Karlsruher Institut für Technologie

Tire in the Loop – Proof of Concept

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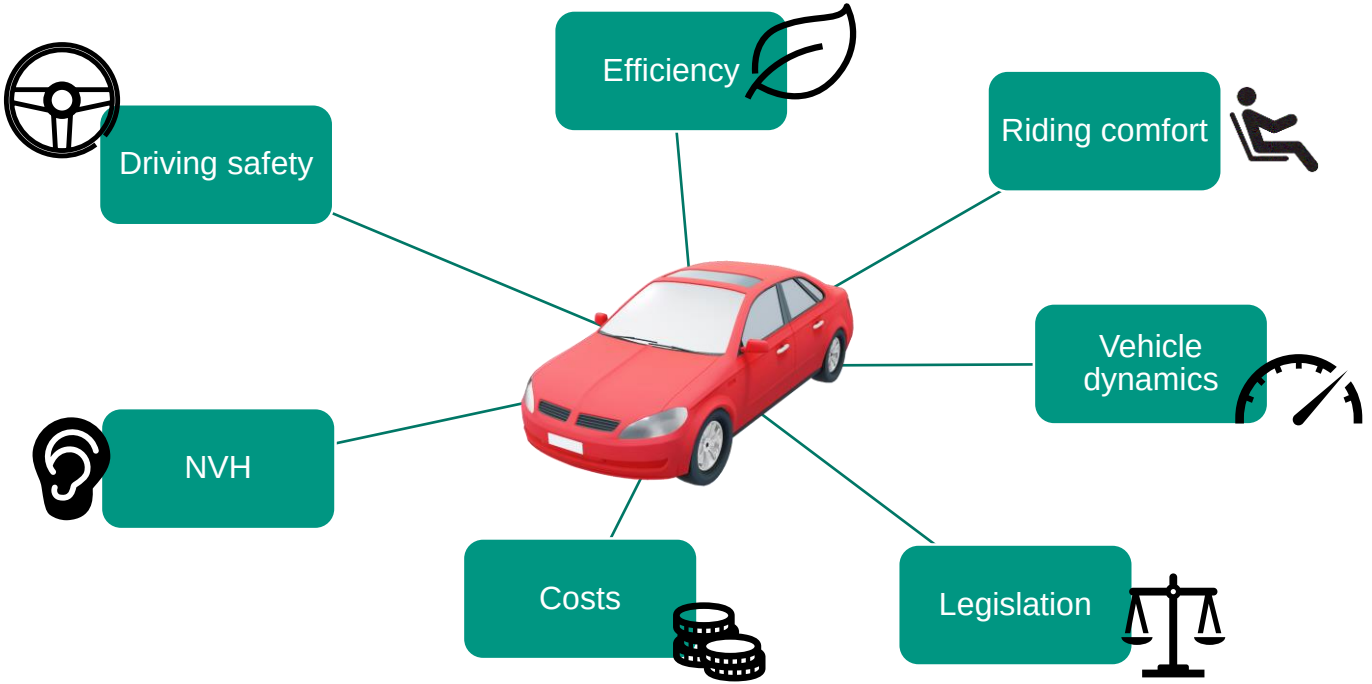
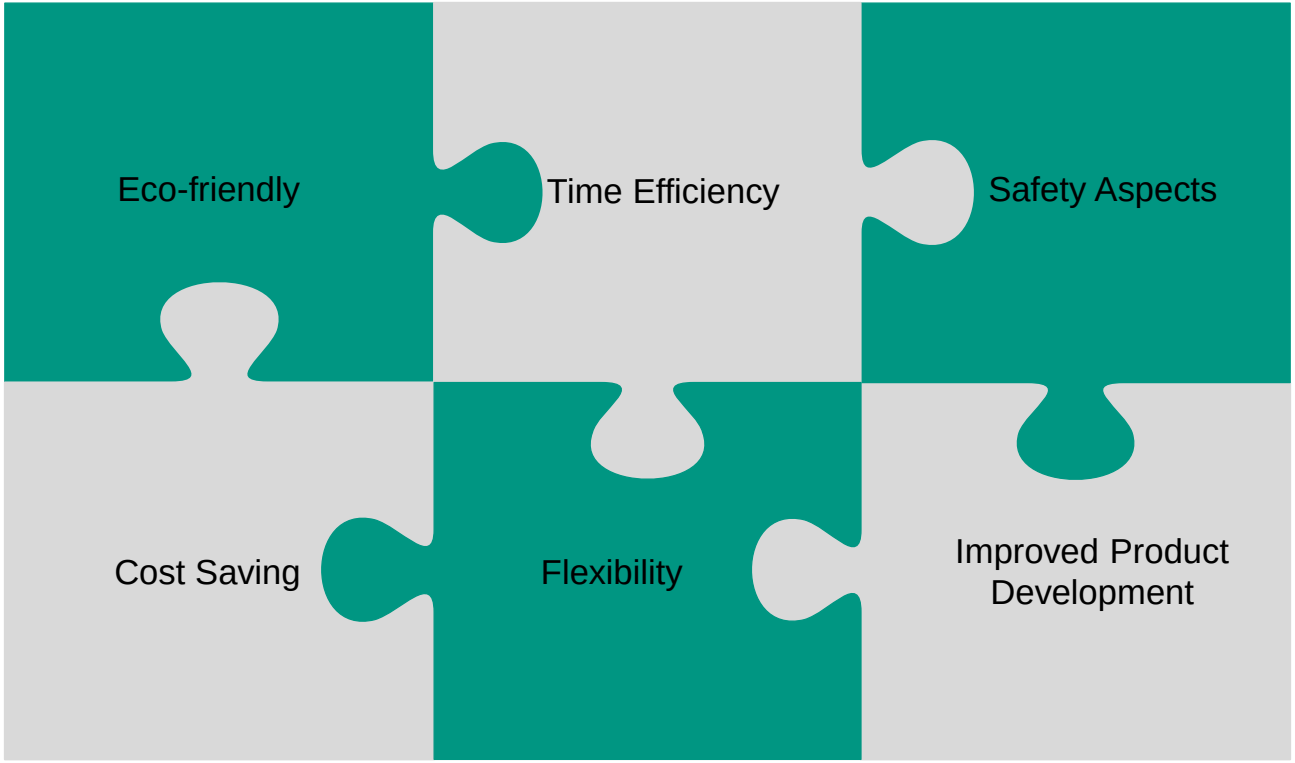
Motivation:
Requirements for the Vehicle Development



