles.

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HIGHLIGHTS AND ACHIEVEMENTS

In a first step, a methodology was developed in order to structure and define combinations of aspects relevant for occupant protection evaluation in future passenger cars (Deliverable D2.1). A so-called Test Case thereby contains specifications regarding seating configurations, sitting postures, individual human variations (for example age and size) as well as future crash configurations (WP1). Two user studies were performed on preferred seat rotation and sitting postures in future cars in order to provide input with regard to the developed methodology.

For the virtual investigation of advanced passenger protection principles respective simulation models were generated (Deliverable D2.2). These generic models represent possible future interior concepts. The main step for identifying and selecting the advanced passenger protection principles (PP) took place in an ideation workshop with involvement of almost all OSCCAR partners. Finally, different advanced protection principles were selected for further investigation (Deliverable D2.3).

Six working groups were established to virtually elaborate and study the advanced occupant protection principles, addressing different 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 were regarded, considering aspects like occupant variety and omnidirectional occupant loading. The respective working groups dealt with rotating 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 (Deliverable D2.4).

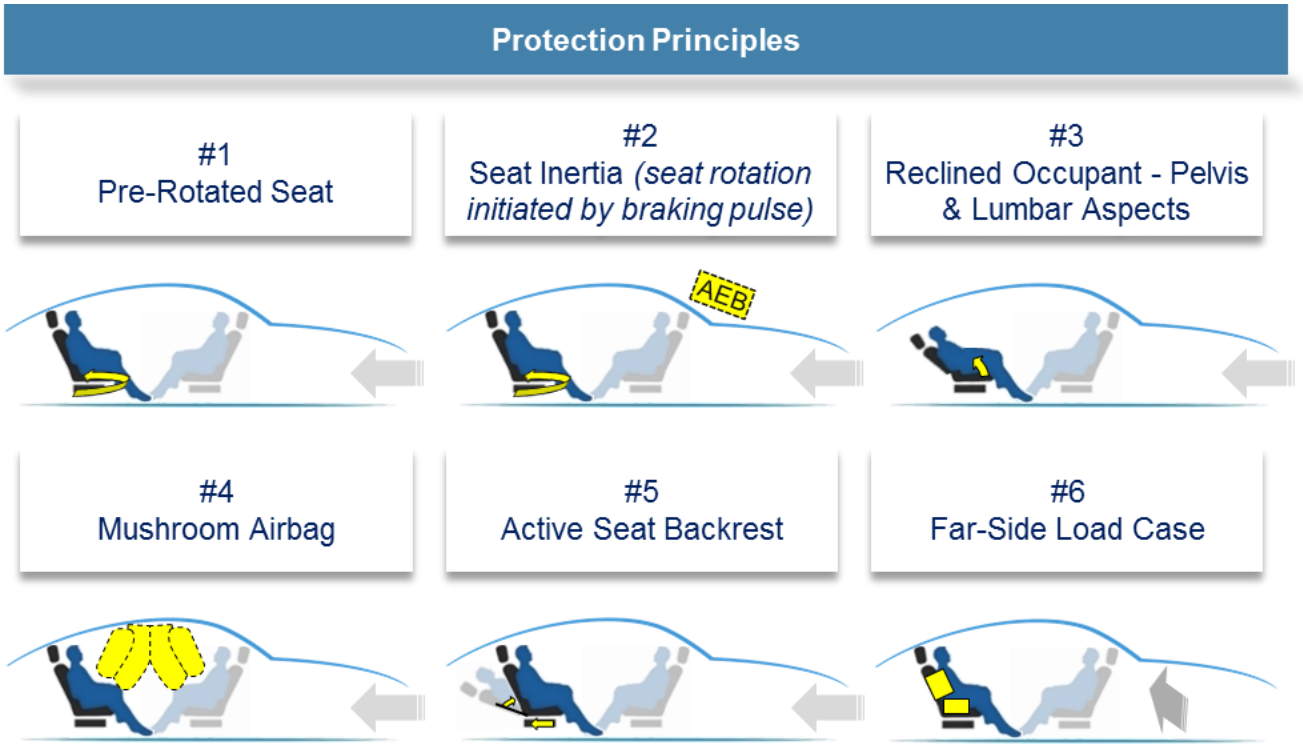

***Figure* 2** *Protection principles analysed in WP2*

The last task of WP2 was the demonstration and validation of a homologation demonstrator test case as well as two of the advanced passenger protection principles (PP2 & PP6). For this purpose, various hardware test series were carried out and corresponding simulation models were generated (Deliverable D2.5). The homologation demonstrator evaluated a reclined seating position and the challenges for the restraint system and the testing devices associated with such a configuration, especially with regard to the restraint of the occupant's pelvis. The focus was on the provision of a robust test setup and complete test results for the validation of the associated virtual demonstrator, primarily as input to WP4 and WP5.

