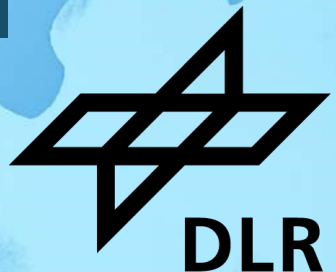


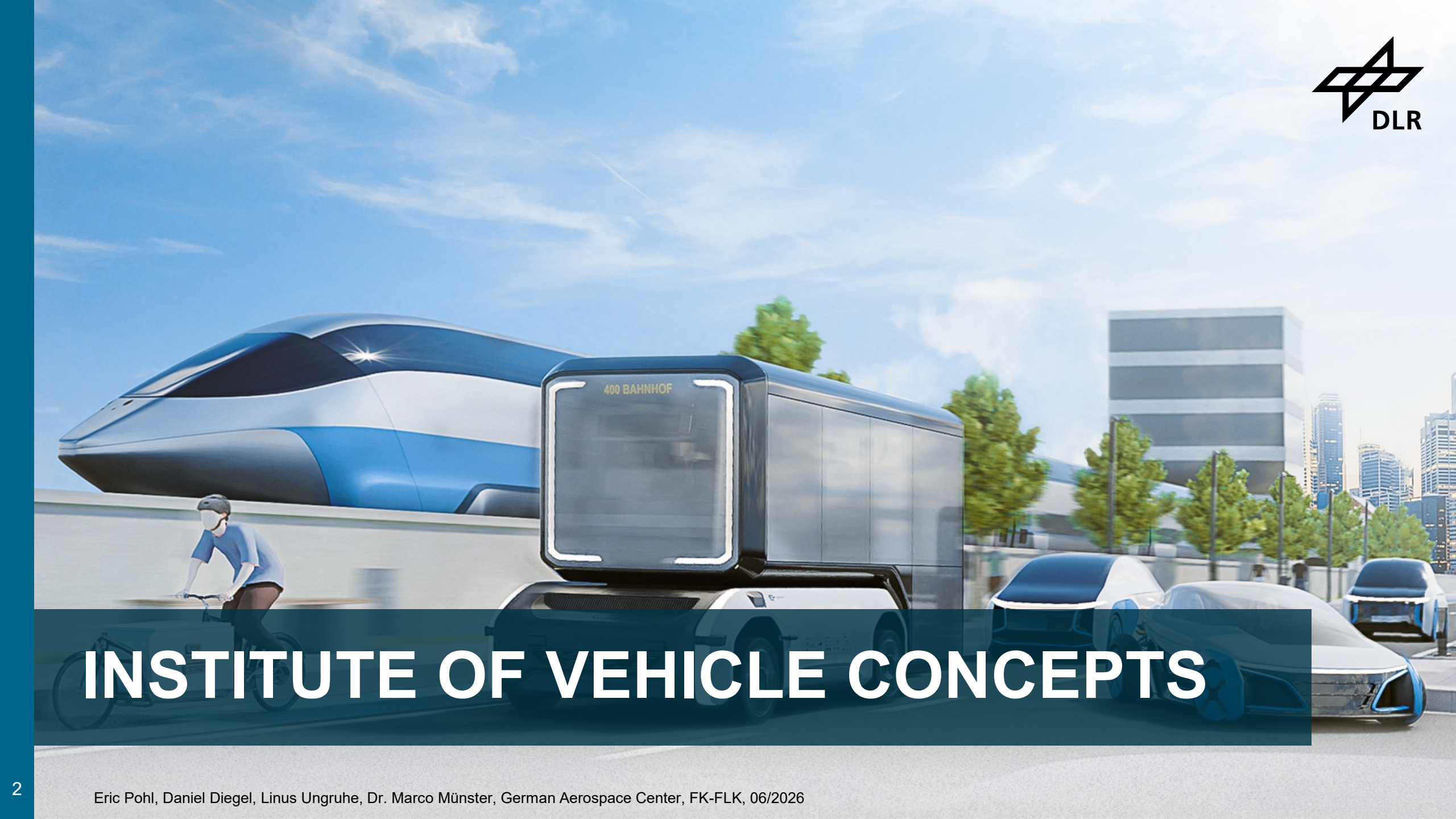
# TOWARD A LIDAR-BASED DOCKING PROCEDURE FOR THE U-SHIFT VEHICLE CONCEPT

Eric Pohl, German Aerospace Center, Institute of Vehicle Concepts, Stuttgart

In corporation with InMach Intelligente Maschinen GmbH, Ulm

Autonomous Vehicle Technology Expo 2026





# INSTITUTE OF VEHICLE CONCEPTS



**Our facts:  
This is how we  
keep things moving  
—  
since 2002**

**125**

multidisciplinary researchers

**€20 million**

Annual budget

**40%**

third-party funding

**5**

fields of innovation

# Table of Content

- **U-Shift Concept**
- **Automated Docking**
  - Technology and Constraints
  - Software Stack
  - Results
- **Outlook**
  - Future Work
  - IMoGer

