cogniBIT

Modellierung realistischer Verkehrsteilnehmer – sowohl in normalen als auch in kritischen Situationen

Alexander Knorr, cogniBIT GmbH

Praxistagung Hochautomatisiertes Fahren, 08. Oktober 2024

THE TEAM BEHIND cogniBIT

| Founders

Dr. Lukas Brostek

CEO

PhD Neurosciences (LMU)

Dipl.-Ing. Electrical Engineering (TUM)

9 years of sensorimotor research experience

3 years as developer for autonomous driving at the BMW Group

Alexander Knorr

CTO

PhD candidate Neurosciences (LMU)

Dipl.-Ing. Electrical Engineering (TUM)

6 years of sensorimotor research experience

Dr. Johannes Drever

Chief SW architect

PhD Neurosciences (LMU)

Dipl.-Ing. Computer Science (TUM)

5 years of sensorimotor research experience

9 years as a Software Engineer at Linova Software GmbH

Dr. Christian Rössert

Chief Researcher

PhD Neurosciences (LMU)

Dipl.-Ing. Electrical Engineering (TUM)

7 years of sensorimotor and recurrent neural network research experience

3 years as a Senior Research Scientist at INAIT SA (Lausanne)

“Understanding human behavior is the key problem in building a capable and safe self-driving car”

Dmitri Dolgov, Co-CEO Waymo

“Modeling the realistic traffic behavior in edge case situations is a key challenge in developing AD”

Dragomir Anguelov, Chief Researcher Waymo, at the CVPR2024

cogniBIT CLOSES THE GAP IN TRAFFIC SIMULATION

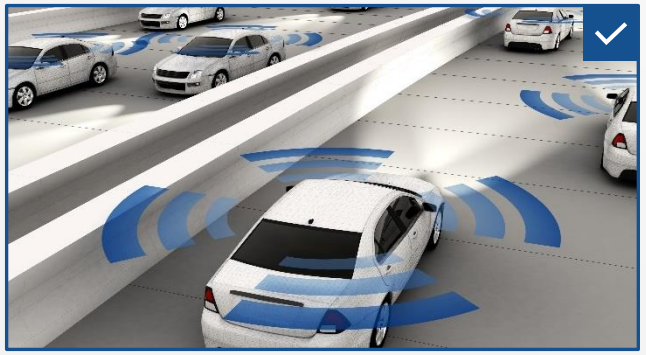
SIMULATION

Fundamental parts of simulation platforms for autonomous driving:

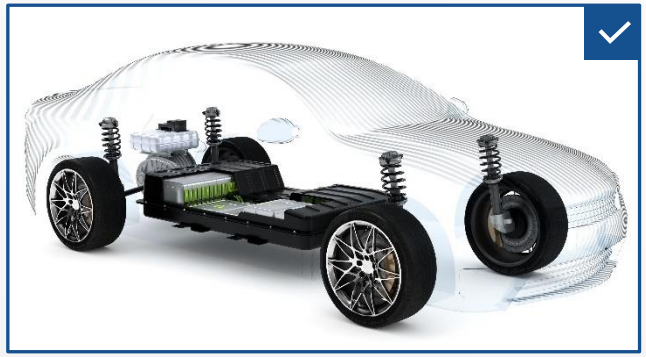
Road user models

World models

Sensor models



Models of driving dynamics



Car testing in simulation requires **reproduceable reality** in all aspects.

Simulation platforms used today include

- realistic models of driving dynamics
- sensor models
- world models

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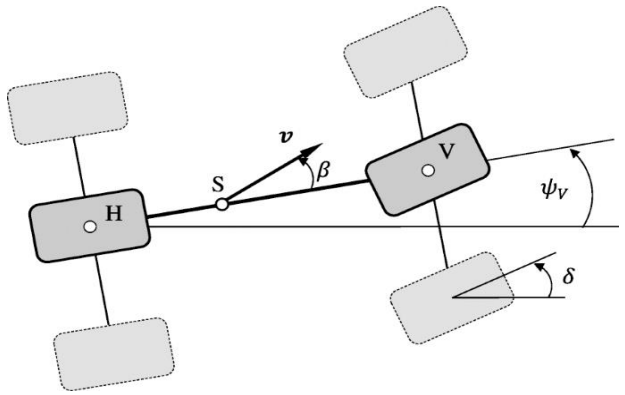
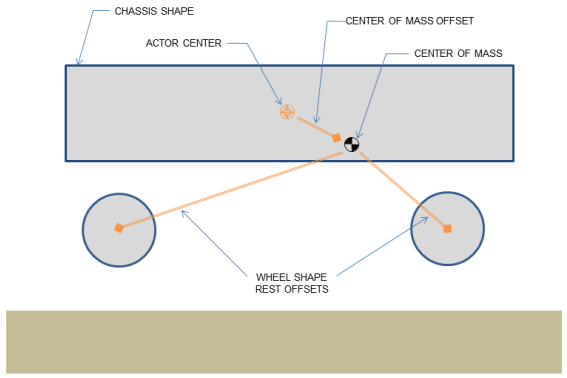
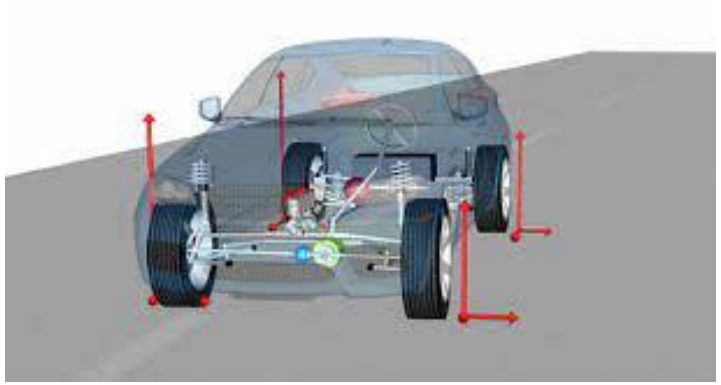
- **delivers realistic models of human road users' behavior**
- and allows large scale testing of autonomous driving related to human behavior

