

# Success stories – continuous assessment

Christoph Klein (VIF)



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

*Disclaimer excluding JU responsibility*

*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.*

- Developed tools for handling HBMs
  - Positioning
  - Transition
- Homologation testcase
  - Combining OSCCAR research results
  - Harmonized Assessment
  - Public available data/information “post OSCCAR”

# Tools for handling HBMs

## Positioning - Transition



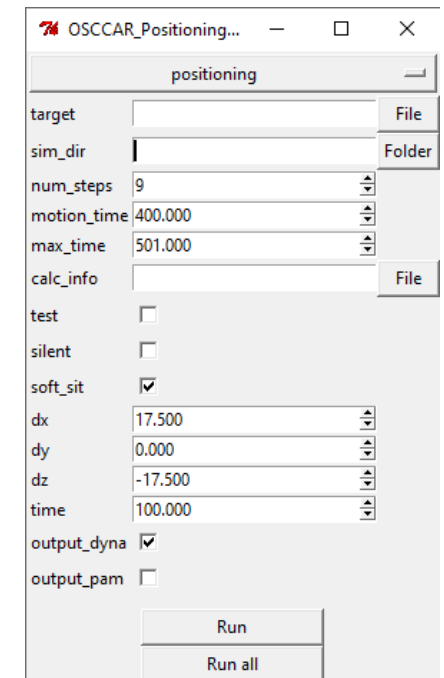
*OSCCAR has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 768947.*

*Disclaimer excluding JU responsibility*

*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.*

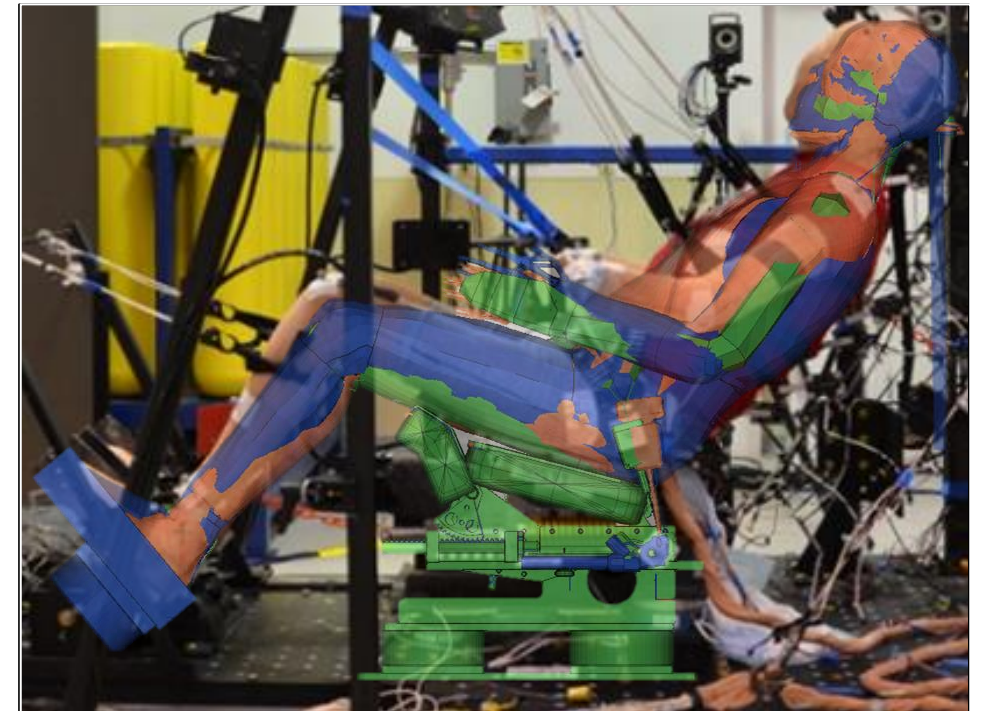
# Tools for handling HBMs - Positioning

- HBMs mostly don't have kinematic joints - Joints work contact based
  - How to position HBMs?
- Open source tool (<https://virtual.openvt.eu/osccar/positioning>)
- Executable in Piper (<http://www.piper-project.eu/>)
- Works with the Piper Metadatafile for each HBM
- Requires target coordinates for certain landmarks
- Simulation based:
  - Calculates trajectories for positioning + creates FE solver input decks
  - adapts to HBMs anthropometry
  - Simulation approach considers contact to e.g. seat
- Published at IRCOBI 2021 (Siemens, VW, VIF)
  - "A Method for Reproducible Landmark-based Positioning of Multibody and Finite Element Human Models", IRC-21-53