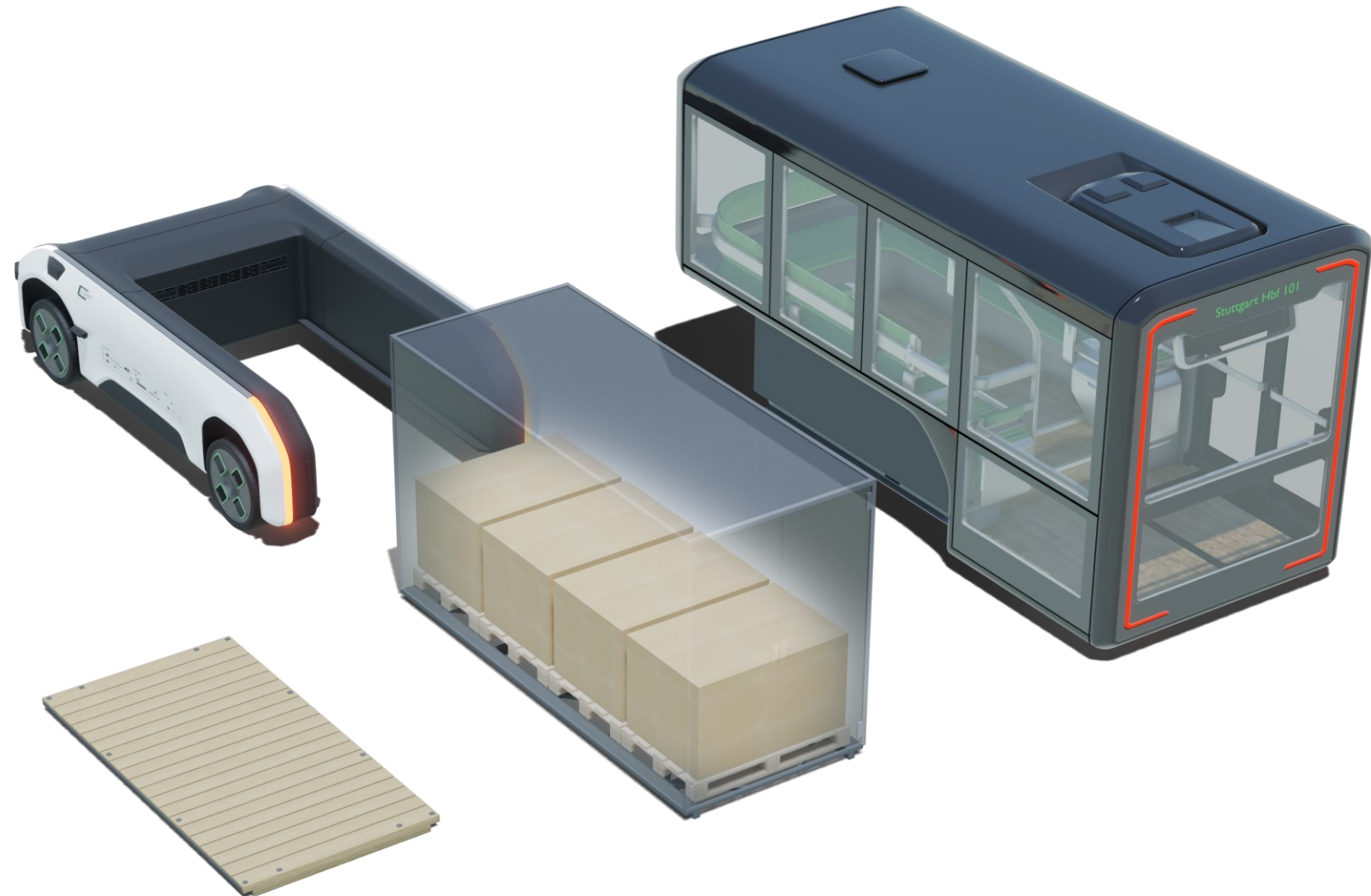




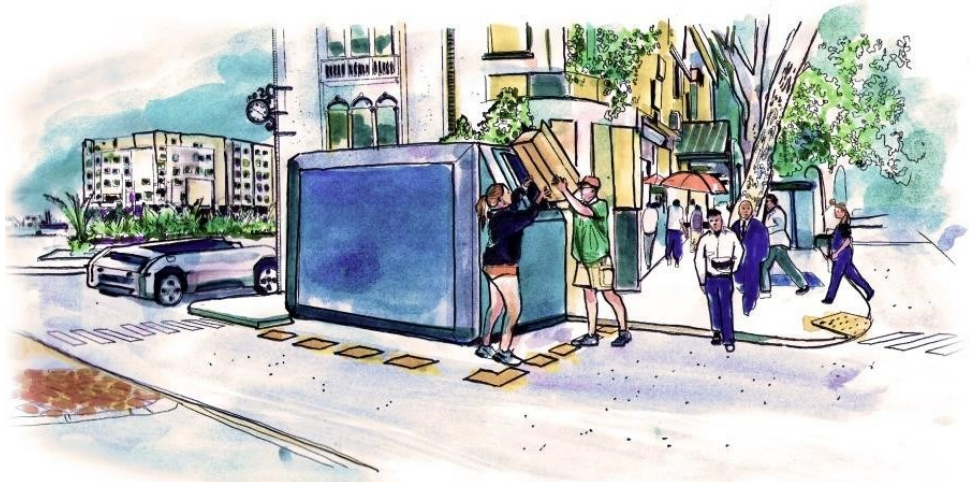
# U-SHIFT CONCEPT

# U-Shift Concept

Urban  
50-70 km/h  
24/7 Service  
Multiple Tasks  
On-Demand



# U-Shift Application



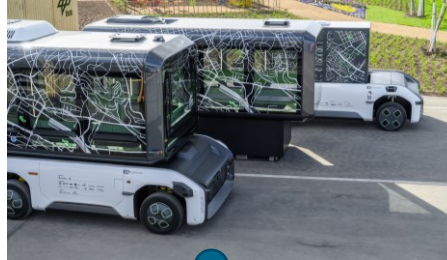
# U-Shift - From THE LÄND to the World



## U-Shift Concept



## U-Shift IV First On Semi Public Road



11/2017

09/2020

09/2023

06/2025

06/2026

...