THE REQUIRED LEVEL OF ABSTRACTION OF A MODEL IS DEFINED BY THE USE CASE

Degree of Realism







Model Complexity

cogniBIT PROVIDES THE MOST REALISTIC MODELS OF HUMAN ROAD USERS

Degree of Realism

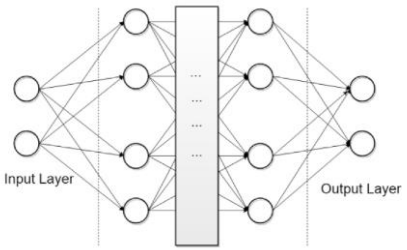
Model Complexity

Rule-Based

$$u = K_p * (x - x_{ref})$$

```
if traffic_light == red:
do_brake()
```

Data Driven



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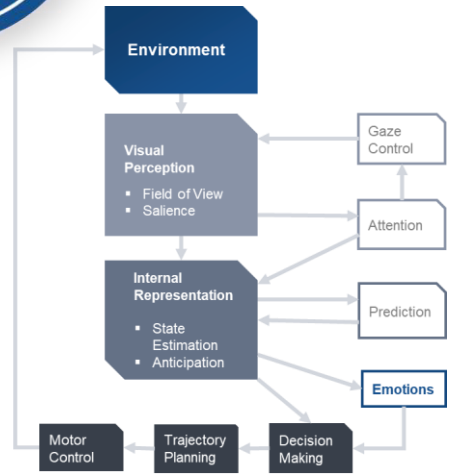
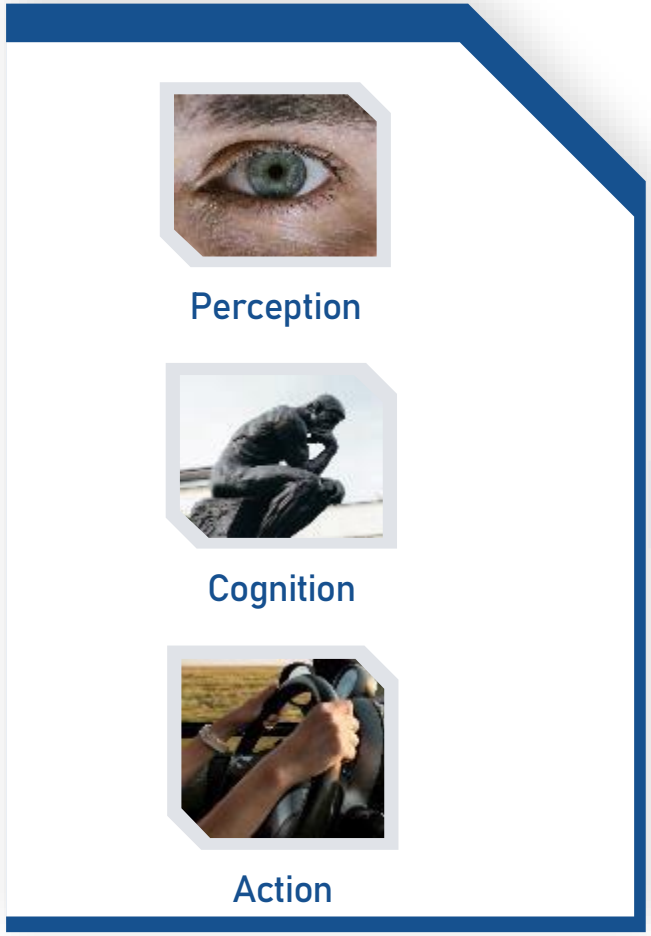
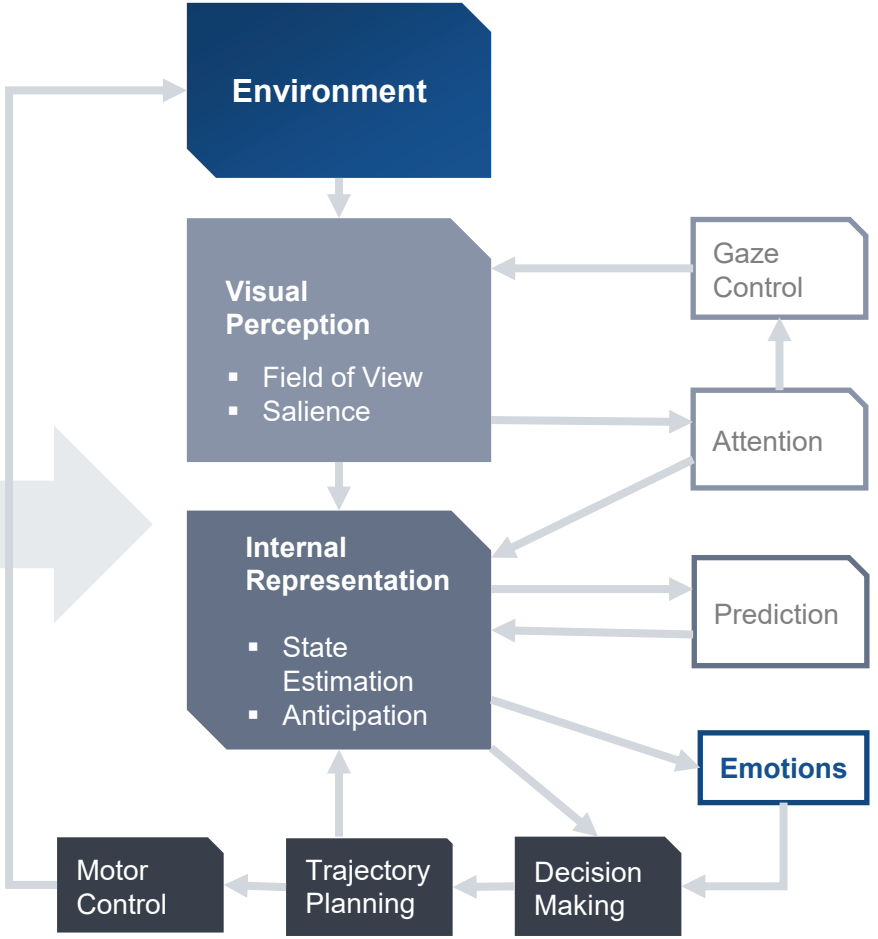
COGNITIVE AI