## ■ Demonstration

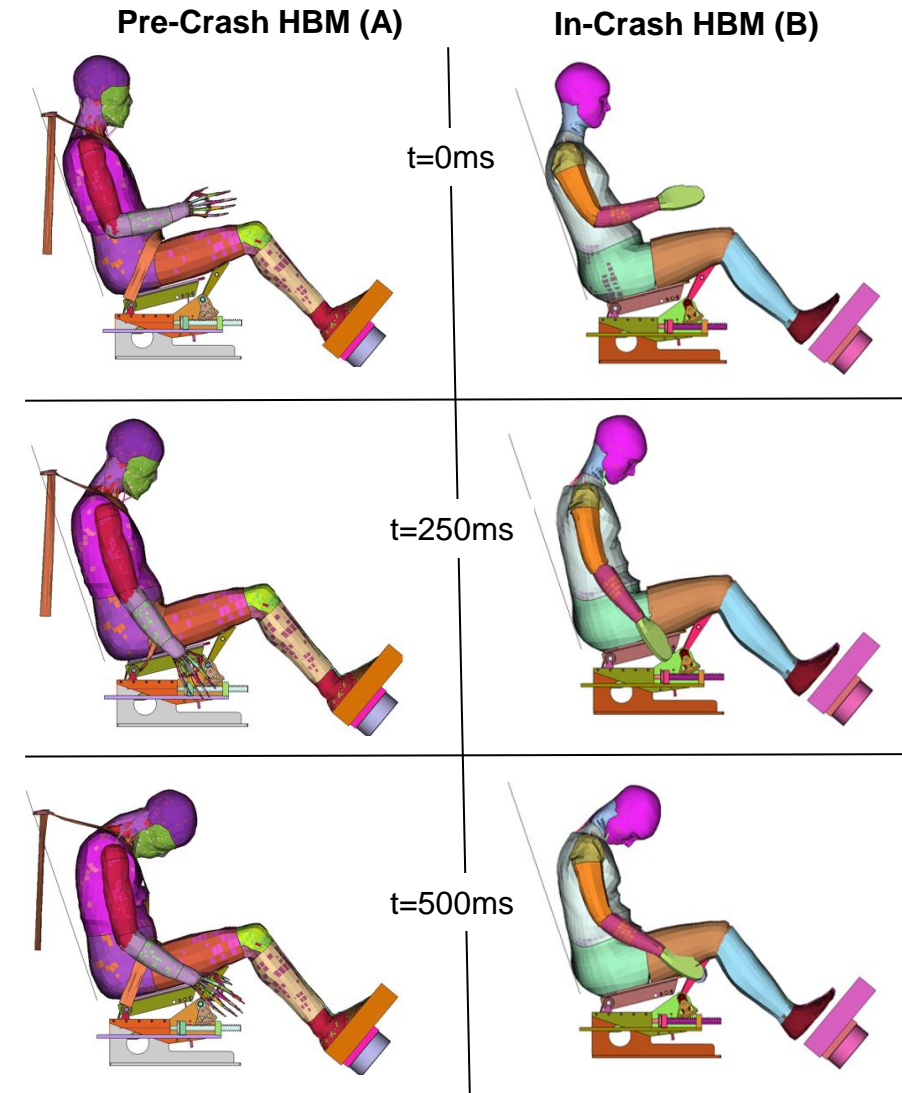
0:OSCCAR.d3plot : 07\_BUCKLE\_\_PBP1d5\_v113\_pass : STATE 1 ,TIME 0.00000000E+00



Richardson R, Donlon et al (2019) Test methodology for evaluating the reclined seating environment with human surrogates. Proceedings of the 26th International Technical Conference on the Enhanced Safety of Vehicles (ESV). Paper Number 19-0243. June 2019.

## Kinematic transition

- Aim:
  - Pre- and in-crash simulation with different HBMs
  - Initialize the in-crash HBM with proper kinematic information at  $t_0$  (In-crash starts)
- Method uses the pre-crash occupant kinematics
- Prescribes it to the in-crash model
- Basically the in-crash HBM repeats the pre-crash phase kinematics
- Possible between different HBMs of roughly the same anthropometry
- Possible between MB and FE HBMs
- Demonstrated in D 4.2



# Homologation testcase

Christoph Klein (VIF)



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

*Disclaimer excluding JU responsibility*

*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.*

## ■ Aim of the homologation testcase

- Occupant simulation using HBMs in 48° reclined position
- 3 solver codes (LS-Dyna, VPS, Madymo)
- Validated environment
- Goal: Comparable simulations

## ■ Necessary checks

- Environment (Pulse, Belt activation times)
- HBM <-> Environment (Contact forces, belt forces)
- is it sensible to compare the simulations?

