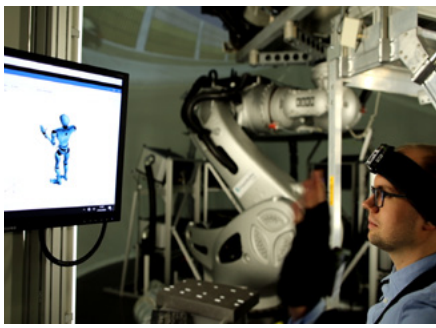
Autonomous Driving: Safe and Comfortable Thanks to Our Innovative Human Model

In the EMMA4Drive project, the "Mathematics for Vehicle Engineering" division is investigating the effects of various driving maneuvers on people, including their reaction behaviour and seat load, in order to calculate new body postures and movement sequences. A digital twin of vehicle occupants helps to investigate scenarios in the simulation and to analyze new seating concepts in terms of safety and ergonomics. Various studies are currently underway.

If a person does not drive themselves and does not pay attention to the traffic, it is hardly possible for them to prepare for driving maneuvers – they merely react to perceived accelerations and forces. In order to reproduce such reactive behavior in a simulation, our researchers use optimal control. This provides realistic movements, with the human optimally compensating for the driving maneuver. However, they are also testing approaches such as nonlinear model predictive control.



The RODOS® driving simulator in use – investigations during autonomous driving

Safe in Autonomous Buses

There are strict regulations for autonomous buses and shuttles with regard to starting and braking. "In order not to endanger standing passengers and still comply with the time-to-collision, we use simulations to determine the optimum load on the occupants. We calculate their compensatory movements in different standing directions and braking accelerations and determine optimum braking profiles for different TTC values. We also take into account the reaction time of the occupants," explains Dr. Monika Harant.

Validate Simulations

Our researchers are also using the RODOS® driving simulator. They examine the seating position and attention of a driver during a sudden lane change. At different speeds, attention levels and positioning, they test the feeling of comfort and safety during the driving maneuvers. In addition, they record the seat pressure distribution via pressure measurement mats in order to obtain information about the mechanical driver-seat interaction.

"In order to compare our EMMA simulations with the observations from the RODOS® experiments and thus also validate the simulation, we then transfer the movements of the vehicle cabin into the simulations," says Harant. To do this, they measure the movements of the vehicle cabin using an IMU (inertial measurement unit) and enter the data into the simulation as a reference movement. Using the optimal control approach, they determine a compensatory movement for the driving maneuver and also take a reaction time into account.

www.itwm.fraunhofer.de/emma4drive_en

Contact

Dr. Monika Harant
Division "Mathematics for Vehicle Engineering"
Phone +49 631 31600-4107
monika.harant@itwm.fraunhofer.de