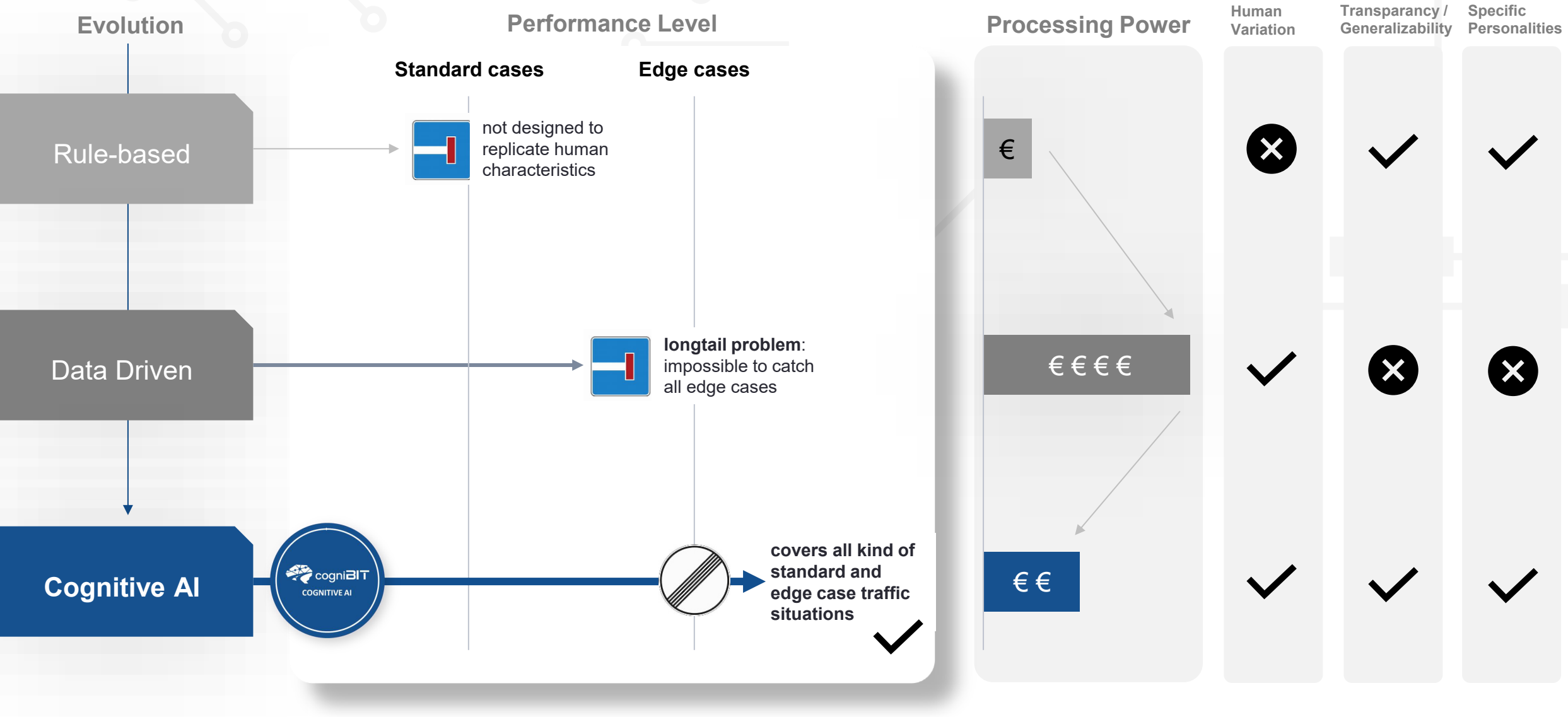
A NOVEL APPROACH TO GENERATIVE AI



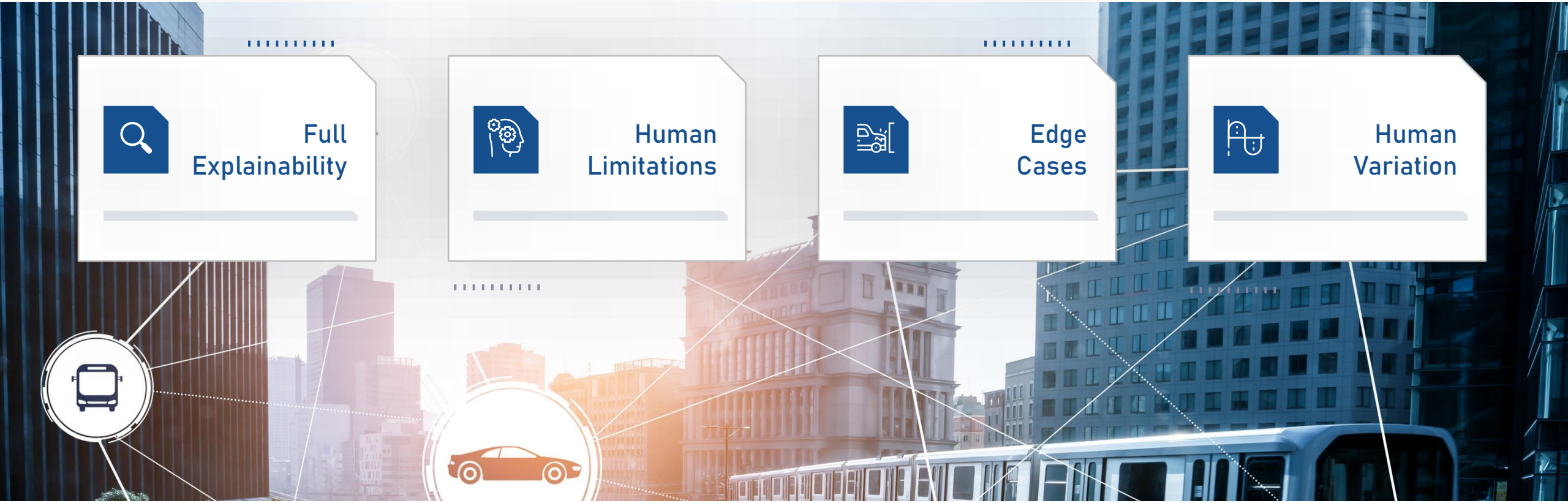
cogniBIT
COGNITIVE AI



COGNITIVE AI EXCEEDS CONVENTIONAL APPROACHES



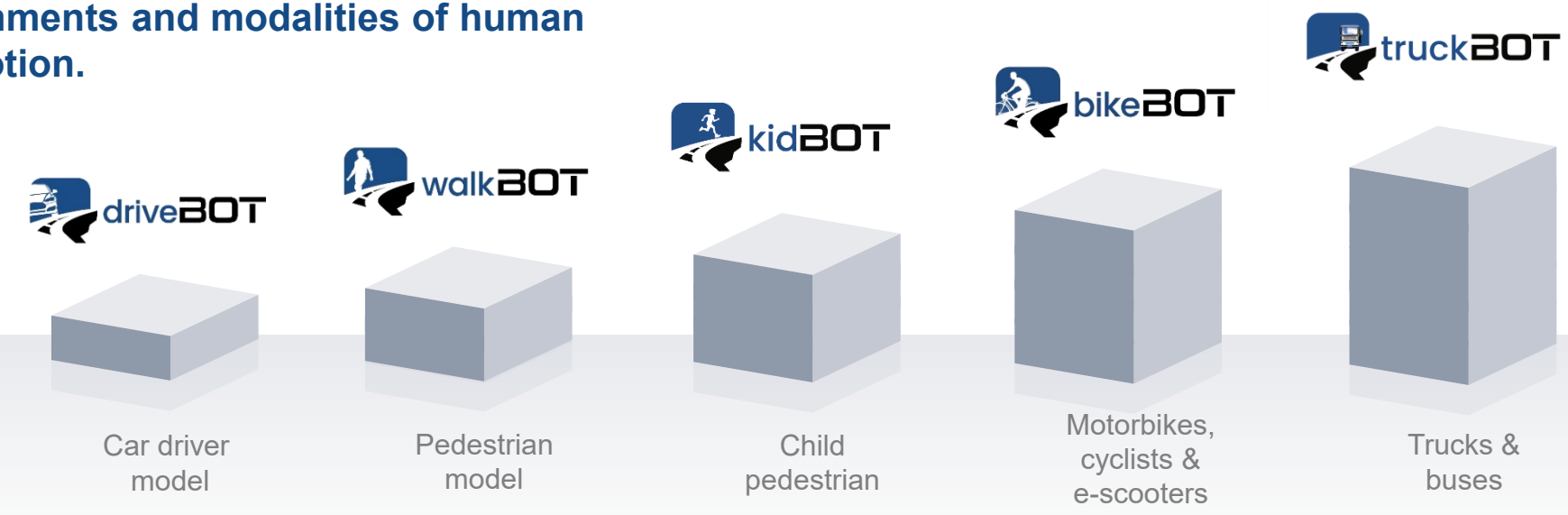
NEURO-COGNITIVE TRAFFIC AGENT MODEL



OUR PRODUCTS COVER ALL ENVIRONMENTS & MODALITIES

SIMULATION

Our cogniBOT system architecture serves as the basis of all cogniBIT products and enables efficient product development to cover all environments and modalities of human locomotion.



cogniBOT

CRITICAL TRAFFIC SITUATIONS

cogniBOT can realistically simulate the entire spectrum of road traffic situations.

