DSC 2018 EUROPE VR

Driving Simulation & Virtual Reality Conference & Exhibition

Round Table

Operational Standards for driving simulators

Mr. Stéphane Masfrand (PSA)
Dr. Stéphane Espié (IFSTTAR)
Dr. Gerd Baumann (FKFS)
Mr. Arne Nåbo (VTI)
Dr. Joost Venrooij (BMW)
Mr. Omar Ahmad (NADS)

Moderated by
Dr. Jens Häcker (Daimler)

Palais des congrès - Antibes

January 17, 2019

Invitation

DSC 2018 EUROPE VR
17th Driving Simulation & Virtual Reality Conference & Exhibition

Operational Standards for driving simulators
DSC 2018 - Round Table Discussion

Wednesday, September 5th, 2:00 p.m. – 3:00 p.m., Davis Room

Participants:

- Mr. Stéphane Masfrand (PSA)
- Dr. Stéphane Espié (IFSTTAR)
- Dr. Gerd Baumann (FKFS)
- Mr. Arne Nåbo (VTI)
- Dr. Joost Venrooij (BMW)
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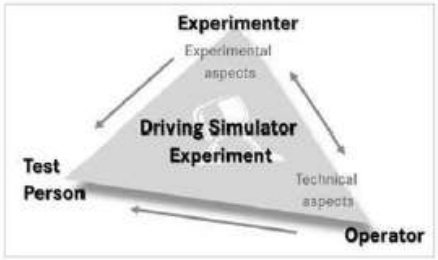


Moderated by Dr. Jens Haecker (Daimler)

Motivation: For simulator methodology both the technical as well as the experimental aspects are fundamental for collecting valuable results from simulator experiments with human drivers in the loop. In order to increase the comparability and the transferability of experiment results collected in different simulators – and thus magnifying the scientific value of simulator results. In this context defining operating standards or guidelines for driving simulators would be beneficial.

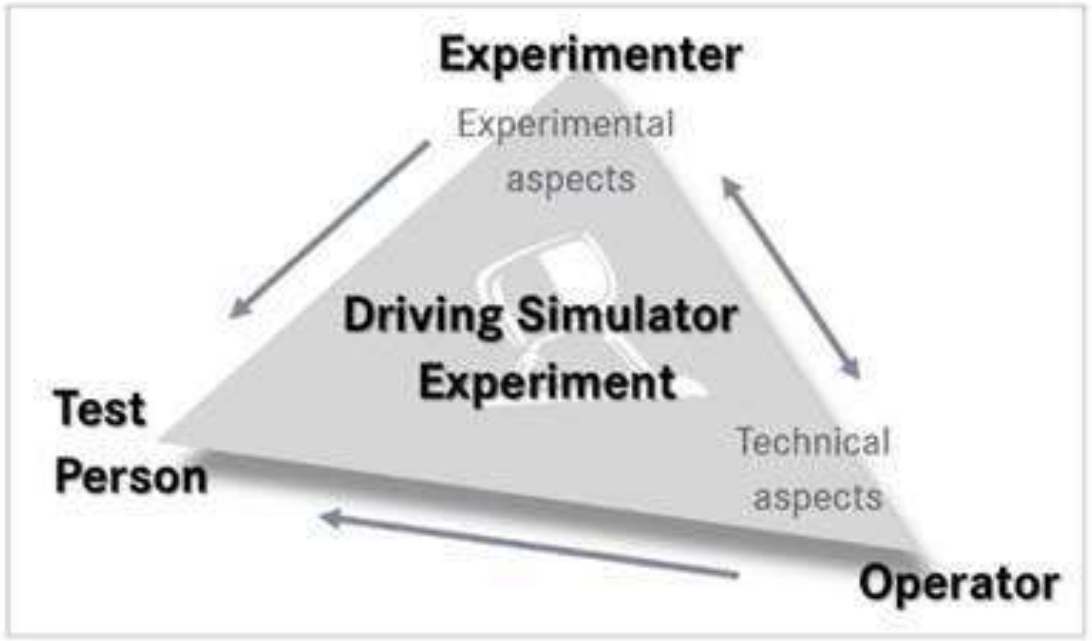
Potential topics to be discussed:

- Validity/reliability/comparability of DS study
- Influence of experimental/technical aspects on DS results
- Ethical aspects of experiments
- Approaches of different institutions
- Guidelines for documentation of DS studies
- Towards defining standards or guidelines (is this even possible?)