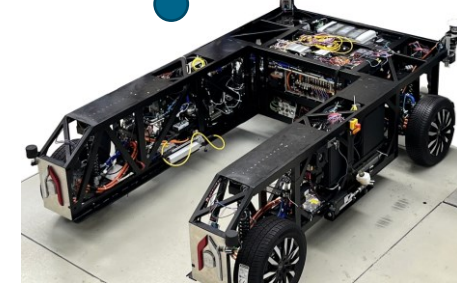
## U-Shift I Mock-up



## U-Shift 33 MAD Urban

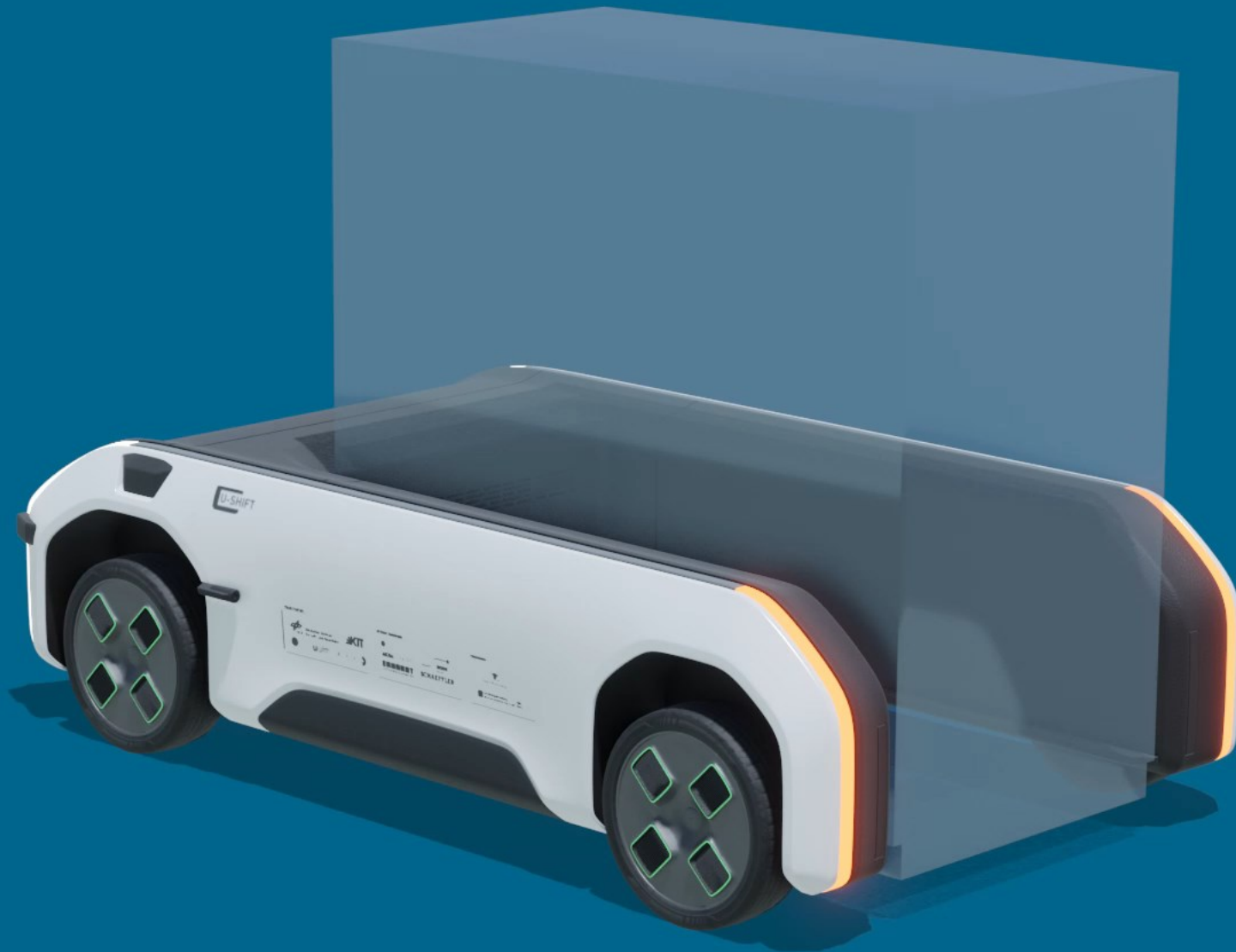


## U-Shift II Researcher



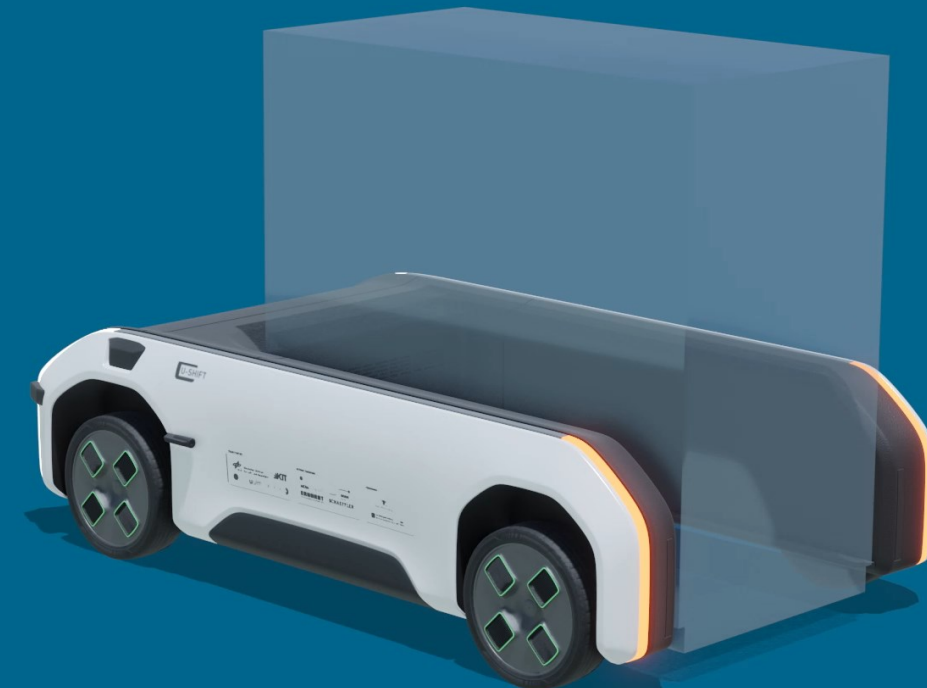
# U-SHIFT - AUTOMATED DOCKING

# U-Shift - Docking Concept

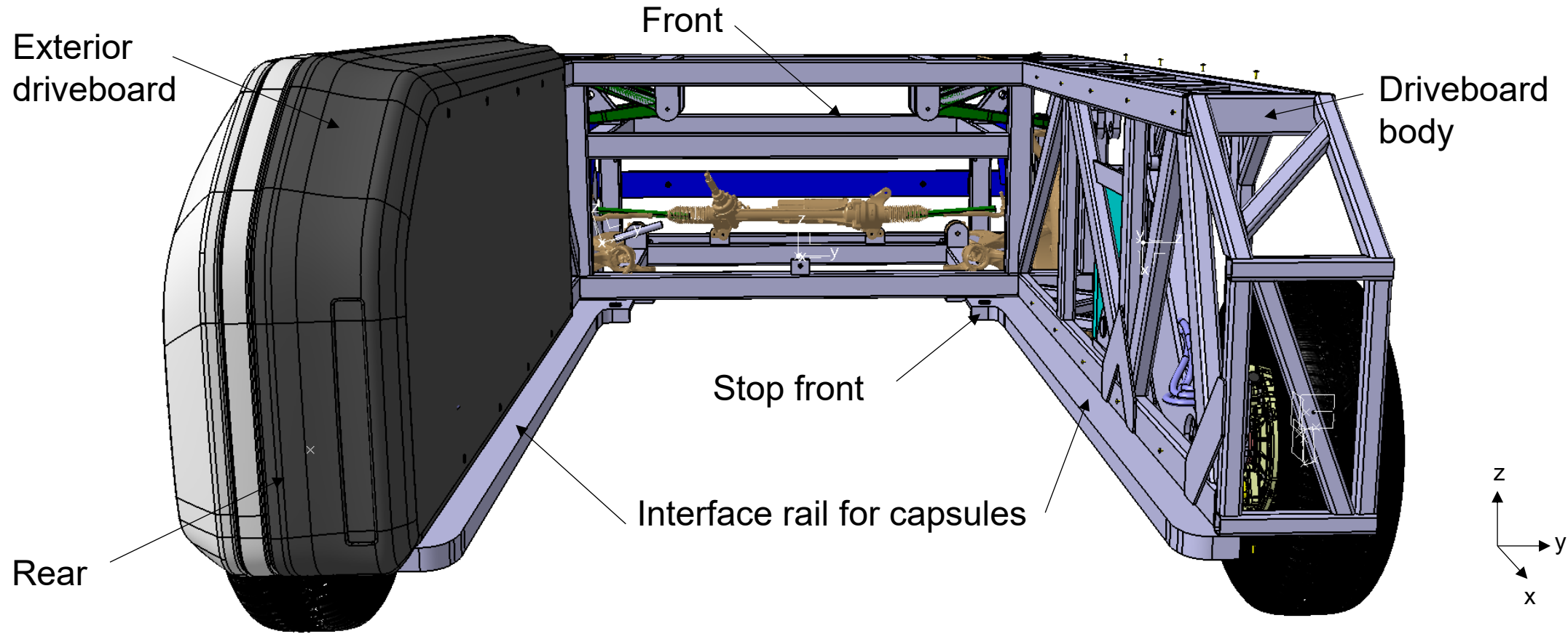


# U-Shift - Docking Sequence

- Drive to capsule position
  - Knowledge of rough absolute capsule position and orientation
  - Collision avoidance
- Align driveboard to capsule
  - High-precision relative capsule pose estimation
  - High-precision low speed maneuvering
- Docking logic
  - Lower driveboard and drive in capsule
  - Lift driveboard and lock the capsule
- Undocking in reverse order
  - No high-precision maneuvering is required



# U-Shift IV - Driveboard Loading Mechanism



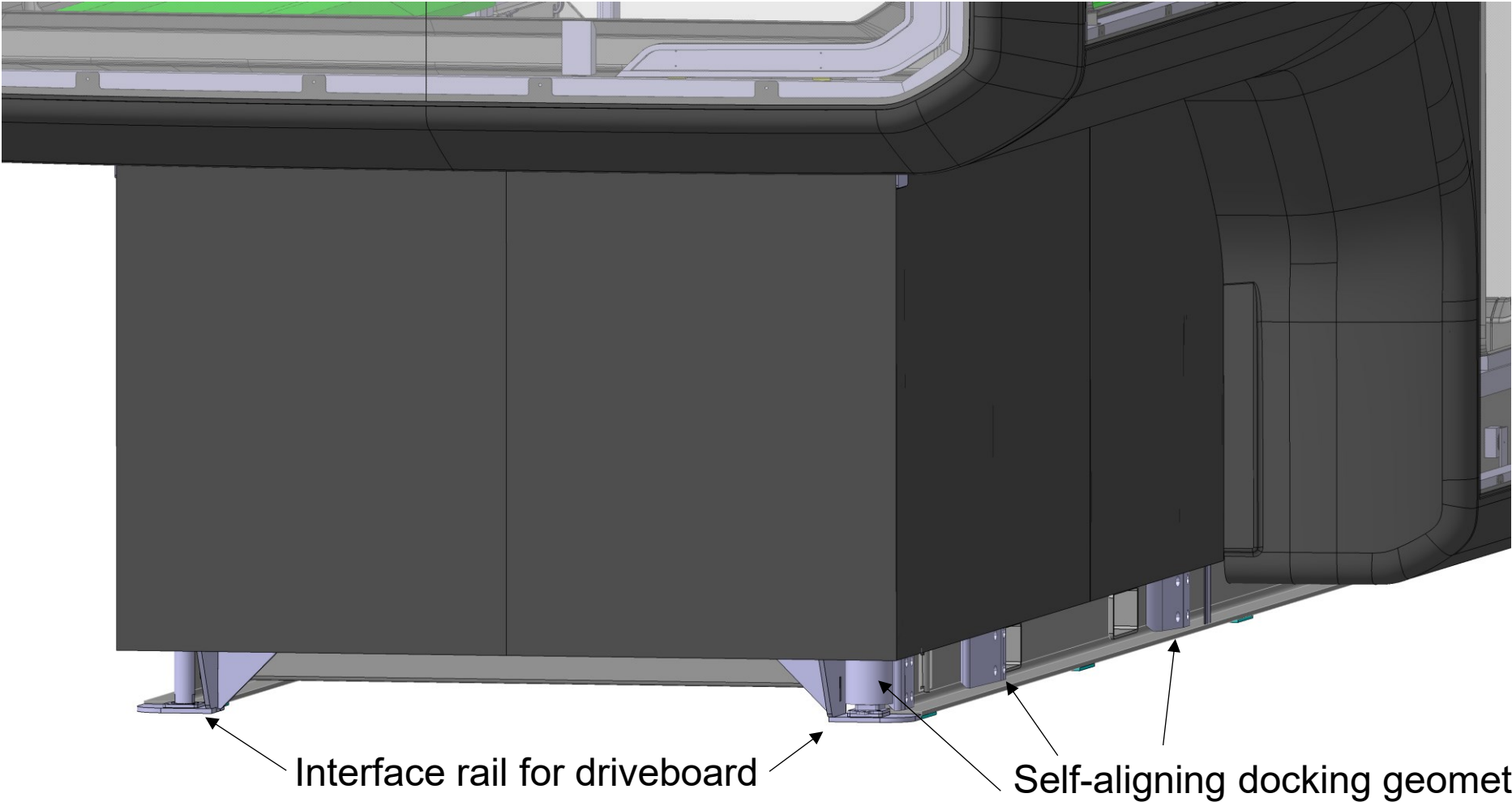
Münster, Marco; Siefkes, Tjark; ... (2021) U-Shift vehicle concept: modular on the road. In: 21st Internationale Stuttgarter Symposium Automobil- und Motorentechnik, 30.-31. März 2021, Stuttgart.



