

ATD Development – Status THOR-AV

Thomas Kinsky, Jerry Wang, Jack Jensen / Humanetics

Some Facts on Automated Vehicles

- Basically, all OEMs and all Tier1 suppliers globally are working on automated vehicles
- They are competing with numberless high-tech companies for sector dominance





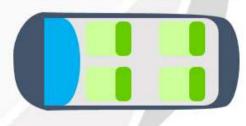


- Automated vehicles will be a step forward towards the Vision Zero
- However, many experts are sure that accidents will not disappear immediately but may even increase in the beginning

Logos above are property of the respective companies and only used to illustrate potential involvement in automated vehicles' development.



Manual driving Standard positions and load-cases



Illustrations: ZF Occupant Safety Systems 2018 acc. to Jarouche 2018, IEDAS, Ingolstadt 2018

Occupant Safety vs. Seating Position





Working High levels of freedom to increase productivity





Relaxing Relaxed seating positions

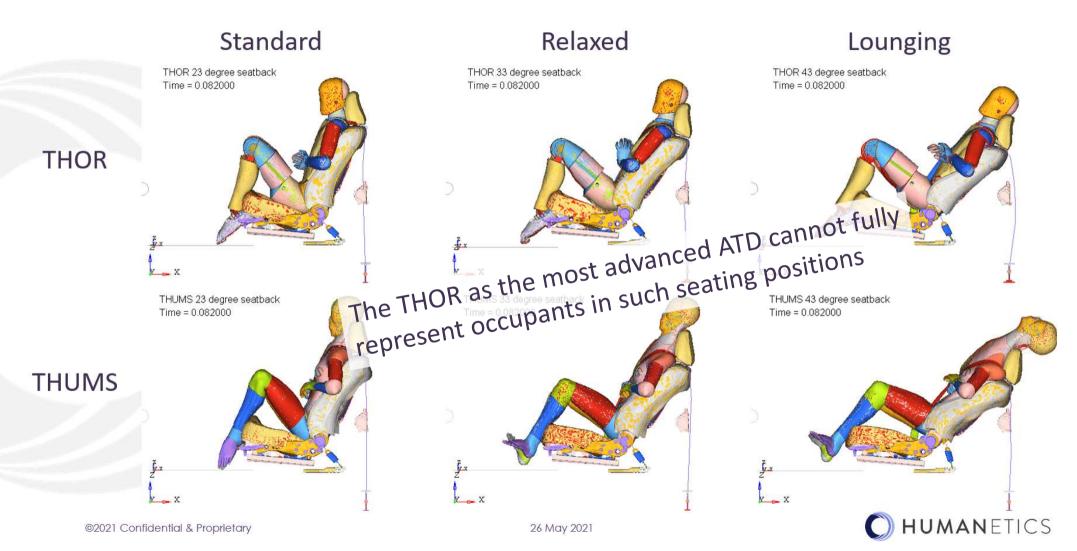




Lounge Entirely new seating positions



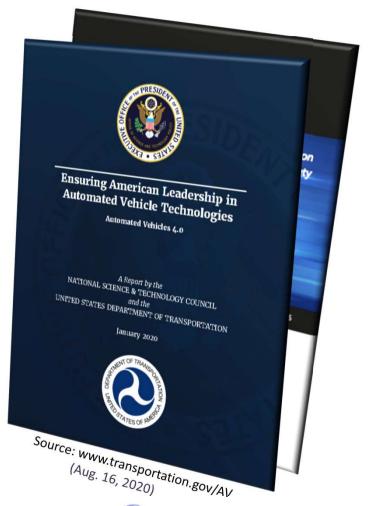
Rearward Seating Positions (Example)



Deutscher Bundestag Drucksache 19/28178 19. Wahlperiode Drucksache 19/27439 Deutscher Bundestag 19. Wahlperiode Drucksache 19/29875 Deutscher Bundestag 19. Wahlperiode Beschlussempfehlung und Bericht des Ausschusses für Verkehr und digitale Infrastruktur (15. Ausschuss) zu dem Gesetzentwurf der Bundesregierung - Drucksachen 19/27439, 19/28178 -Entwarf eines Gesetzes zur Änderung des Straßenverkehrsgesetzes und des Pflichtversicherungsgesetzes – Gesetz zum autonomen Fahren Line Enterschange systems un n'esseich des automaniserten, sectement und ver-netzen Falzens ist ungebrochen hoch. Es ist robrendig, über die un offiseischen weigen Farren uit ungestrocken noch ist uit robbening, über die im obseinichen Fallenverheite bereits mögliche Ergreichung aufonzume, faltweites er Fahrande Bereichtung der Bereichtung der Bereichtung aufonzume, der Bereichtung der Bereic languruqeien und demn Kagebelten enmississ. Alankus 164an unterst. Falgunugs daßt in festgelagten Betuebibereichen eingesetzt werden können. g antimospe dant in bengsagan dietneonestenbut eingesetzt werden komen. Dant sind Regelungen der Gesetzgeben zum Beltrieb von Krafffaltzeitgen mit Dam 11M Regelungen des Oesetzgebers zum zieltneb von Kraftlabzeiten zur anbrotnert Fahrfunktion towie zu den Andreiterungen an die Beleitigten und an Ablehrung / Annahme einer Ertschließung Source: www.bundestag.de (May 25, 2021)