Course of the Discussion:

- Introduction and motivation (moderator)
- Brief introduction and main statements (app. 5 minutes per participant)
- Each participant can offer topics or questions which might be of interest during the discussion.
- Panel will then be open for some questions from the audience (all)
- Short final statement (voluntarily) from everyone (participants)
- Next steps and Closing remarks (moderator)

Operational Standards for driving simulators



Motivation: For simulator methodology both the technical as well as the experimental aspects are fundamental for collecting valuable results from simulator experiments with human drivers in the loop. In order to increase the comparability and the transferability of experiment results collected in different simulators – and thus magnifying the scientific value of simulator results.

Issues

- Validity/reliability/comparability of DS study
- Influence of experimental/technical aspects on DS results
- Ethical aspects of experiments
- Approaches of different institutions
- Guidelines for documentation of DS studies
- Towards defining standards or guidelines (is this even possible?)

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Operational Standards for driving simulators.

Stéphane Masfrand

Palais des congrès - Antibes

September 5, 2018

Some ideas in order to initiate the discussion

- What could be standardized ?
  - Number of participants ?
  - Welcome procedure ?
  - Environment of simulator ?
  - Simulator itself (cockpit, motion, projection, sound …) ?

- Questions
  - Know-how of the companies/institutions ? Intellectual property ?
  - What about aeronautic background ? How can we learn from this industry ?