Gefördert durch



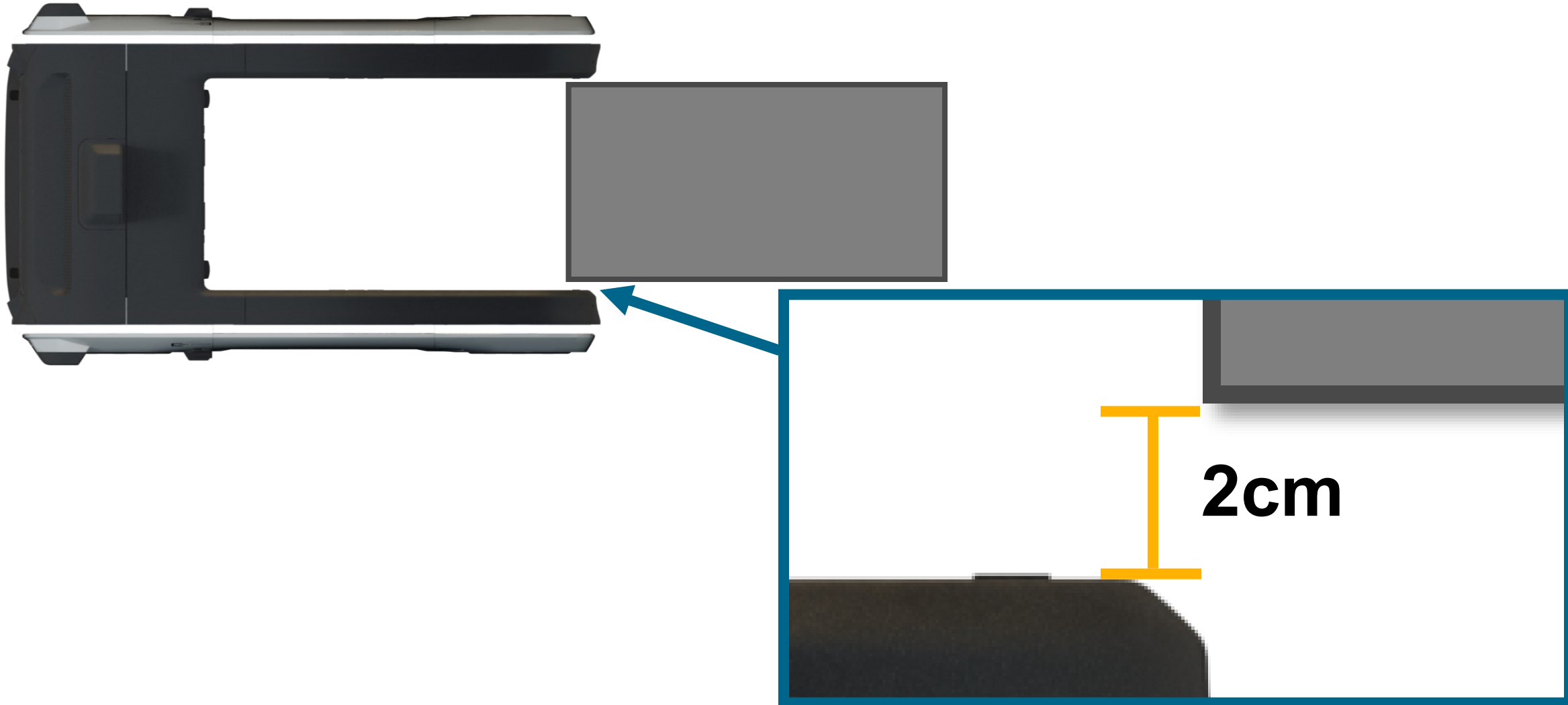
# U-Shift IV - Driveboard Loading Mechanism



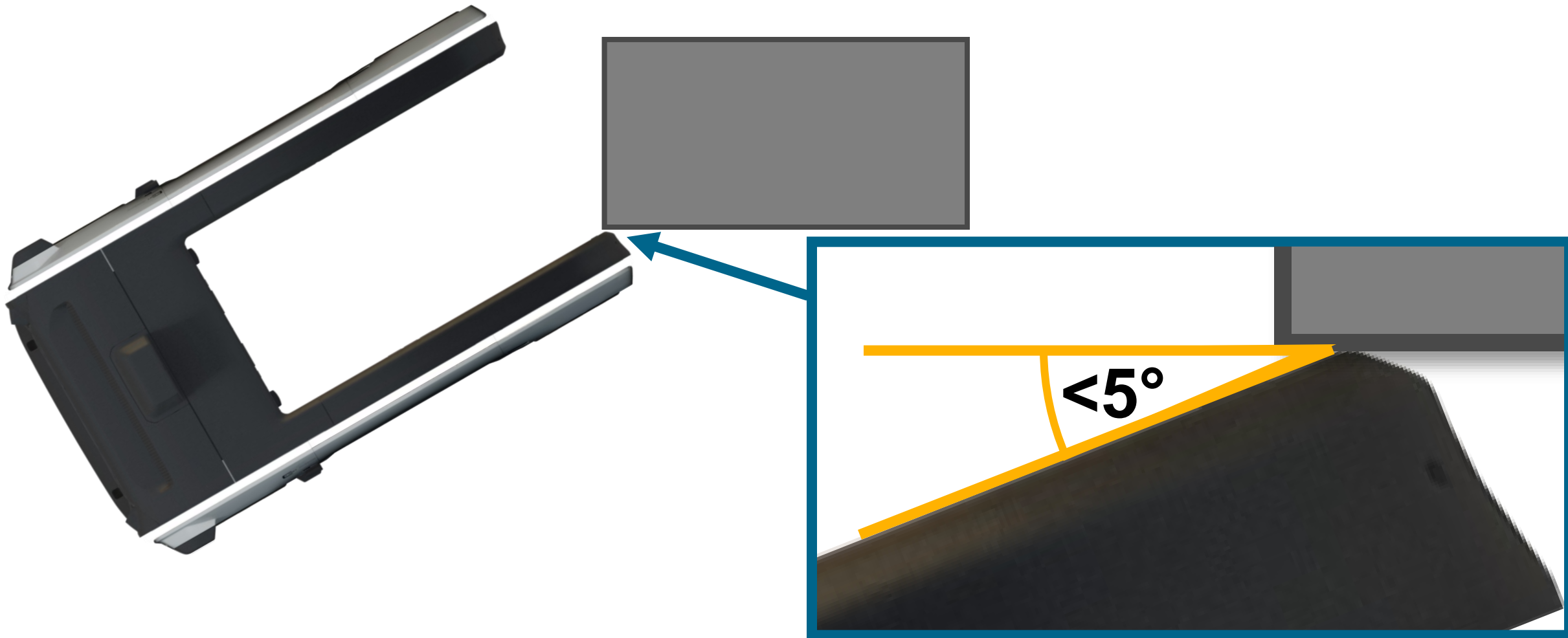
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# U-Shift IV - Driveboard Loading Mechanism Accuracy