The tire is the force transmitter between the vehicle and the road and has a strong influence on a number of requirements

Motivation:
Advantages of the TiL Method



Motivation:
Influence of Tires on Evaluation of Driving Maneuver

Tire parameters

- Tread pattern
- Rubber compound
- Dimension
- Lateral force stiffness
- Longitudinal stiffnes
- Vertical stiffness

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Operation conditions

- Inflation pressure
- Wheel load
- Ambient temperature
- Speed
- Road surface
- Slip angle
- Camber angle
- Driving force
- Braking force

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Driving maneuver

- Slalom course
- Lane change
- Stationary circle
- VDA Ausweichtest
- Brake test
- Public road simulation

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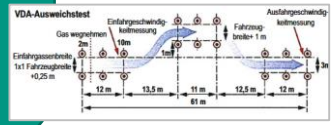

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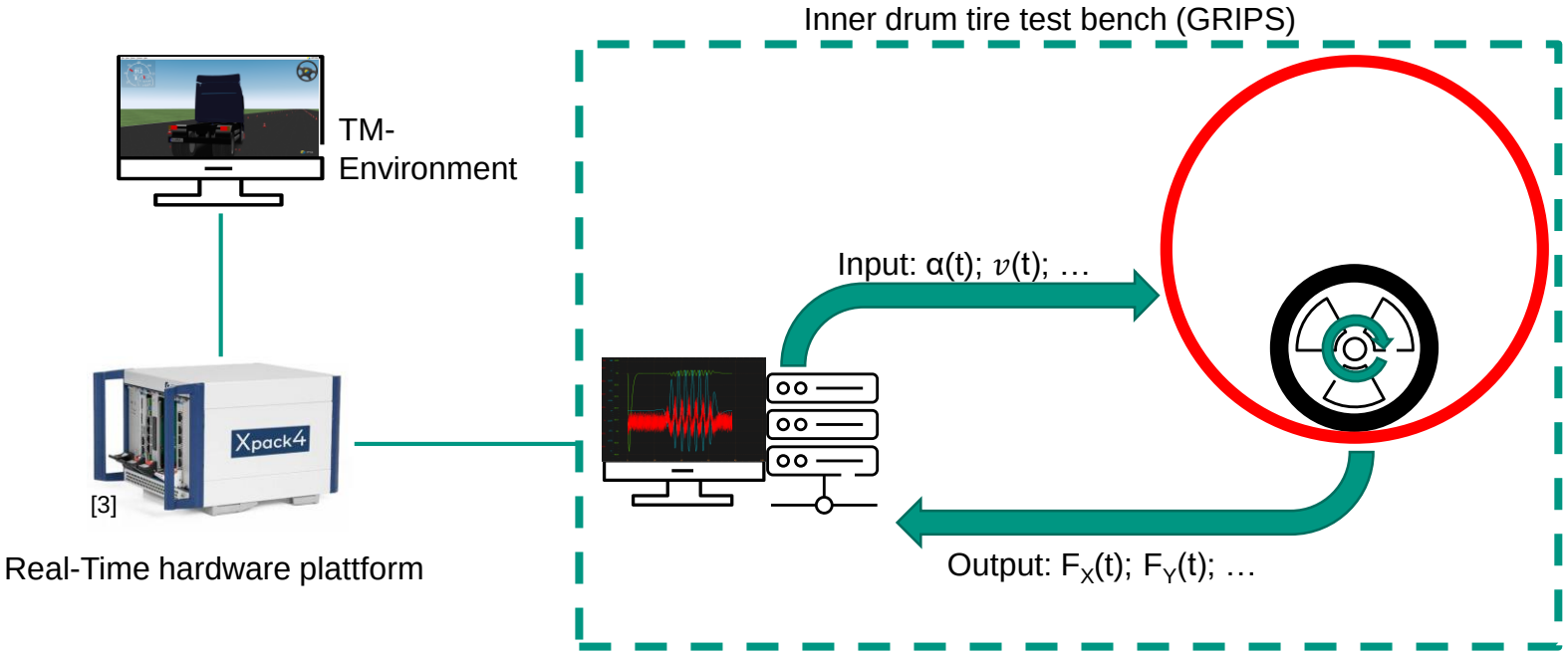
TiL Setup at GRIPS