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FKFS

Considerations on Scaling in Dynamic Driving Simulators

Gerd Baumann, FKFS

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Stuttgart Driving Simulator

dome

hexapod

sled

gantry

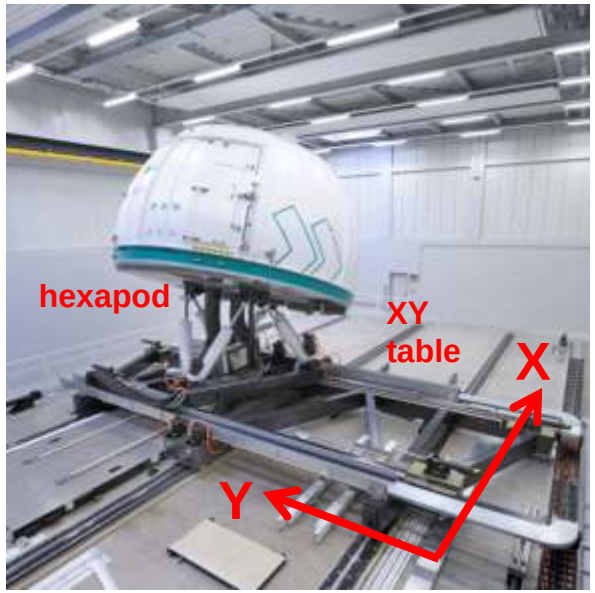
XY-table

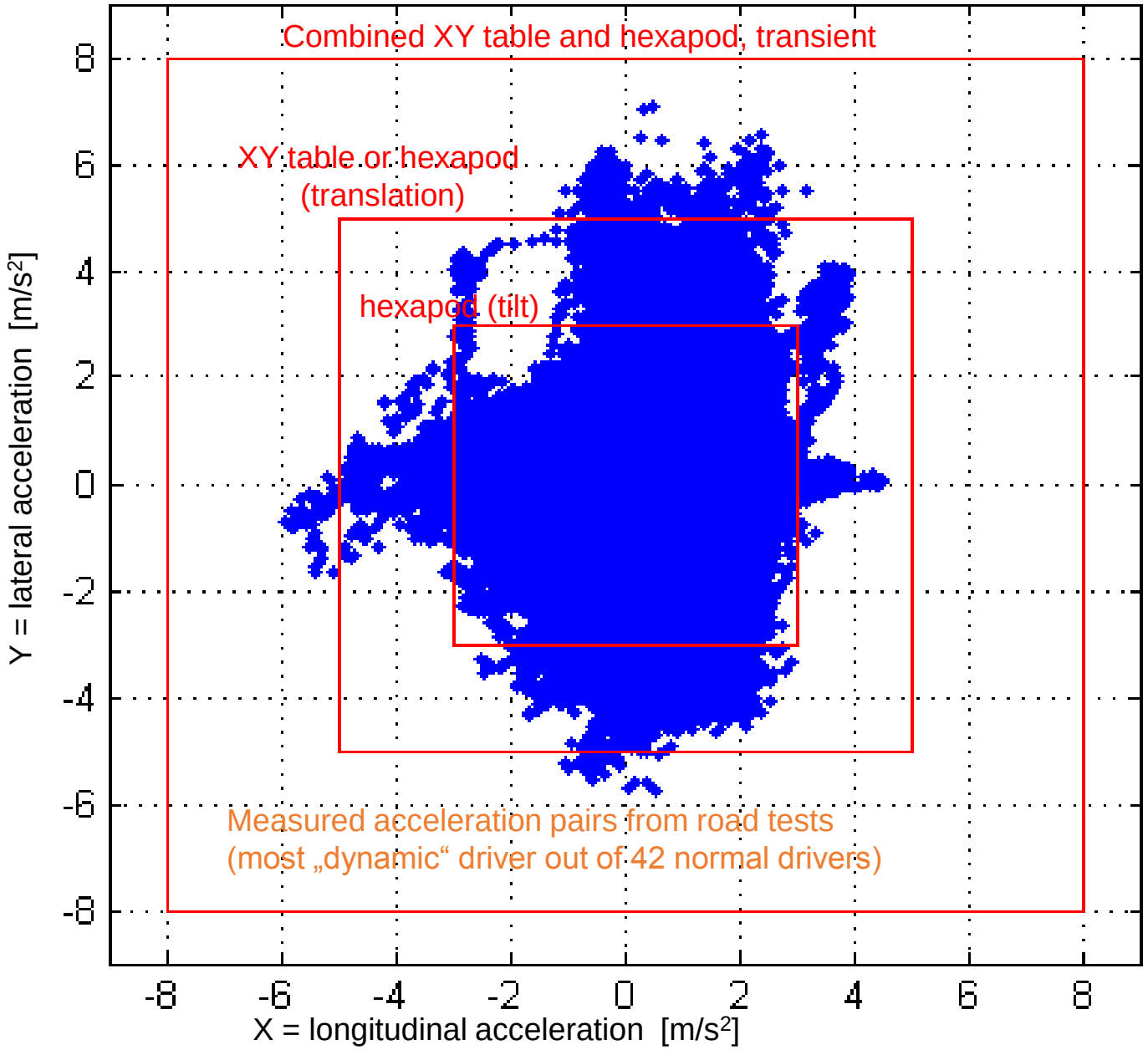
X

Y

vehicle lift

Acceleration Simulation





Proposals for the Use of Scaling in Driving Simulator Tests

- Scaling means that the amount of motion (e.g. lateral and longitudinal acceleration, yaw rate, ...) perceived by the subject is lower than the motion perceived in real-world driving during the same driving manoeuvre.
- Avoid scaling, if possible!
- Rather try to adapt the experimental setup / scenario to the technical limitations of the driving simulator
- If scaling is unavoidable:
  - Scaling of acceleration and rotation is appropriate for comparative test setups (e.g. benchmarking different chsssis or drivetrain setups)
  - Use constant scaling factors throughout your scenario (no dynamic scaling)
  - Describe the applied scaling algorithm in your experiment documentation.