Legislators' Policies

- Legislation processes seem to slow and to complicated for such a new and fast developing subject
- However, legislators do not wish to block progress but also are committed to safety of vehicle occupants
 - Occupant safety is not specifically highlighted but certainly expected to just be considered
- Guidance is limited: Industry to assure that no unrealistic promises are made and available resources are considered appropriately





Automated Vehicles' Occupant Safety

- Knowledge on AV occupant safety testing is limited
- Humanetics initiated the THOR-AV project in 2018
- First step is to make the minimum necessary changes to provide an immediate tool for testing, and then to improve the tool as we gain more knowledge into the process

Main areas of necessary improvements identified

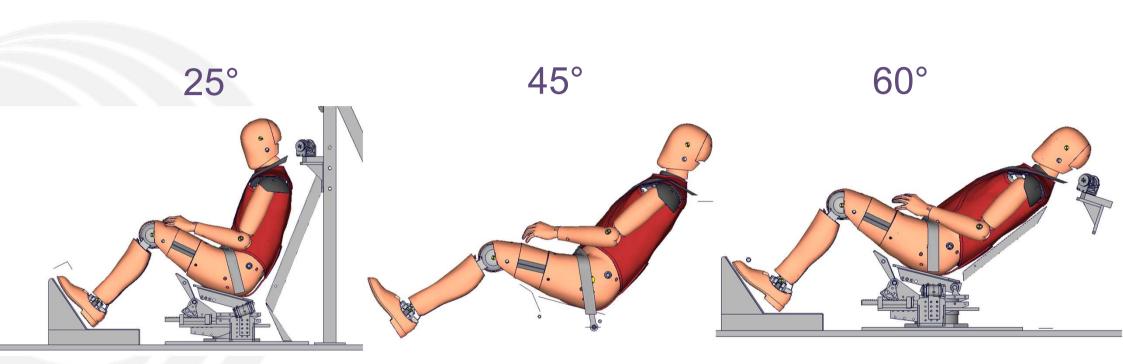
Seating postures for AV

Submarining (reclined seat)

Neck torsion
(oblique
loading) and
extension
(rearward
facing)



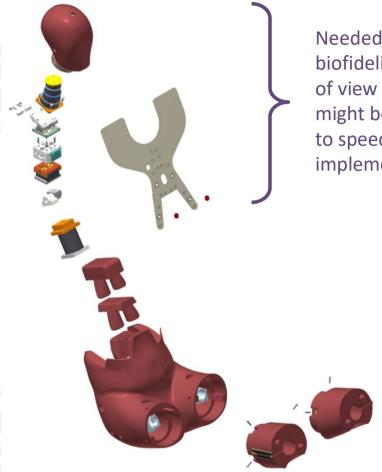
Seating Postures at Different Seatback Angles



