Highly Immersive Driving Simulator

Field of Study
- Driving dynamics and ride comfort simulation tests
- Analysis of the effect chain understanding of stimuli from different domains
- Human Machine Interaction (HMI) and Human Factors
- Studies on driver assistance systems (ADAS/AD)
- Traffic psychological aspects

Technical specification – Dome/Mockup
- Architecture:
  - Concurrent RealTime iHawk
    (RedHawk Linux, Xeon Gold 6234 @3.3GHz (8 CPUs), 48GB RAM, NVIDIA Quadro P400, Real-Time Clock & Interrupt Module, SIMulation Workbench)
  - Simulation Master
    (Win10, Core i9-10850K @3,60GHz (10 CPUs), 128GB RAM)
  - 4x Image Generator (3x Projection, 1x Mirrors)
    (Win10, Core i7-10700K @3,80GHz (8 CPUs), 32GB RAM, NVIDIA GeForce RTX 3080)
- Visualization:
  - Spherical CFRP projection screen (Dome)
    - Horizontal: 225° Field-of-View
    - Vertical: 40° Field-of-View
  - 3-channel projection system
    - NORXE P1 Projektoren with N1 lense
    - WQXGA resolution (3x 2560x1600) @120Hz
    - Projection ratio ~1:1
  - Exterior mirrors, rear view mirror, dashboard and center console designed as displays
- Acoustics:
  - 5.1 audiostem system
  - Real-time simulation of powertrain, wind, ambient traffic and tire rolling noise
- Haptics:
  - Automatic gearshift
  - D-Box Seat Shaker
  - Motorized seat belt
  - Sensodrive Force-Feedback SensoWheel
  - JoysonSafety Steering Wheel
    - 360° RGB-Lightbar
    - Hands-on-Detection
    - Individual buttons
- Misc.:
  - Individual display visualization (driver information system, HMI)
  - Contactless SmartEye head- & eyetracking

Simulation software
- Realtime-Backbone: SIMulation Workbench
- Simulation-Framework: VI-DriveSim, Matlab Simulink
- Vehicle simulation: VI-CarRealTime
- Traffic & environment simulation: VI-WorldSim
- Visualization: VI-WorldSim
- Acoustics: Simsound

Metrics
- Driver/Mockup:
  - Gas/brake pedal actuation, steering angle/torque, gear, indicator, lights, hand brake
  - Touch display interaction
  - Steering wheel: Hands-On-Detection
- Traffic & Environment simulation:
  - Positions, speeds, accelerations of ego and target vehicles, suspension/powertrain/aerodynamics, sensor data etc.

Location
Driving Simulator Laboratory, 01705 Freital

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## Technical specification – Motion platform

<table>
<thead>
<tr>
<th>Component</th>
<th>Equations</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motion platform</strong> (3 DOF*)</td>
<td>$\ddot{x}; \dot{y} (m/s^2) / \ddot{\psi} (°/s^2)$</td>
<td>9; 9 / 206</td>
</tr>
<tr>
<td>* active</td>
<td>$\dddot{x}; \ddot{y} (m/s^2)$</td>
<td>14; 14 / 320</td>
</tr>
<tr>
<td></td>
<td>$x; y (m) / \dot{\psi} (°)$</td>
<td>inf; inf / inf</td>
</tr>
<tr>
<td><strong>Yaw bearing (1 DOF)</strong></td>
<td>$\dddot{\psi} (°/s^2)$</td>
<td>180</td>
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<tr>
<td></td>
<td>$\dot{\psi} (°/s)$</td>
<td>220</td>
</tr>
<tr>
<td></td>
<td>$\psi (°)$</td>
<td>inf</td>
</tr>
<tr>
<td><strong>Hexapod (6 DOF)</strong></td>
<td>$\dddot{x}; \dddot{y}; \dddot{z} (m/s^2) / \dddot{\phi}; \dddot{\theta}; \dddot{\psi} (°/s^2)$</td>
<td>6; 6; 9 / 300; 300; 500</td>
</tr>
<tr>
<td></td>
<td>$\dddot{x}; \dddot{y}; \dddot{z} (m/s)$ / \dddot{\phi}; \dddot{\theta}; \dddot{\psi} (°/s)$</td>
<td>0,45; 0,45; 0,42 / 50; 50; 45</td>
</tr>
<tr>
<td></td>
<td>$x; y; z (m) / \phi; \theta; \psi (°)$</td>
<td>0,15; 0,15; 0,13 / 17; 17; 15</td>
</tr>
<tr>
<td><strong>Seat shaker</strong></td>
<td>$\dddot{z} (m/s^2)$</td>
<td>10</td>
</tr>
<tr>
<td><strong>Overall dimensions (m x m x m)</strong></td>
<td></td>
<td>4,4 x 4,4 x 4,6</td>
</tr>
<tr>
<td><strong>Overall mass (kg)</strong></td>
<td></td>
<td>~ 5000</td>
</tr>
</tbody>
</table>