Thanks for your attention!

DSC 2018 Round-Table

Operational Standards for driving simulators

Arne Nåbo

Operational Standards for driving simulators

- **Simulator selection in relation to use case**. Level of motion cueing, visual field of view, etc. in relation to what is essential in the use case, for example basic driver education, evaluation of infotainment/entertainment/communication systems, active safety systems etc.
- **Standardized performance criteria and measures** for simulated systems and for actors: reaction time, response time, safety margins (lateral/longitudinal), etc.
- **Managing test participants**: recruitment, selection criteria, scanning for simulator sickness syndrome, information/instructions given before test, de-briefing, compensation.
- **Round robin tests.** Same scenario and procedures executed in several simulators (advanced and less advanced) and at several organisations. Comparison of results (behavior of humans and simulated actors).

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Towards Operational Standards for Driving Simulators

Omar Ahmad
Deputy Director, National Advanced Driving Simulator
The University of Iowa

Palais des congrès - Antibes September 5, 2018

THE NATIONAL ADVANCED DRIVING SIMULATOR

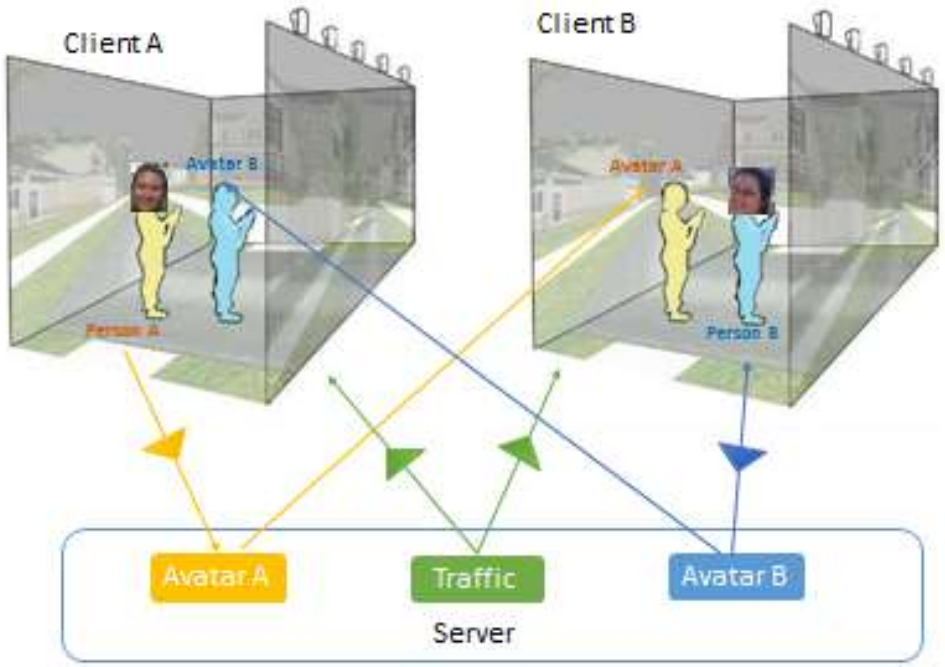
THE UNIVERSITY OF IOWA

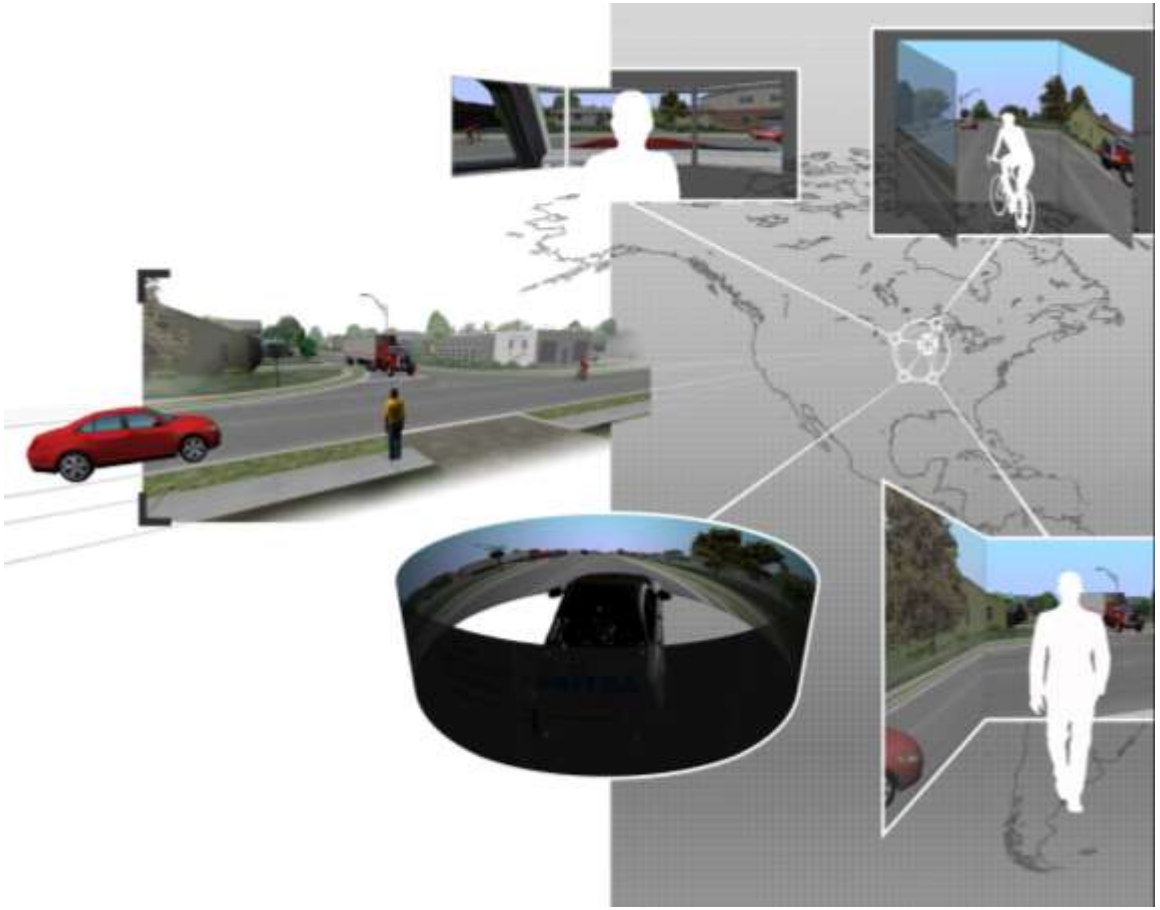
Issues

- Validity/reliability/comparability of DS study
- Influence of experimental/technical aspects on DS results
- Ethical aspects of experiments
- Approaches of different institutions
- Guidelines for documentation of DS studies
- Towards defining standards or guidelines (is this even possible?)
- Transportation is multi-modal; need connectivity with DS across modes
- Vehicles moving toward automation; simulators crucial for looking at takeover and enabling billions of miles of testing
- Increasing use of pharmaceutical drugs; increasing use of cannabis as US legalizes it
- Building new driving environments is expensive
- DS is one tool for experimental research; how to make it more effective and complement other tools such as naturalistic driving
- Can the industry, government and academia to work together? What are our shared goals?