## ■ HBM Kinematics + injury indicators and risk

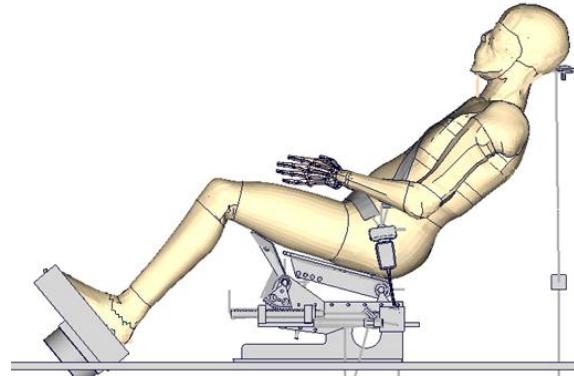


# Homologation testcase: Initial positions

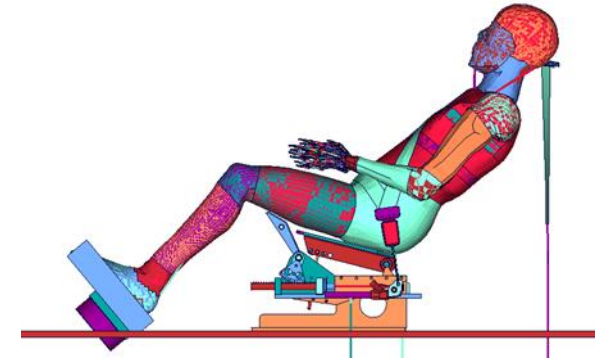
**Simcenter AHM v3.1**



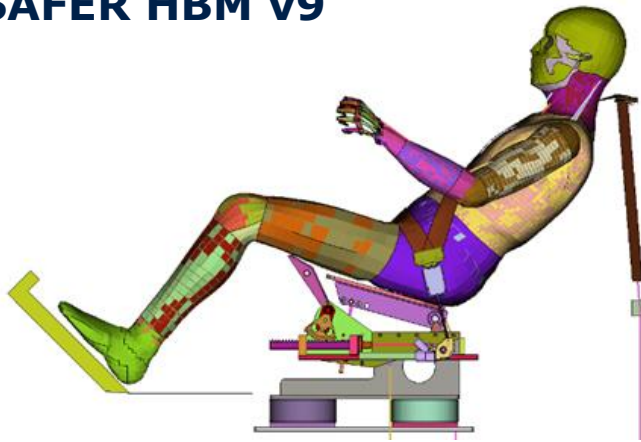
**THUMS TUC v2020.01 VPS**



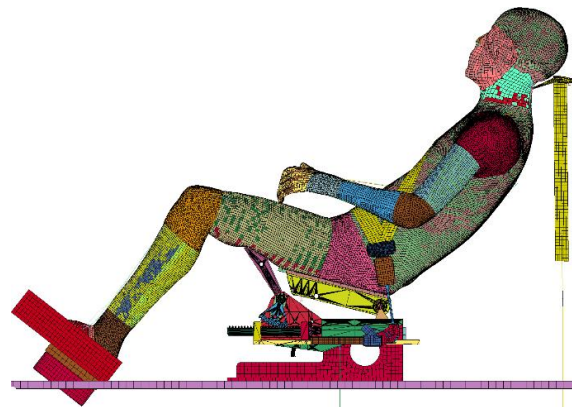
**THUMS TUC v2020.01 LS-Dyna**



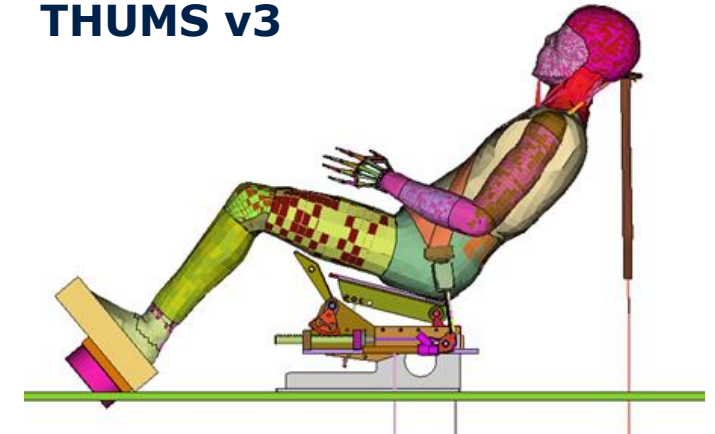
**SAFER HBM v9**



**THUMS v6.1**

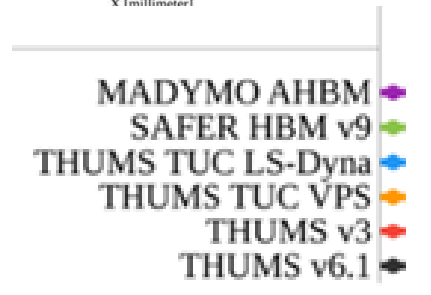