Road traffic can cover an immense variety of different situations:

- Road types (Highway, Urban, etc.)
- Traffic Density
- Environmental influences (Weather, Time of Day, etc.)
- Participating modalities (Pedestrians, Cyclists, etc.)
- Regional specifics (e.g. countries)
- Personalities of road users

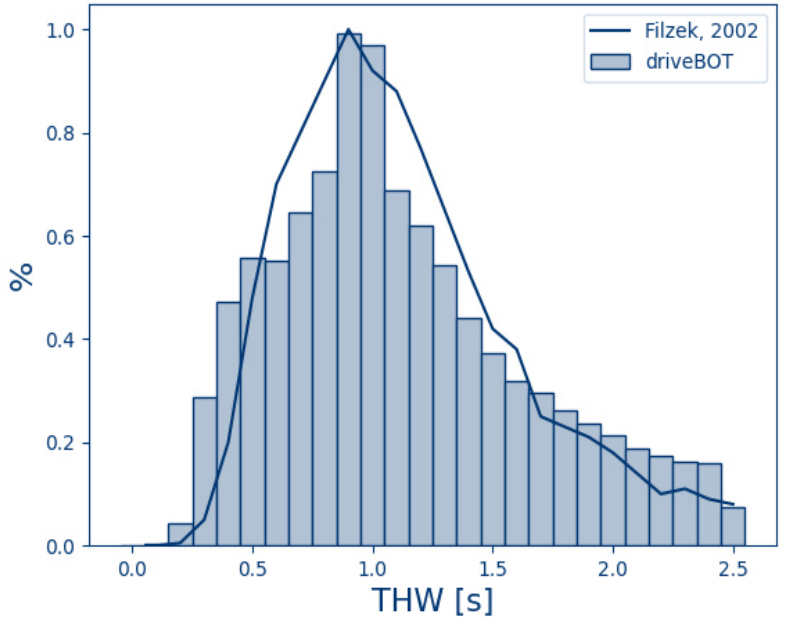
driveBOT

walkBOT


osition: 36
1, 1_2, 2_2, 3_2, 1_3, 2_3, 3_3,]
0.48 Y=3.81 Z=0.37 km
0.00 km
2)
4 Z=0.367 meters
Z=0.37 km
X=-100000 Y=300000 Z=0
CARLA
SPEED
LIMIT
20

OUR MODELS ARE VALIDATED BY REAL-WORLD DATA

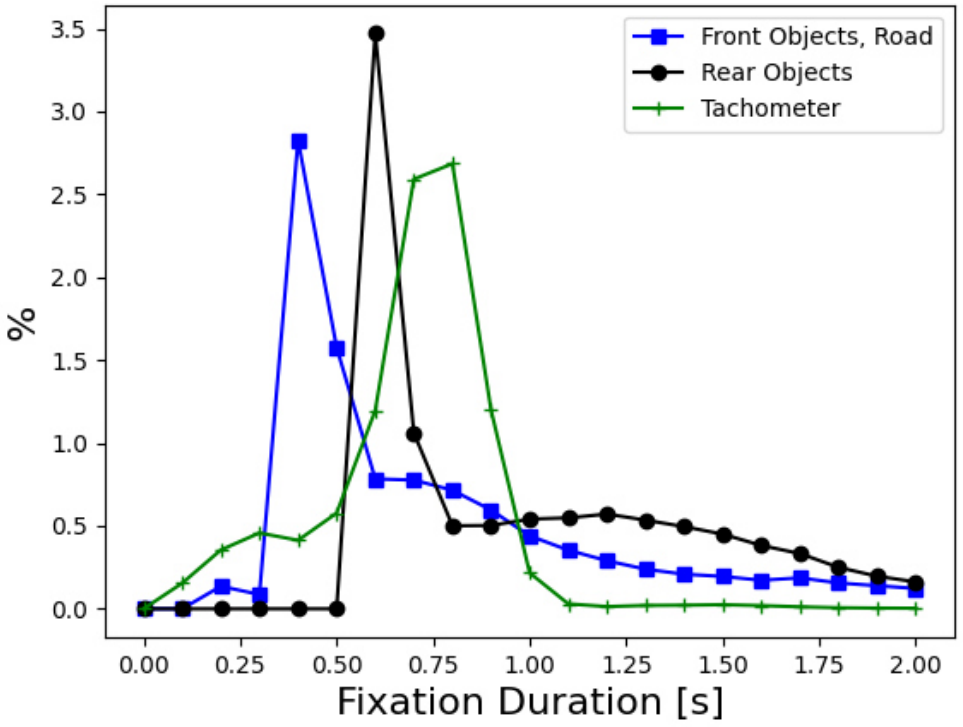
Our models are validated by comparing data resulting from our simulation with real-world data, such as traffic data or physiological data.