# U-Shift IV - Driveboard Loading Mechanism Accuracy



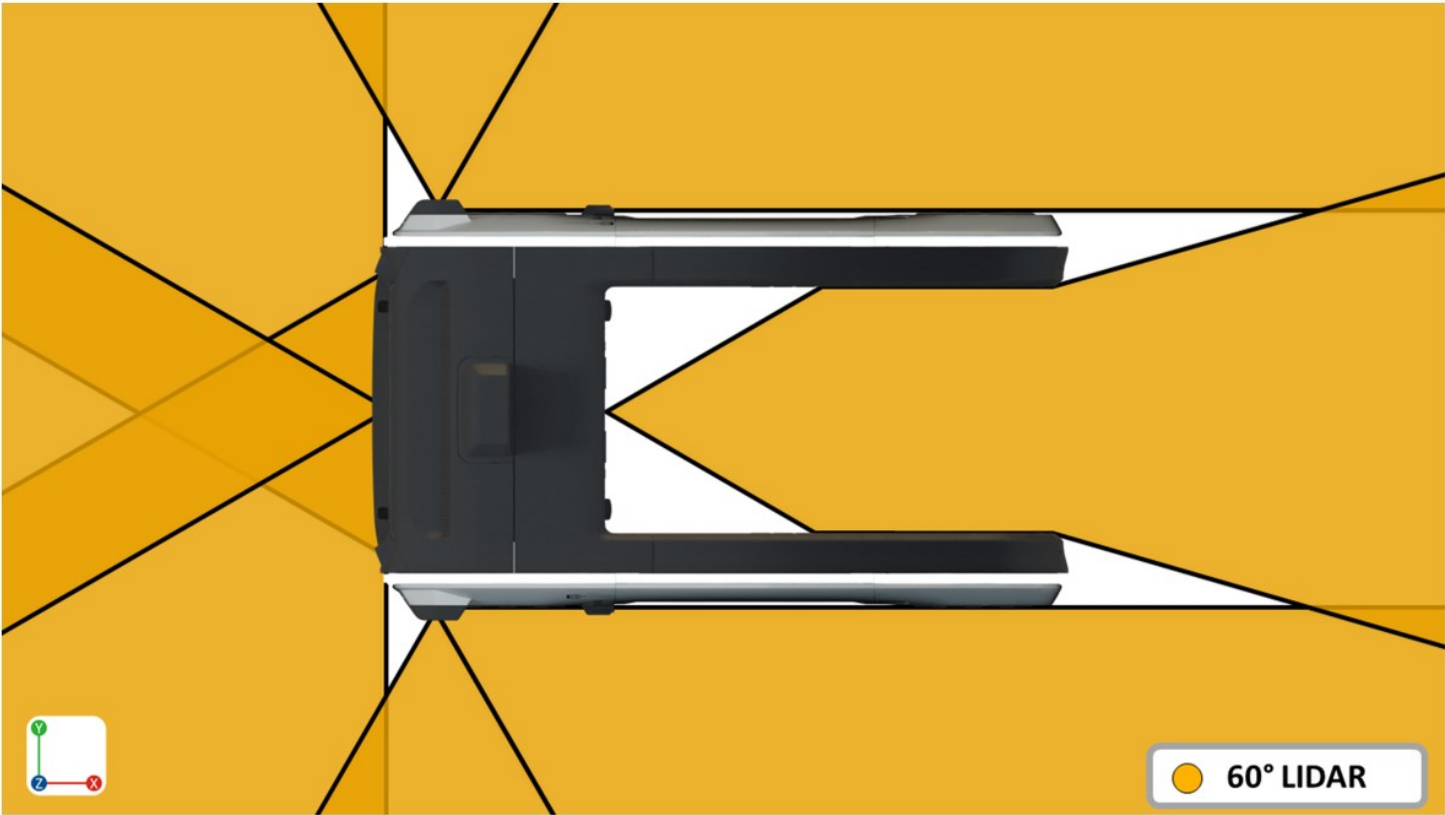
# U-Shift IV - Multi-Modal Perception Suite



# U-Shift IV - 2023 LiDAR Suite



## U-Shift IV – LIDAR Setup

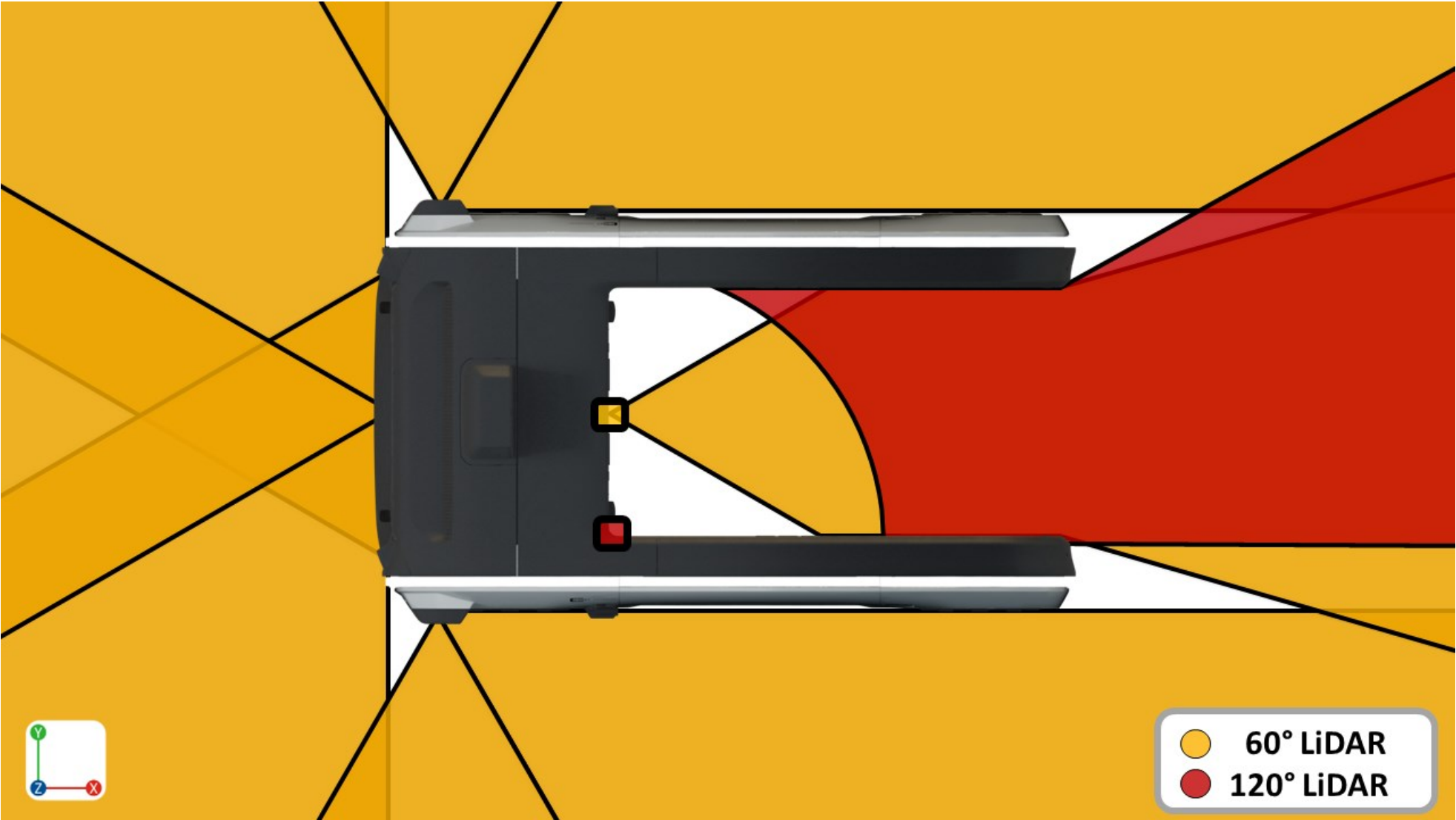


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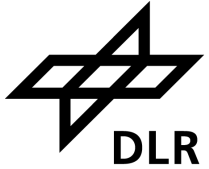
Eric Pohl, German Aerospace Center, FK-FLK, 04/2025