The functionality of PP2 was demonstrated by a physical demonstrator on a test sled for different types of occupants and footrest configurations. The seat was not actively rotated (as for PP1) but the rotation was initiated solely by an emergency braking prior to the crash with a simultaneous release of the seat, considering an optimised rotation axis. For all dummy sizes, a complete seat rotation from an initial seat angle of 30° inwards could be achieved within a total time of around 500 ms for a maximum brake deceleration of only 0.5 g. Besides the physical tests, corresponding simulations were conducted within the framework of a virtual demonstrator.

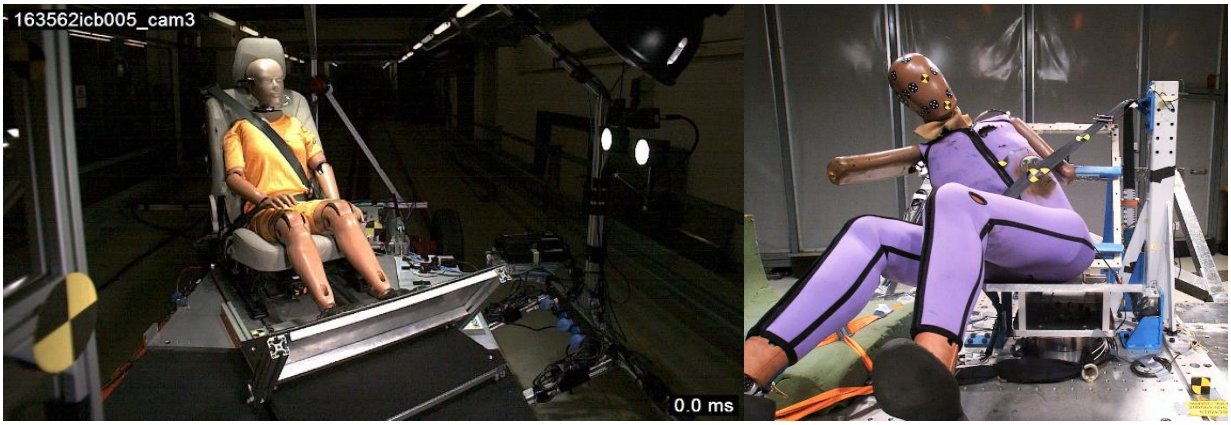

Figure 3 *Physical demonstrators for PP2 5th percentile female – footrest implemented (left) and PP6 test with no seat side supports (right)*

Another physical demonstrator was used to study the performance of PP6. Different restraint system configurations as well as seat side supports were evaluated with a side impact dummy in a far-side load case (opposite side to the one that is struck in a side crash), representing a future crash scenario for vehicles with flexible interiors without the presence of a centre console. Ten sled tests were performed using a generic simplified vehicle environment. The test data was compared to the simulation results of the corresponding numerical models, looking at dummy kinematics and injury assessment values.

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

lead by VIRTUAL VEHICLE RESEARCH GMBH

Workpackage 4 aims at developing the necessary methods to allow a harmonized simulation and assessment of pre-and incrash. That includes a quality check, ensuring a harmonized initial sitting position (1st OSCCAR newsletter), enabling to handover the kinematic information of the HBM from pre- do incrash (2nd OSCCAR newsletter) and finally assessing (Dynasaur) HBMs after the in-crash simulation.

HIGHLIGHTS AND ACHIEVEMENTS

One of the requirements for comparable occupant simulations is a clearly defined initial occupant position. To achieve that for different versions of HBMs a method and a tool were developed. The developed tool is a script which is executable in Piper (http://www.piper-project.eu/). It allows the definition of the initial occupant position and provides the necessary solver input files for VPS and LS-Dyna.

If a pre-crash simulation is conducted prior to the in-crash simulation, the kinematics at t_0 needs to be taken into account besides the initial position. Since only some models are capable / validated for both phases, a method and a tool were developed. It allows the kinematic transition from pre-crash simulations to the in-crash model, even, if these models differ slightly or if the kinematics should be handed over from a multibody to a FE model.

The final step of ensuring comparable results is a harmonized assessment. Therefore, the tool Dynasaur is used and enhanced in OSCCAR. It reads the simulation output files directly, processes them and creates a standardized output. Latest updates concerning injury risk curves (Rib fractures) from OSCCAR WP 3 were included and the possibility of reading results files from three codes (LS-Dyna, Madymo, VPS) was added.

The developed methods are finally applied in the OSCCAR Homologation testcase. In this simulation testcase, several partners run pre- and incrash simulations in a well-defined environment under the same boundary conditions (pulse, belt firing times, sitting position,…) using their own 50% M HBMs. The aim is to get comparable simulation results in the understanding of "it is possible and makes sense to compare the results". The testcase is a prove of concept for a harmonized simulation and assessment.