Real-world data of time-headway distribution on German Autobahn (Filzek, 2002, black line) closely resembles simulated data from a highway scenario of our driveBOT Version 1.1

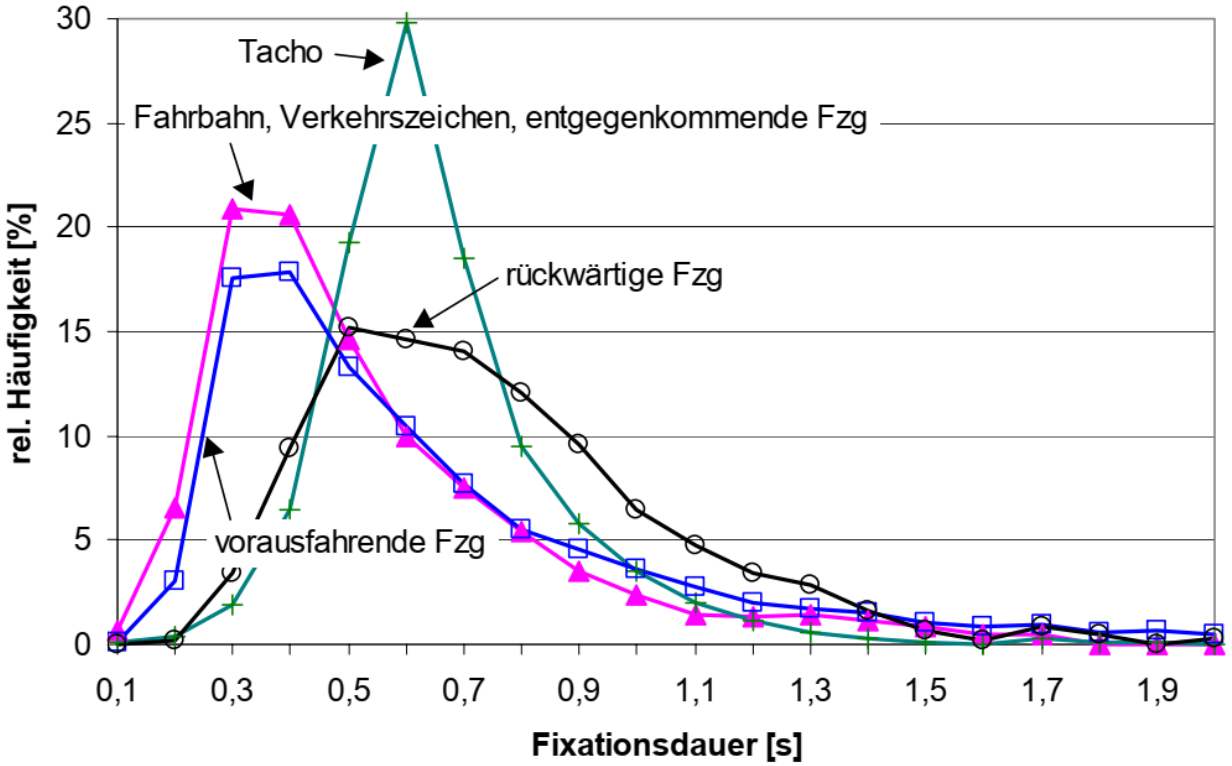
OUR MODELS ARE VALIDATED BY REAL-WORLD DATA