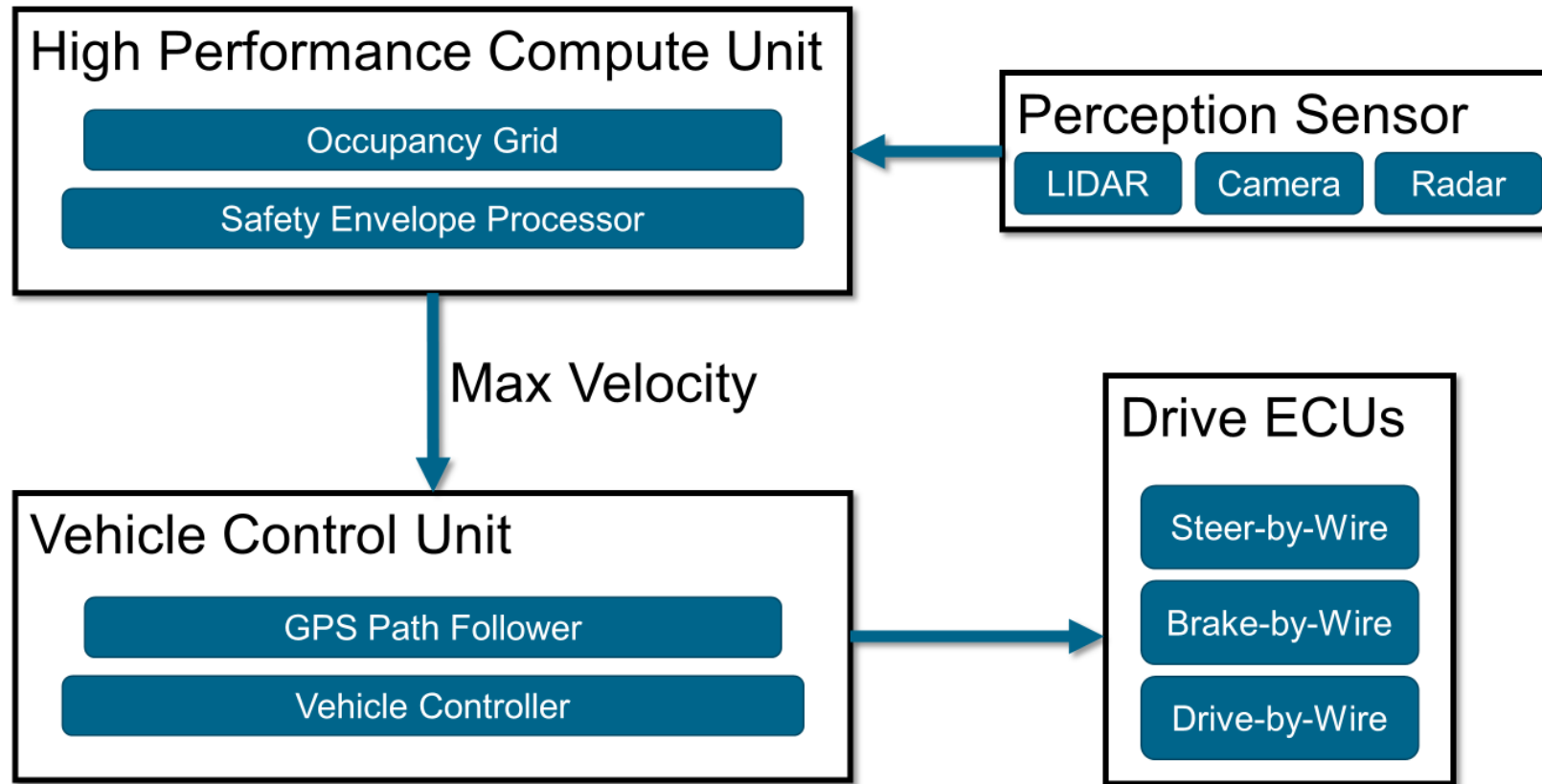
# U-Shift IV - 2026 LiDAR Suite



# U-Shift IV - 2023 Software Stack



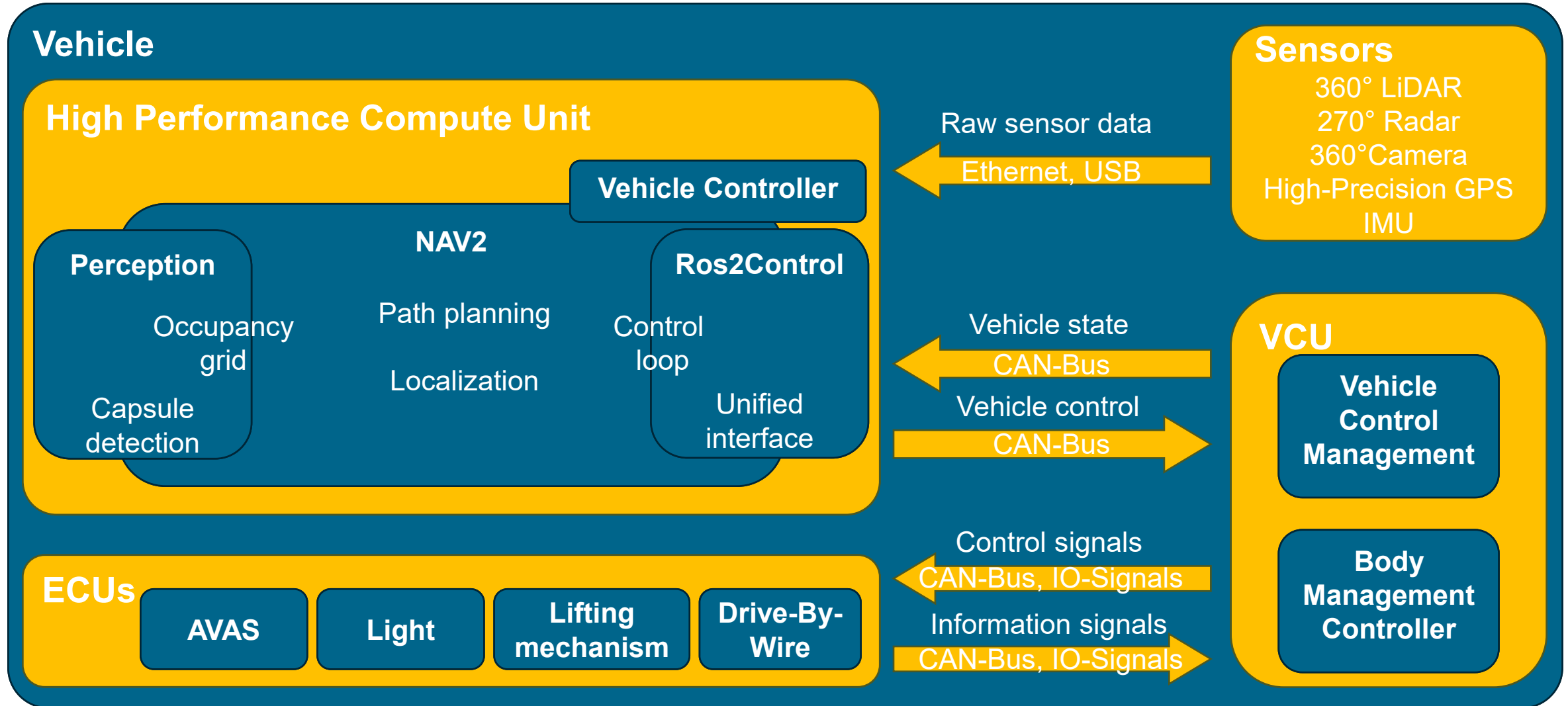
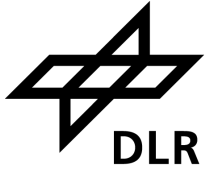
## U-Shift IV – AD-Architecture