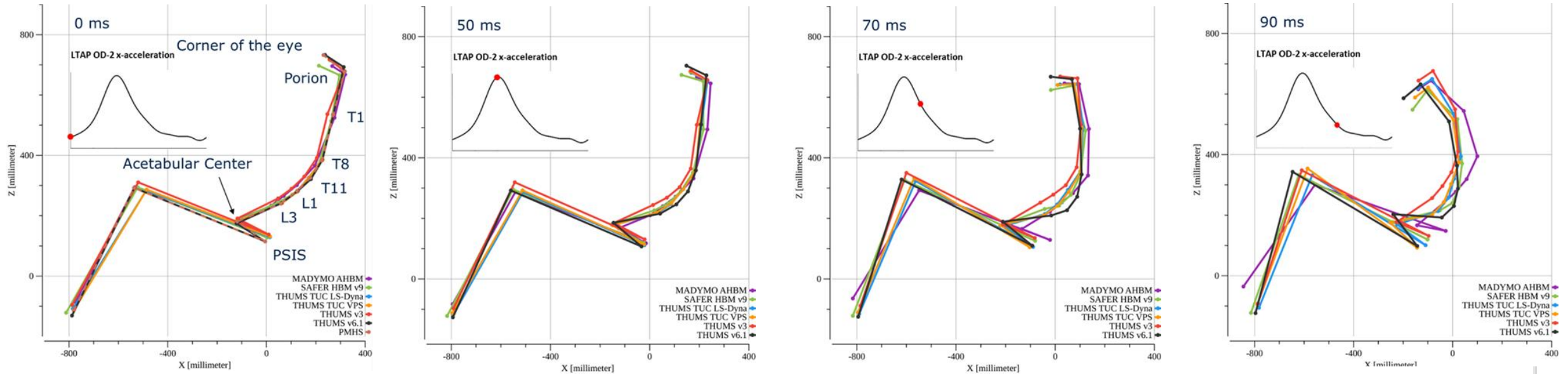


**THUMS v3**



# Homologation testcase: Harmonized kinematic assessment

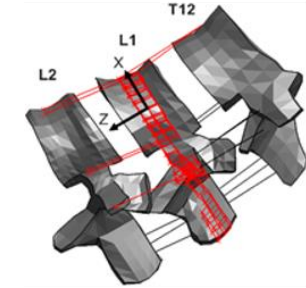
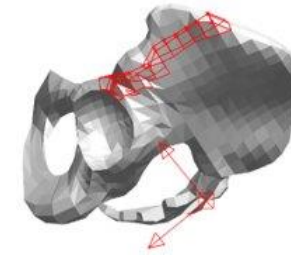
## Kinematic depiction by anatomical landmarks (stick figures)



# Homologation testcase: Harmonized injury assessment

## ■ Injury indicators

- Lumbar spine forces / moments
- ASIS forces



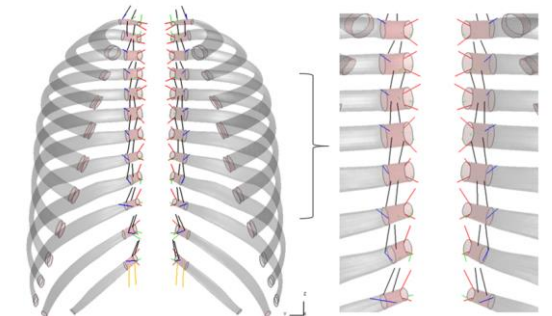
## ■ Injury risk parameters

- Head injury risk (analysed with SUFEHM)