driveBOT



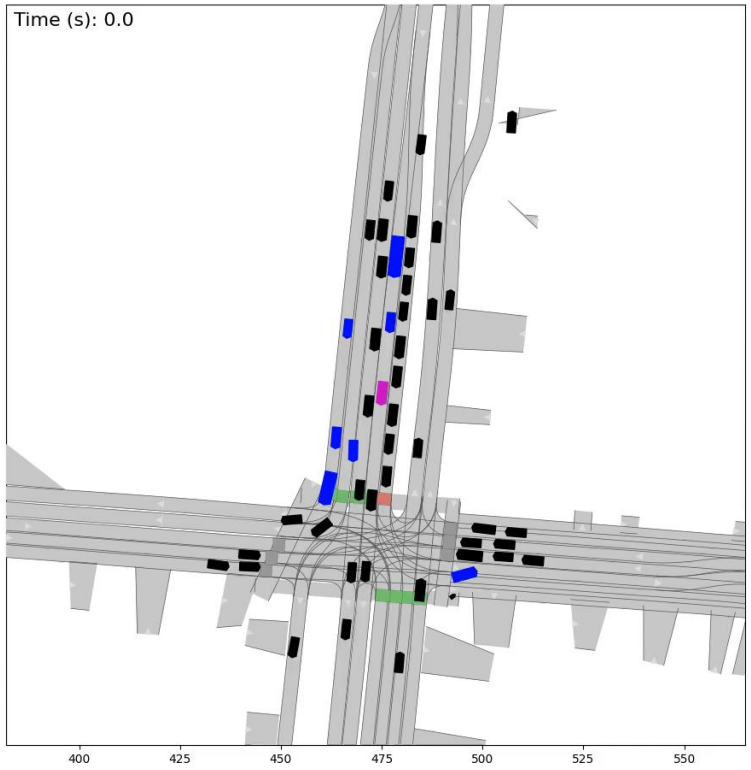
driveBOT Version 1.1, Highway scenario

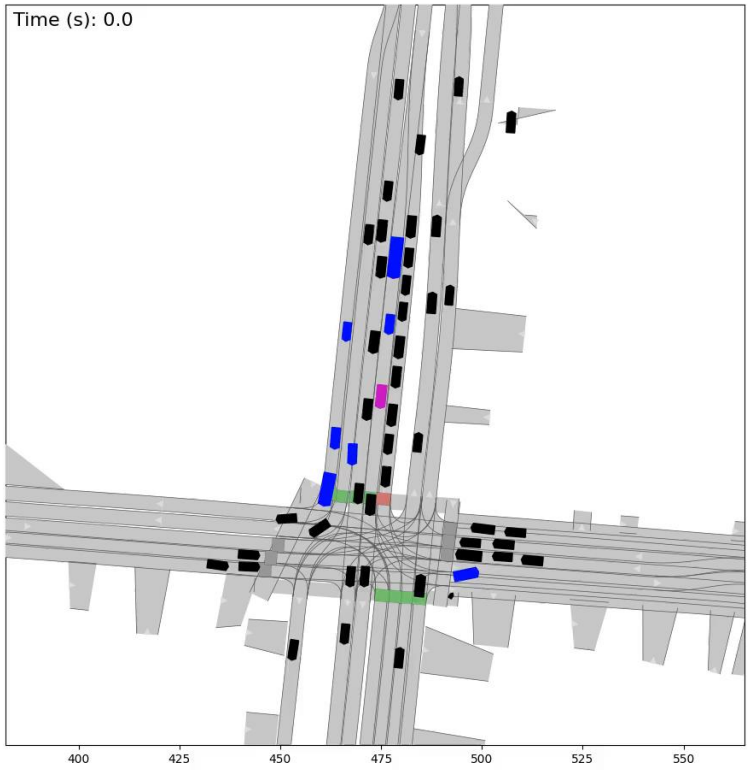
Real-World data

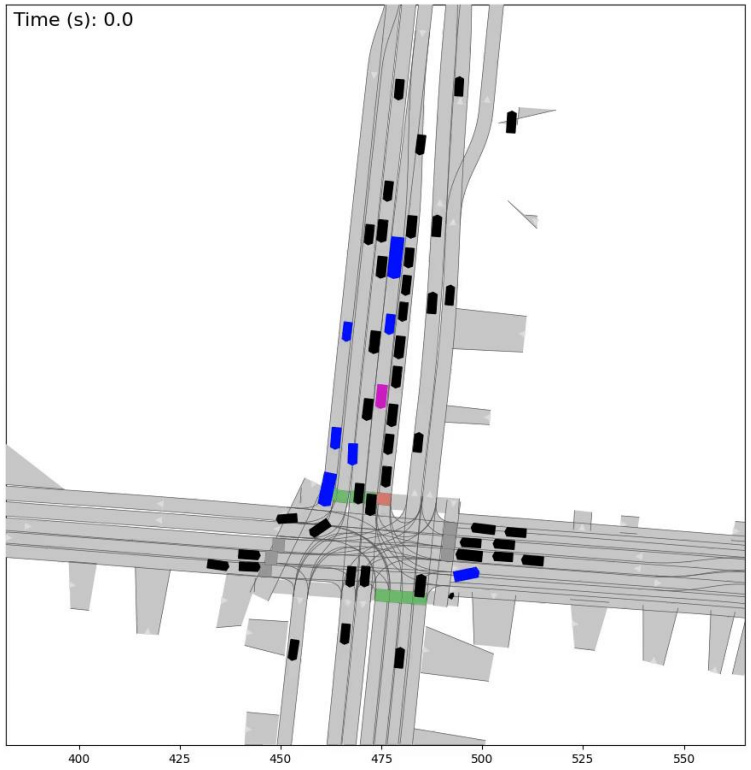


Distribution of fixation durations during highway driving (Schweigert, 2003)

WHICH OF THESE TRAFFIC SCENES IS RECORDED?







CRITICAL TRAFFIC SITUATIONS

cogniBOT realistically simulates the emergence and outcome of critical scenes.

Critical traffic situations can occur due to a wide variety of reasons.

- Negligence
- Distraction
- Inappropriate driving style
- Disobeying traffic rules
- Intoxication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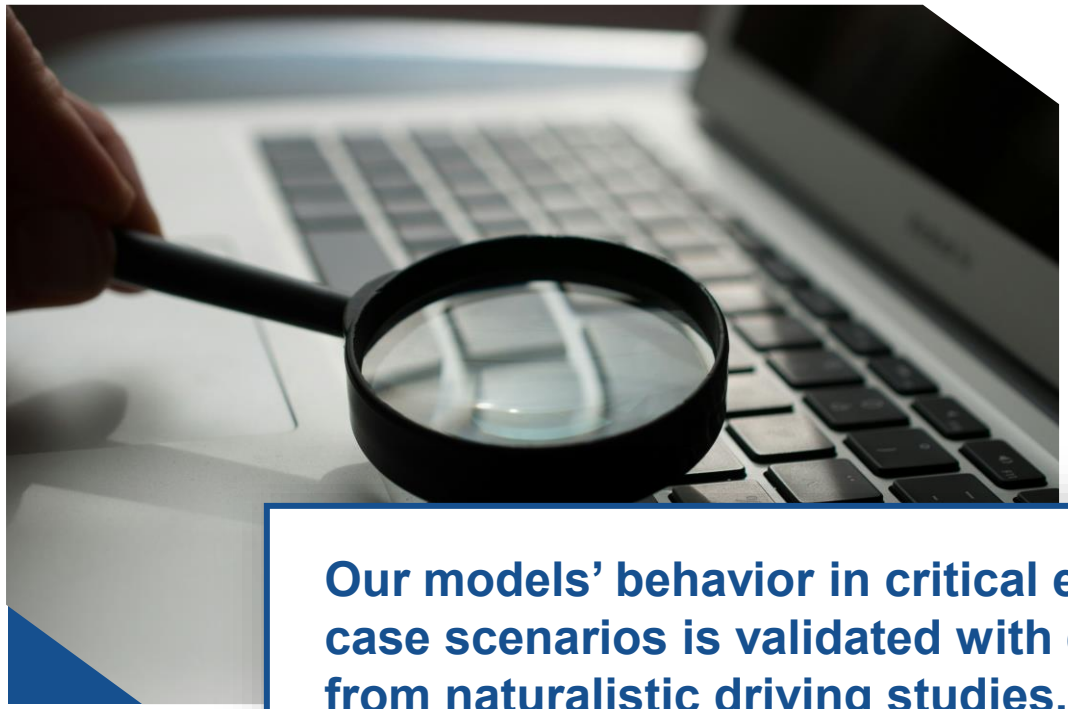
Logistics yards offer a variety of challenging situations for autonomous systems.