Cross-Model Distributed Simulation (Vehicle, Bicycle and Pedestrian)

- Standards already exist for simulator connectivity
- Issues: scenario control across simulators, avatar representation, performance metrics, analysis



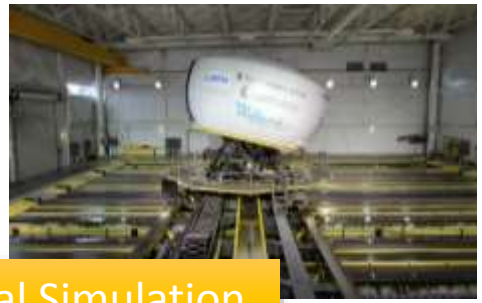


A Connected Framework for Studying Driver Behavior

On-Road

Digital Replicas of Actual World Locations

Simulation



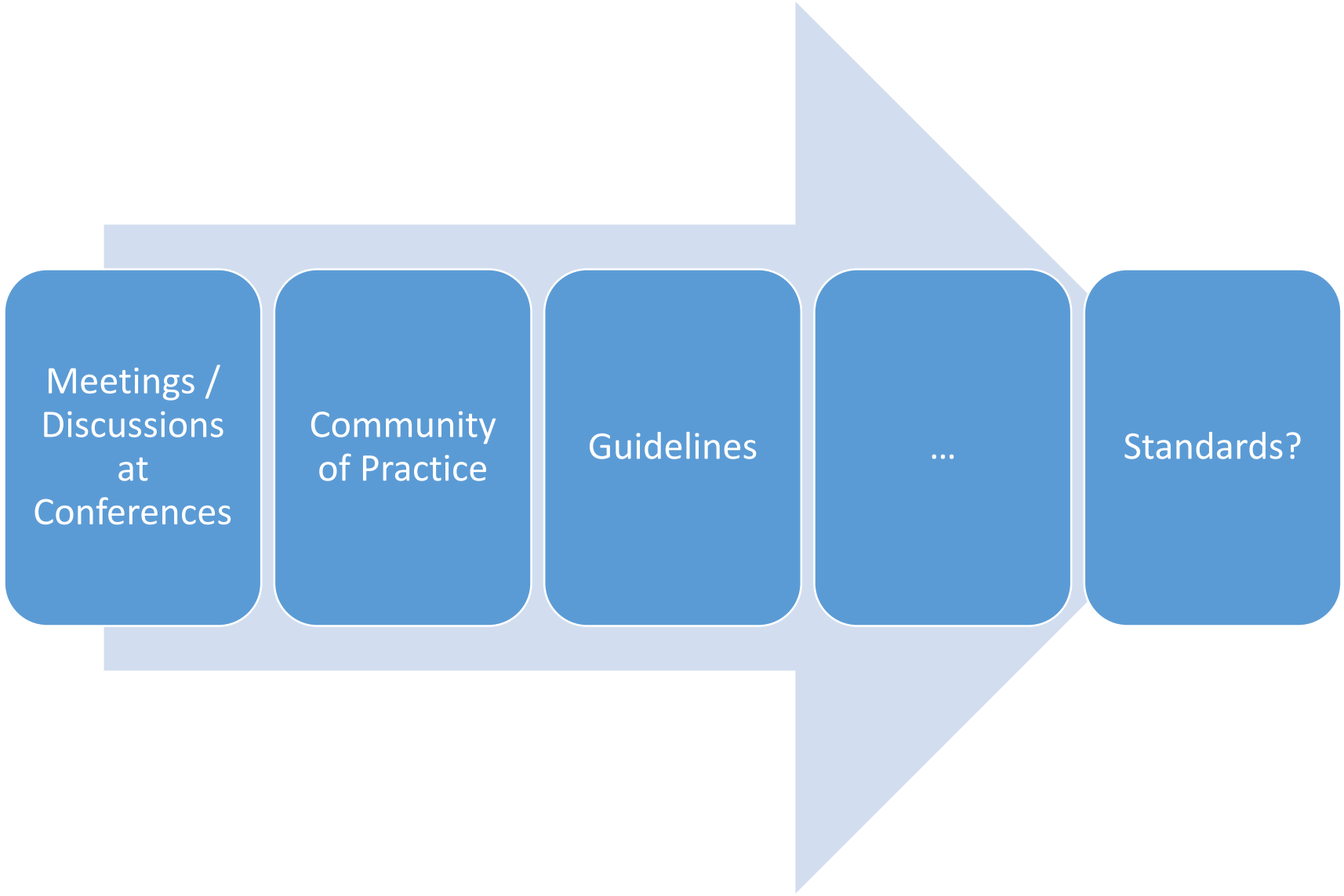
Cloud Connected HD Maps

Live Virtual Constructive

Crash Reconstruction

Distributed Cross-Modal Simulation

How Do We Get There?



DSC 2018 Europe

DAIMLER

Technical and experimental aspects of driving simulator studies:

Towards Defining Operating Standards for Driving Simulators

used in vehicle development

Hannsjörg Schmieder, Dr. Katja Nagel, Dr. Jens Häcker
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Motivation

This contribution is focusing on simulator methodology and will discuss some of the **technical** and **experimental aspects** related to driving simulator studies. From the authors' point of view, both the technical as well as the experimental aspects are fundamental for **collecting valuable results from simulator