Based on Reed, Ebert 2018



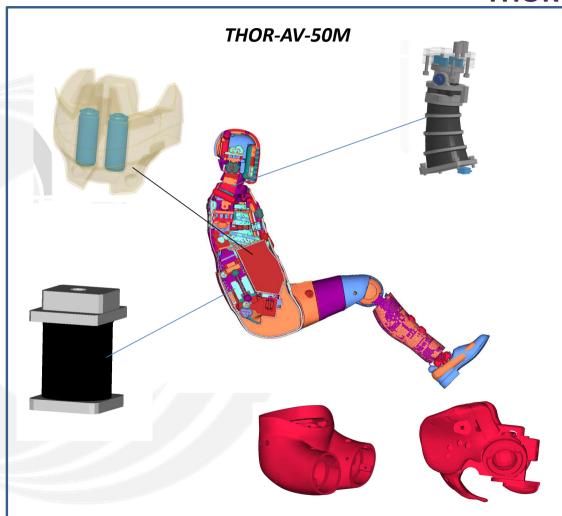
THOR-AV-50M

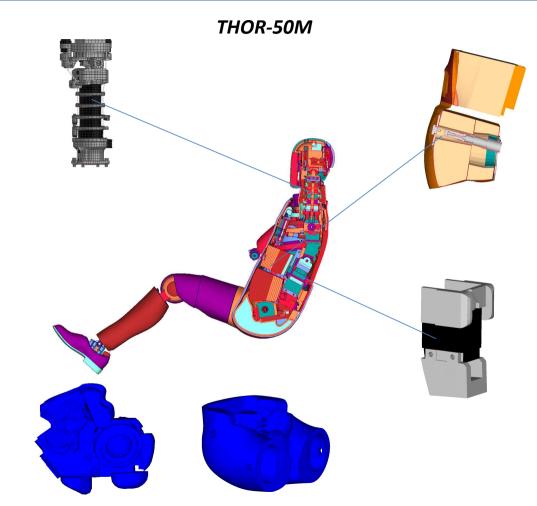


Needed from a biofidelity point of view – but might be skipped to speed-up implementation

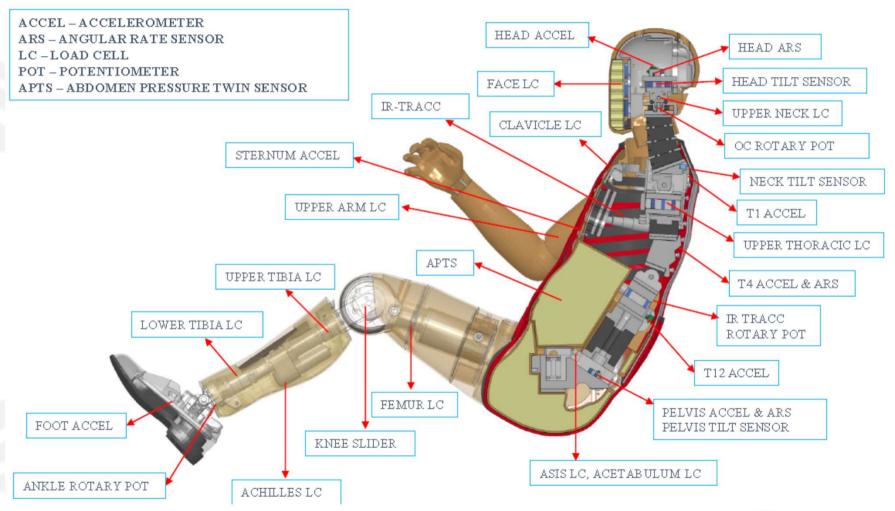
- Numerous modifications to achieve reclined seating positions as in automated vehicles
- Complemented by further improvements to the existing THOR-50M ATD
- Aiming for high biofidelity ranking in forward, rearward and lateral seating positions
- Based on latest biomechanical research
- Users to decide for a new dummy, a full AV kit or a simplified kit for reclined seating only

THOR-AV-50M in Comparison to THOR-50M





THOR-AV-50M Instrumentation



Testing with THOR-AV-50M

- THOR-AV-50M is a tool to meet immediate needs for the fast growing AV restraint system development
- THOR-AV-50M goals
 - Test alternative seating postures
 - Further improve biofidelity
 - Starting forward and rearward
 - Provide hardware and FE model
- NHTSA's PMHS test program is expected to provide further know-how

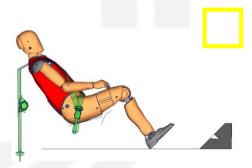


PMHS = Post-Mortem Human Subjects

Biofidelity Evaluation of the THOR-AV-50M (not yet finalized)



Uriot et al. 2015 Stapp setup with LAB seat (25deg)



UMTRI setup with LAB seat (45deg)



Richardsen et al. 2020 IRCOBI setup with LAB seat (50deg)



Faurecia with LAB seat (60deg)

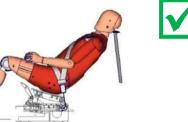


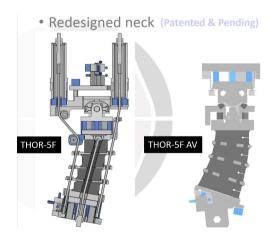
FIGURE 2: Test set-up.

Uriot et al. 2006 Stapp setup of CEESAR for belt pulling test

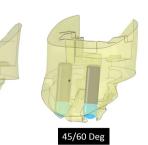


Introduction THOR-AV-5F

- THOR-AV-5F is based on THOR-5F dummy
- Less design changes required due to better recent
 THOR-5F design
- Updates from THOR-5F to THOR-AV-5F are mainly abdomen and neck



- Abdomen with APTS
- Bigger Abdomen
- APTS inserted from Bottom
- APTS Cap





For both hardware available, CAE model available, feel free to contact us for a budgetary quote!

ATD Solutions for AV





Thank you!