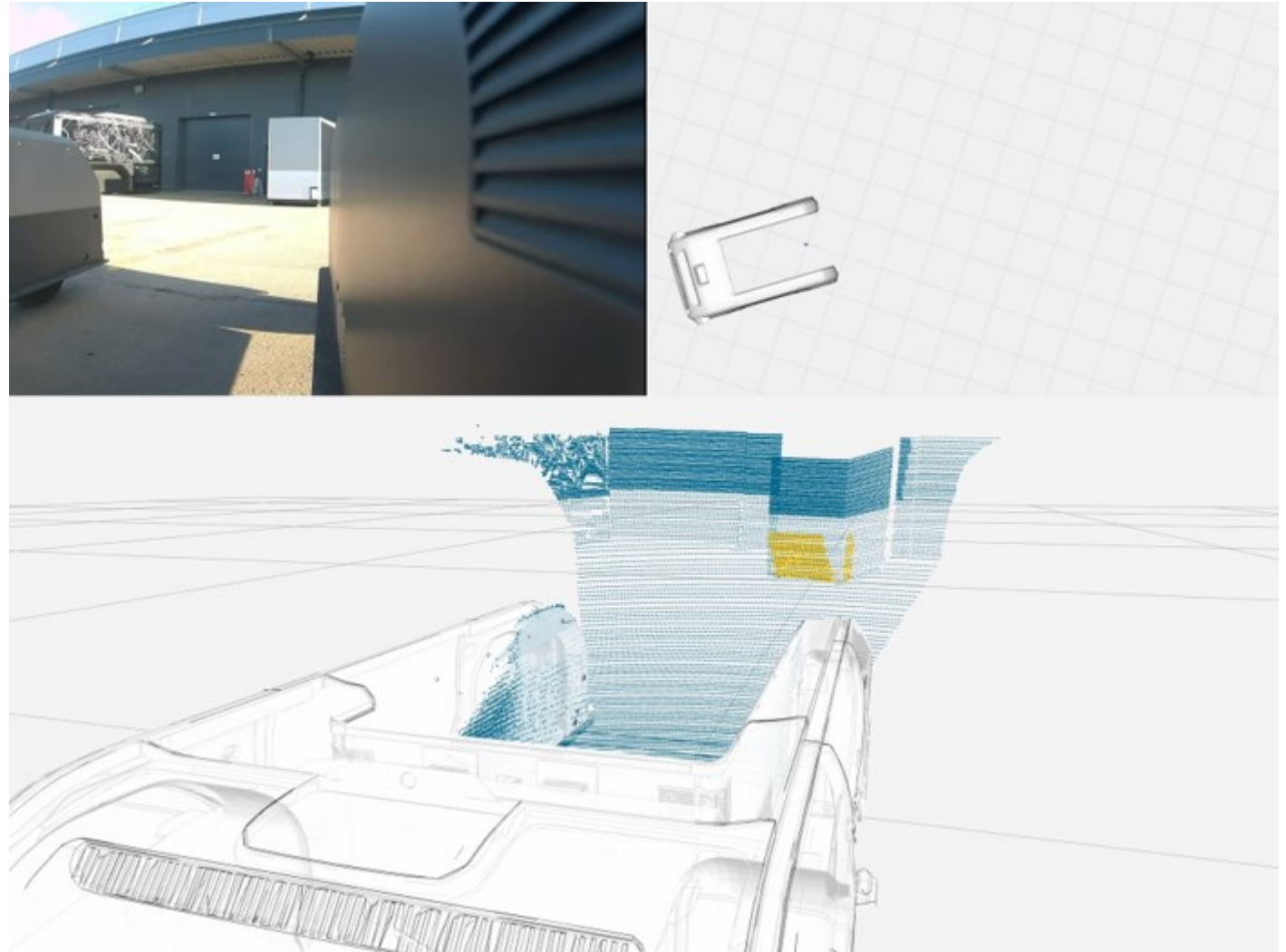
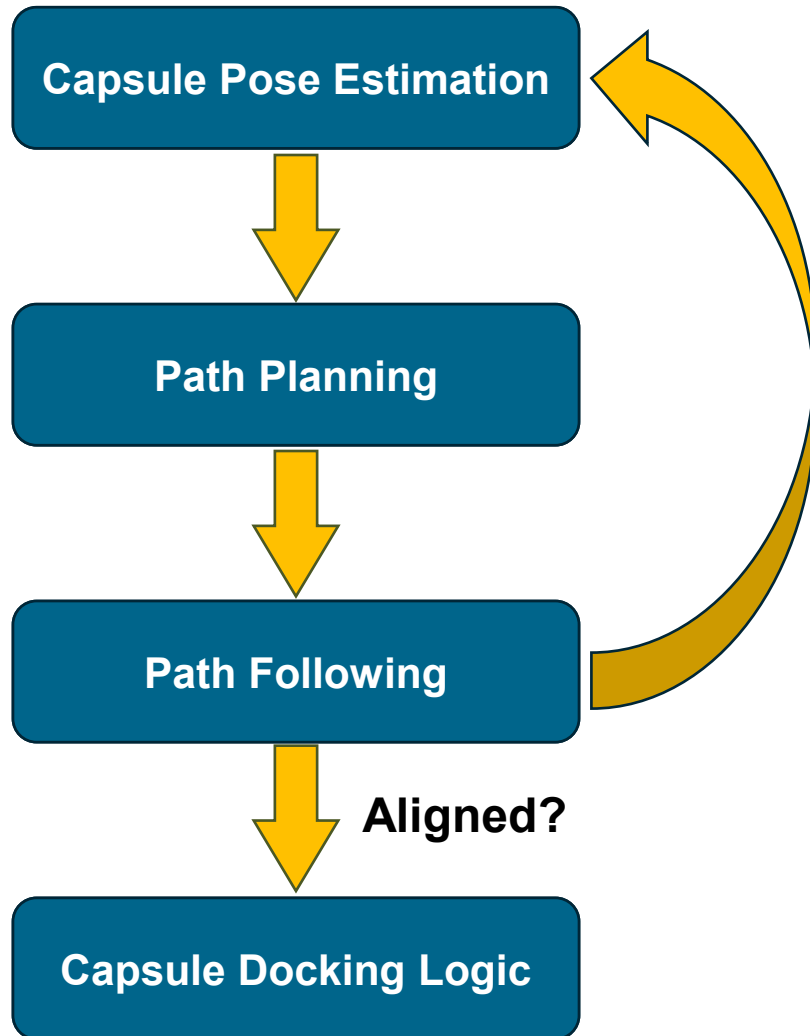
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Eric Pohl, German Aerospace Center, FK-FLK, 04/2025

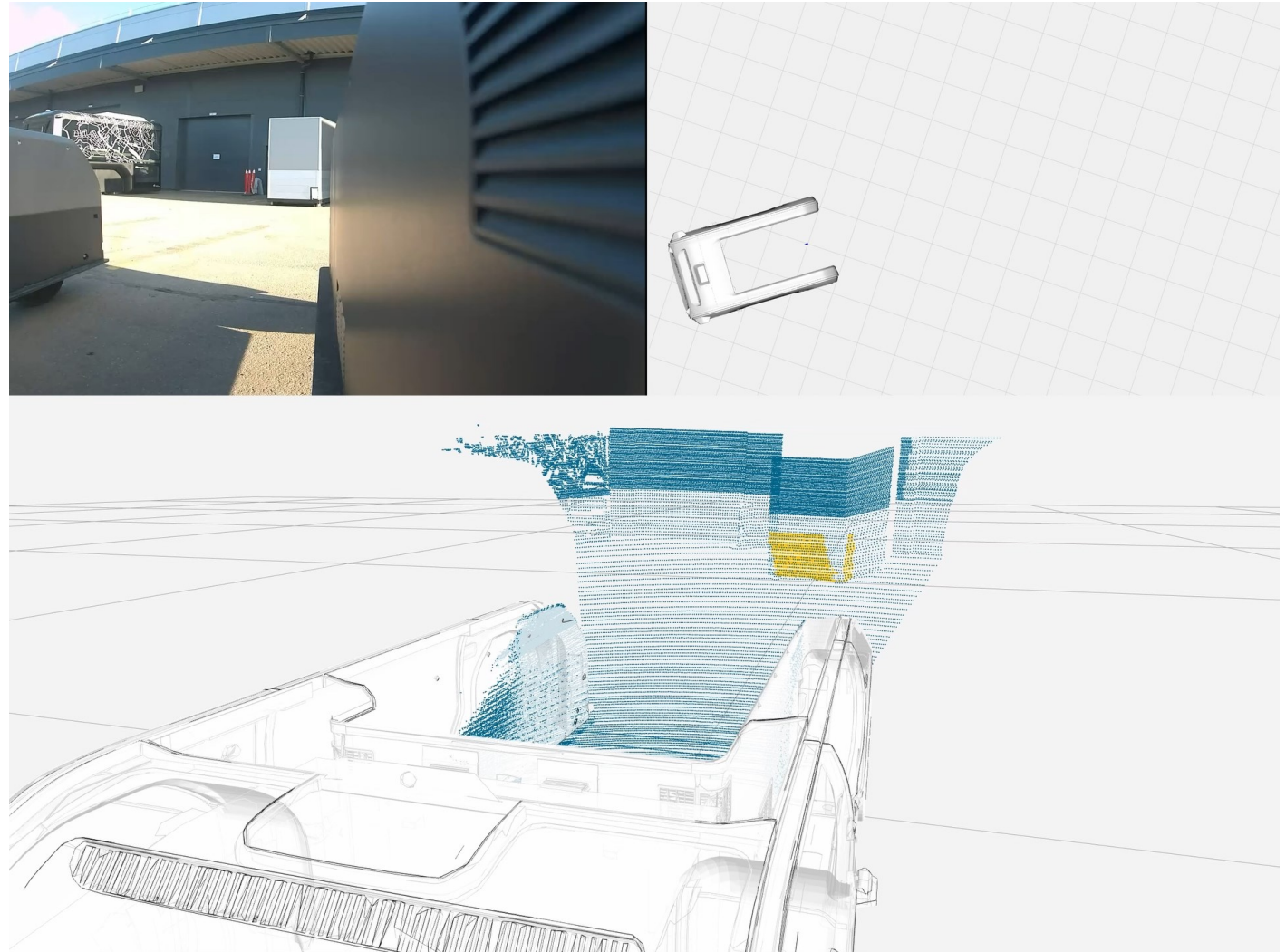
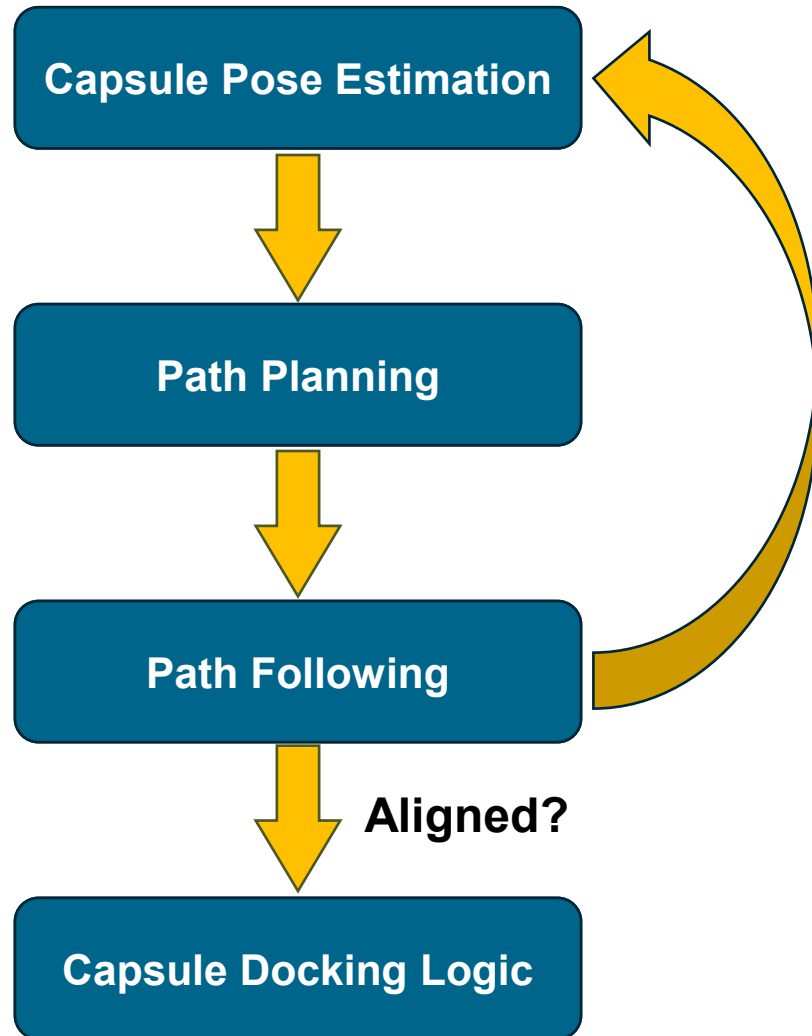
# U-Shift IV - 2026 Software Stack