experiments** with human drivers in the loop. In order to increase the **comparability** and the **transferability** of experiment results collected in different simulators – and thus magnifying the value of simulator results – we are convinced that defining **standards for operating simulators** would be very helpful.

Methodology

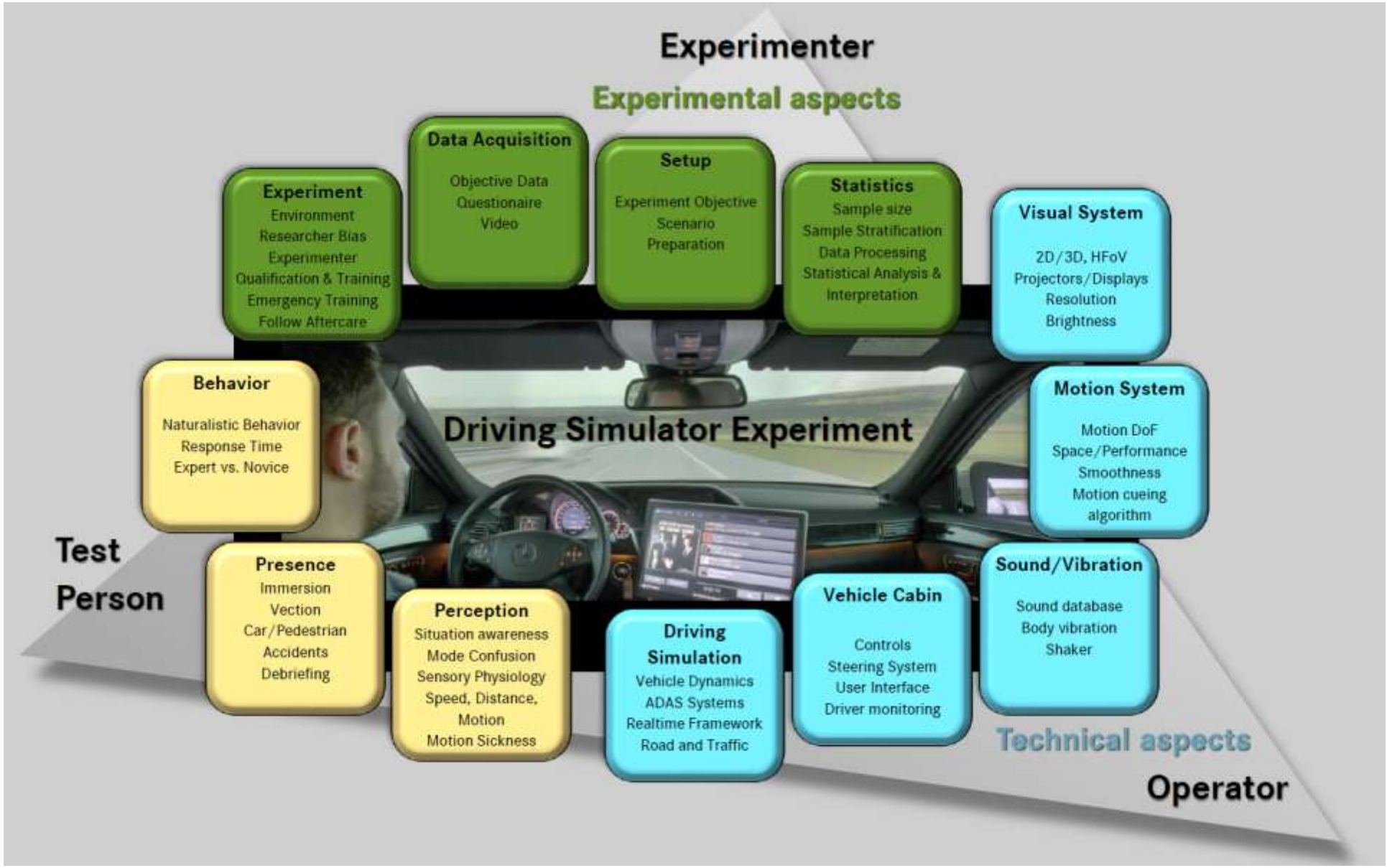
In any experimental situation in a simulator study a wide range of special requirements have to be considered. The figure above specifies a set of aspects and characteristics of experimental and technical nature. They all do affect and **influence the driver** in the driving simulator experiment in several ways that might be characterized as **perception, presence, and behavior**. A well balanced consideration and interaction of all these different topics in summary has a major impact on the validity of the results, extracted from simulator studies. The authors would like to encourage the discussion on these essential prerequisites of simulator studies, hopefully leading to an intense communication on all the important driving simulator operation issues among other simulator teams around the world