Model	HIC15	HIC 15 AIS 2+	BRIC	BriC MPS AIS2+	SUFEHM [kPa]	SUFEHM_RISK [%]	A3MS
SAFER HBM v9	102	3%	0.68	75%	6.29	7%	37
Madymo AHM	136	7%	0.72	81%	5.27	6%	40
THUMS TUC LS-Dyna	117	5%	0.51	47%	5.02	6%	37
THUMS v6.1	202	19%	0.82	91%	5.01	6%	47
THUMS v3	108	4%	0.67	74%	4.96	6%	36
THUMS TUC VPS	106	4%	0.60	62%	5.87	6%	37

## ■ Rib strain determination according to Forman et al. 2021

- Extraction of rib strains was further harmonized in OSCCAR Task 3.3



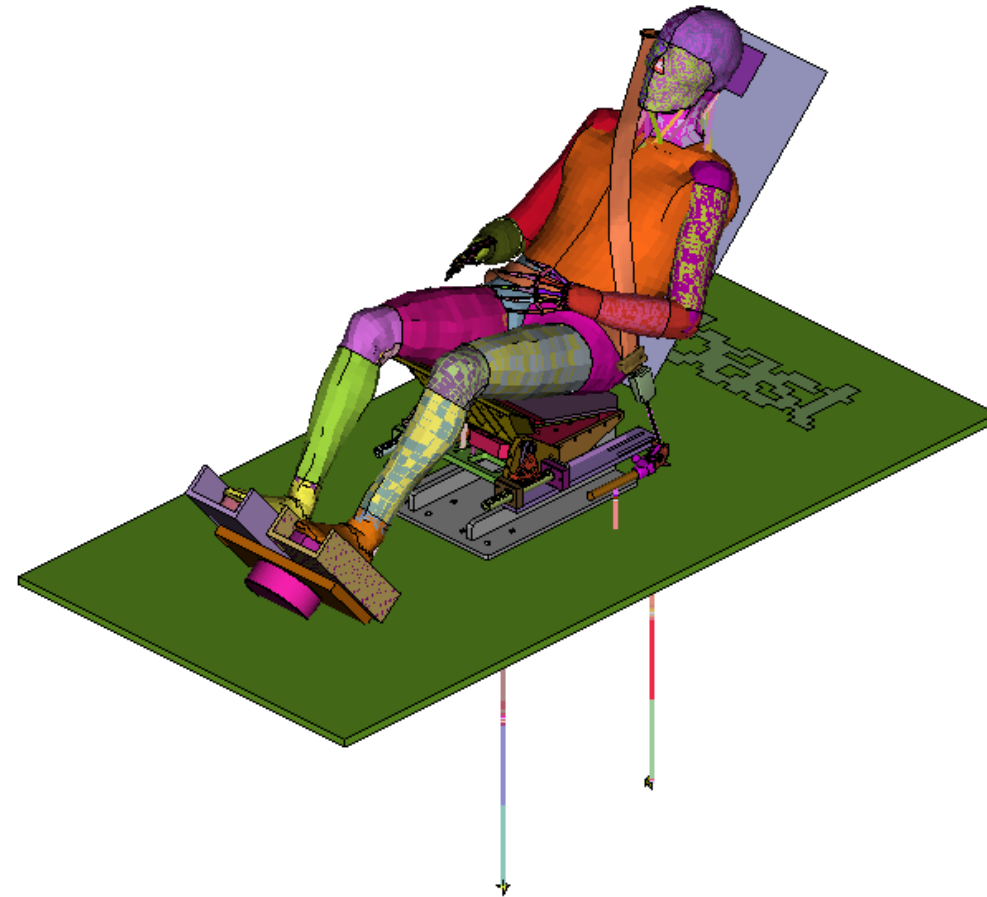
## ■ Harmonized simulation result processing with Dynasaur (<https://gitlab.com/VSI-TUGraz/Dynasaur>)

# Homologation testcase: Combining OSCCAR research results

Pre-Crash Pulse

In-Crash Pulse  
LTAP-OD2

Validated  
environment model  
in 3 codes



Open source tool for  
HBM positioning

Harmonized landmark  
definitions

Harmonized „post  
processing“  
(kinematics + injury)

Enhanced (active)  
HBMs

# 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](mailto: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>

christoph.klein@v2c2.at

www.osccarproject.eu



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

*Disclaimer excluding JU responsibility*

*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.*