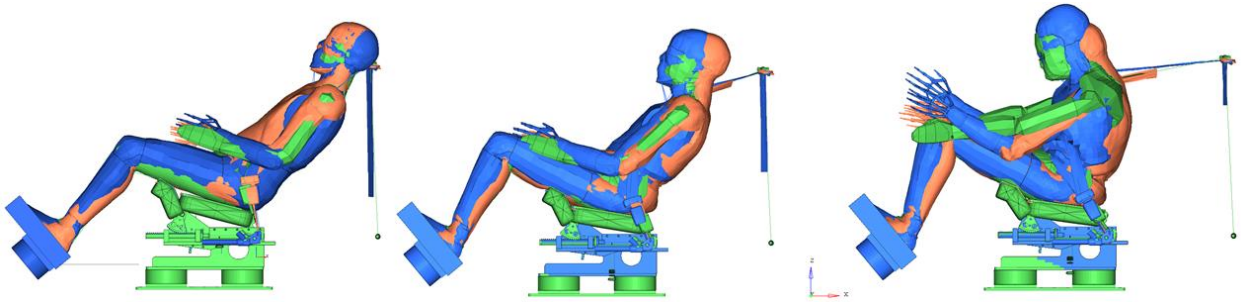

Figure 4 *WP4 Pilot Group*

OSCCAR OUTLOOK

The OSCCAR project is set to run until November 2021, and we still have some plans. There are some deliverables to be finalized. The public documents will be openly accessible on the webpage as soon as they are approved by the European Commission.

A workshop on ***Human Body Modelling Applications in Biomechanics*** will take place on the 19th of November in the frame of the IRCOBI 2021 including a talk about OSCCAR project. **The final OSCCAR consortium and General Assembly meeting will take place from 29-30 November**, and we are looking forward to presenting the results and achievements of the project on 30th of November for the public from 09:00 – 12:00. **If you want join us online please register via this link.**

You will certainly hear from us!

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

New publications out of OSCCAR since the last newsletter

- **Predicted crash configurations for Autonomous Driving vehicles in mixed German traffic for the evaluation of occupant restraint system.** Martin Östling, Hanna Jeppsson, Nils Lubbe; IRCOBI – International Research Council on the Biomechanics of Injury Europe Conference, Florence, Italy
- **Occupant safety use cases in Highly Automated Vehicles.** Julian Becker , Gian Antonio D'Addetta, Maja Wolkenstein, Freerk Bosma, Ruud Verhoeve, Swen Schaub, Michael Sprenger, Michael Hamacher; IRCOBI – International Research Council on the Biomechanics of Injury Europe Conference 2020, online
- **Transition of a Pre-crash Occupant Kinematic to an In-crash Simulation Model.** Dominik Breitfuß; 8th International Symposium: Human Modeling and Simulation in Automotive Engineering, Wiesbaden, Germany
- **Application of Human Body Models to analyse the challenges of future occupant use cases in highly automated vehicles – OSCCARs advanced protection principles.** Julian Becker, Michael Hamacher, Gian Antonio D'Addetta, Maja Wolkenstein, Atul Mishra, Christian Mayer, Thomas Wohllebe, María González-García, Jens Weber, Lennart Nölle, Oleksandr Martynenko, Syn Schmitt, Freerk Bosma, Ruud Verhoeve; 8th International Symposium: Human Modeling and Simulation in Automotive Engineering, Wiesbaden, Germany
- **With or Without Foot Support? Influence on reclined SAFER Human Body Model Kinematics and Loading.** Krystoffer Mroz, Nils Lubbe, Martin Östling; Human Modeling and Simulation in Automotive Engineering, 2020
- **Defining Injury Criteria for the Muscle-Tendon-Unit**. Lennart V. Nölle, Syn Schmitt, OleksandrV. Martynenko; IRCOBI – International Research Council on the Biomechanics of Injury Europe Conference 2020, online
- **Development of a detailed human neck FE model and injury risk curves under lateral impact**. Meyer F., Humm J., Yoganandan N., Leszcznski A. Bourdet N., Deck C., Willinger R; Journal of the Mechanical Behavior of Biomedical Materials
- **The influence of car passenger' sitting postures in intersection crashes**. Alexandros Leledakis, Jonas Östh, Johan Davidsson, Lotta Jakobsson; Accident Analysis & Prevention Journal
- **Female Kinematics and Muscle Responses in Lane Change and Lane Change with Braking Maneuvers**. Ghazaleh Ghaffari and Johan Davidsson; Traffic Injury Prevention Journal
- **Rib cortical bone fracture risk as a function of age and rib strain: Updated injury prediction using Finite Element Human Body Models**. Karl-Johan Larsson, Amanda Blennow, Johan Iraeus, Bengt Pipkorn, Nils Lubbe; Frontiers in Bioengineering and Biotechnology
- **Validation Procedure for a Vehicle Environment Simulation Model to be used for HBM-based Virtual Testing**. Andre Eggers, Christian Mayer, Steffen Peldschus

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**

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