walkBOT makes it possible to systematically test the various possible interactions.


bikeBOT


MUSEUM
MUSEUM

cogniBOT IS VALIDATED BY REAL-WORLD DATA IN CRITICAL SITUATIONS



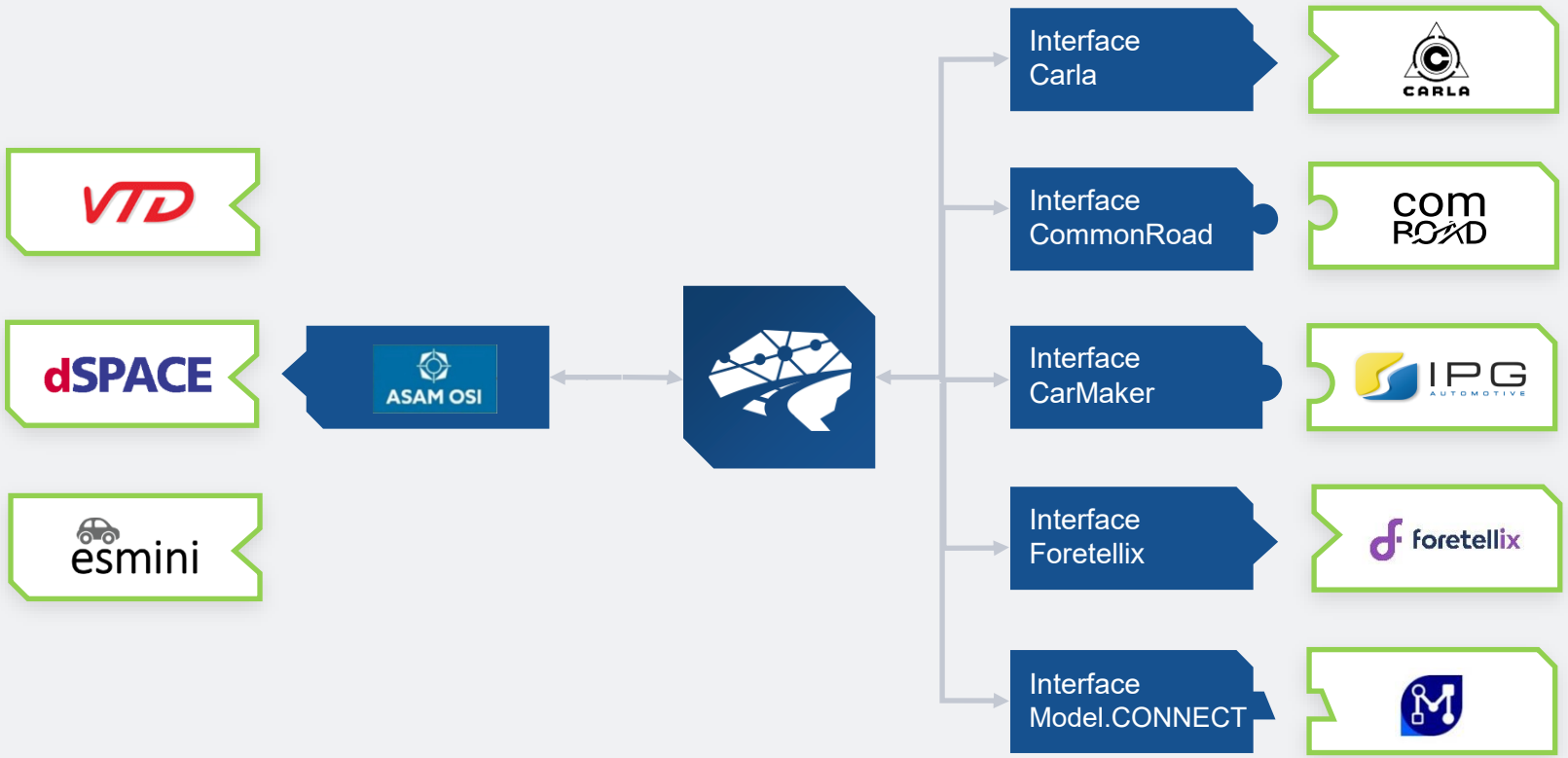
Our models' behavior in critical edge-case scenarios is validated with data from naturalistic driving studies.

For critical edge-case scenarios, specific scene parameters are used for validation.

- Reaction Times
- Brake kinematics
- Characteristics of evasion maneuvers
- Correlations between behavior and scene criticality

OUR SOFTWARE CAN BE EASILY INTEGRATED INTO ANY SIMULATION PLATFORM VIA ASAM OSI OR SPECIFIC INTERFACES

SIMULATION



Our road user models are **platform-independent** and can be integrated into any simulation platform, **supporting common industry standards.**

OpenDRIVE
managing the road ahead

OpenSCENARIO
bringing content to the road

ASAM OSI

fmi

cogniBIT

Human Cognition and Behavior in Traffic

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