# U-Shift IV - Automated Docking

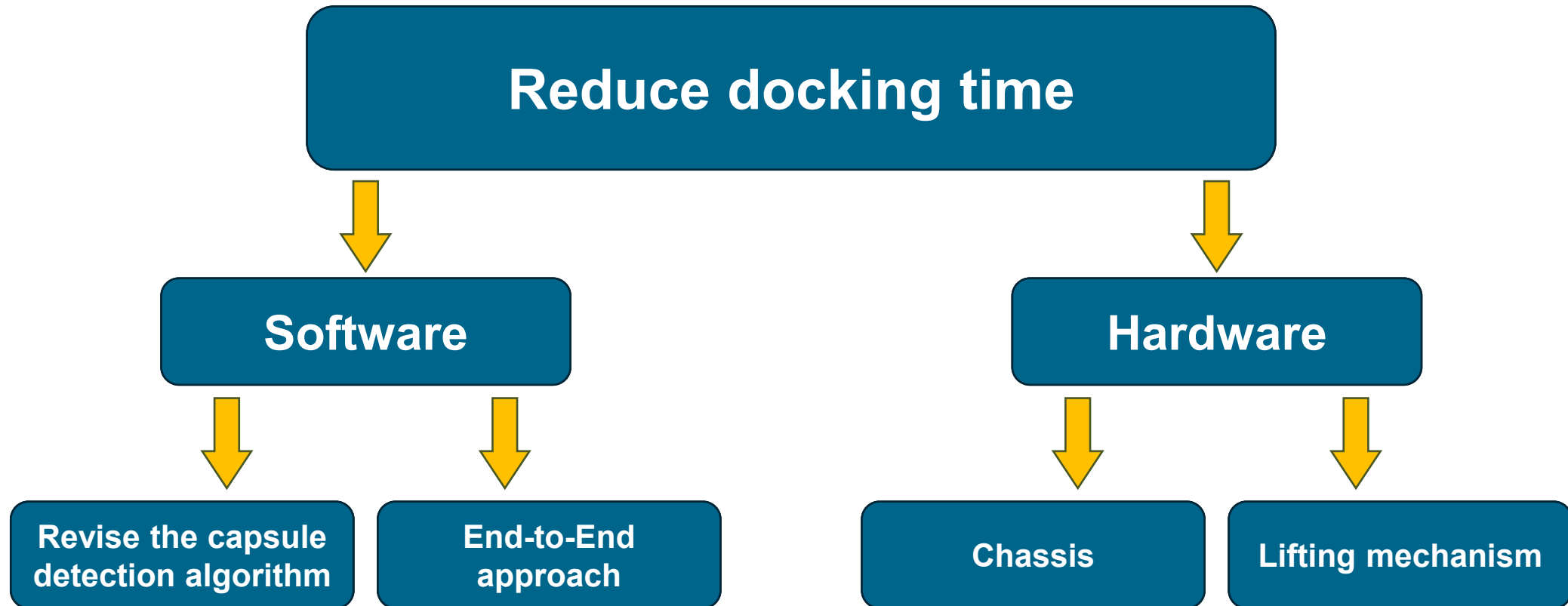


# U-Shift IV - Automated Docking





# U-SHIFT - OUTLOOK

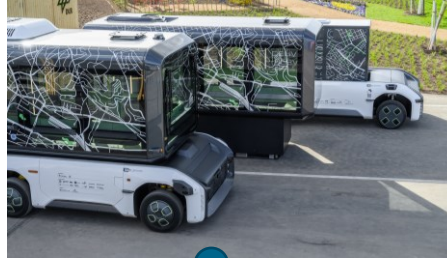


# U-Shift - From THE LÄND to the World

## U-Shift Concept



## U-Shift IV First On Semi Public Road



11/2017

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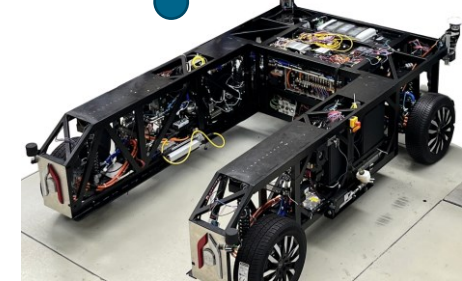
## U-Shift I Mock-up



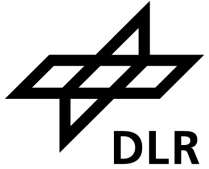
## U-Shift 33 MAD Urban



## U-Shift II Researcher



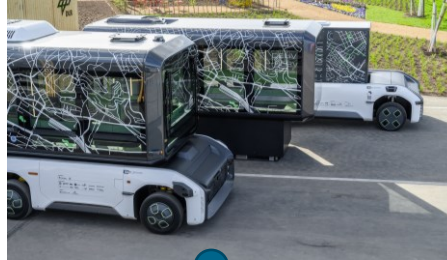
# U-Shift - From THE LÄND to the World



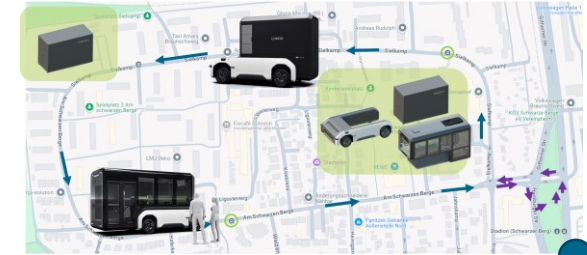
## U-Shift Concept



## U-Shift IV First On Semi Public Road



## U-Shift V / IMoGer First On Road



11/2017

09/2020

09/2023

06/2025

06/2026

07/2027

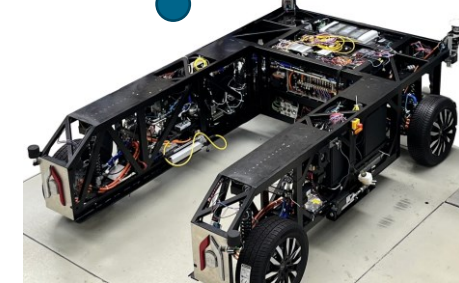
## U-Shift I Mock-up



## U-Shift 33 MAD Urban



## U-Shift II Researcher



# THANK YOU



Topic: Toward a lidar-based docking procedure for the U-Shift vehicle concept  
June 23-25, 2026, Stuttgart, Germany

Date: June 24, 2026

Authors: Eric Pohl, Daniel Diegel, Linus Ungruhe, Dr. Marco Münster

Contact: [eric.pohl@dlr.de](mailto:eric.pohl@dlr.de)

Institute: Institute of Vehicle Concepts

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