Conclusion

In order to enable reliable and comparable results, we would like to start a discussion on these topics within the driving simulator community. This might in a first step lead to defining a list of recommendations and risks involving operational issues of driving simulator experiments, that can utilized every interested driving simulator team. Finally, a set of commonly agreed operation standards might be definable, helping to enhance the validity and comparability of driving simulator experiment results in the future.

References

Fisher, D, Matthew Rizzo, JK Caird, and J Lee, *Handbook Of Driving Simulation For Engineering, Medicine And Psychology*. Eds. CRC Press-A Taylor and Francis Company, 2011.
Kluever, M., *Can We Trust Driving Simulator Studies? The Behavioral Validity of the Daimler AG Driving Simulators*, Dissertation, Johannes Gutenberg University, Mainz, 2016.


Experimenter
Experimental aspects
Data Acquisition
Objective Data
Questionaire
Video
Setup
Experiment Objective
Scenario
Preparation
Statistics
Sample size
Sample Stratification
Data Processing
Statistical Analysis &
Interpretation
Experiment
Environment
Researcher Bias
Experimenter
Qualification & Training
Emergency Training
Follow Aftercare
Visual System
2D/3D, HFoV
Projectors/Displays
Resolution
Brightness
Behavior
Naturalistic Behavior
Response Time
Expert vs. Novice
Driving Simulator Experiment
Motion System
Motion DoF
Space/Performance
Smoothness
Motion cueing
algorithm
Test
Person
Presence
Immersion
Vection
Car/Pedestrian
Accidents
Debriefing
Perception
Situation awareness
Mode Confusion
Sensory Physiology
Speed, Distance,
Motion
Motion Sickness
Driving
Simulation
Vehicle Dynamics
ADAS Systems
Realtime Framework
Road and Traffic
Vehicle Cabin
Controls
Steering System
User Interface
Driver monitoring
Sound/Vibration
Sound database
Body vibration
Shaker
Technical aspects
Operator