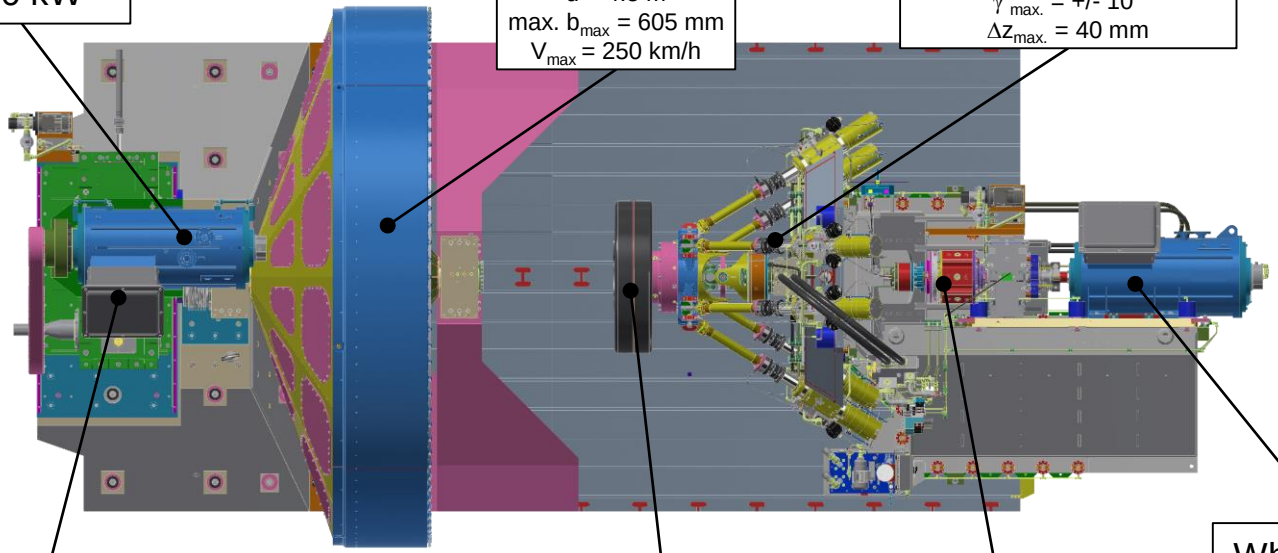


Technical Description GRIPS

Drum drive
630 kW

Drum
d = 4.5 m
max. b_{max} = 605 mm
V_{max} = 250 km/h

Hexapod
a_{z_max} = 1.1 m/s²
$f_{max.}$ = 30 Hz
$\alpha_{max.}$ = 15°
$\gamma_{max.}$ = +/- 10°
$\Delta z_{max.}$ = 40 mm



Transmission

Test object:
Truck / PLT Tire
$r_{dyn\ max.}$ = 650 mm

Transmission

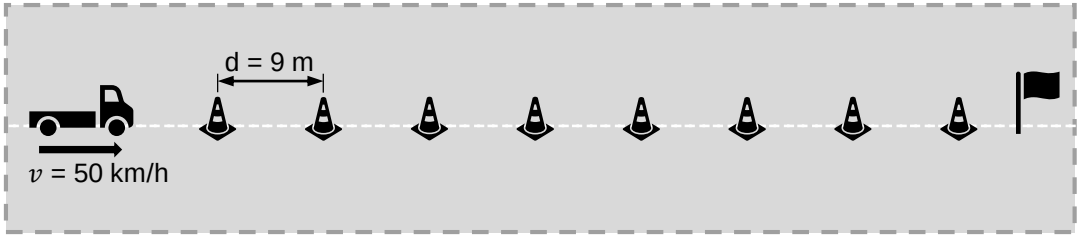
Wheel drive
630 kW

d = inner diameter
b = track width

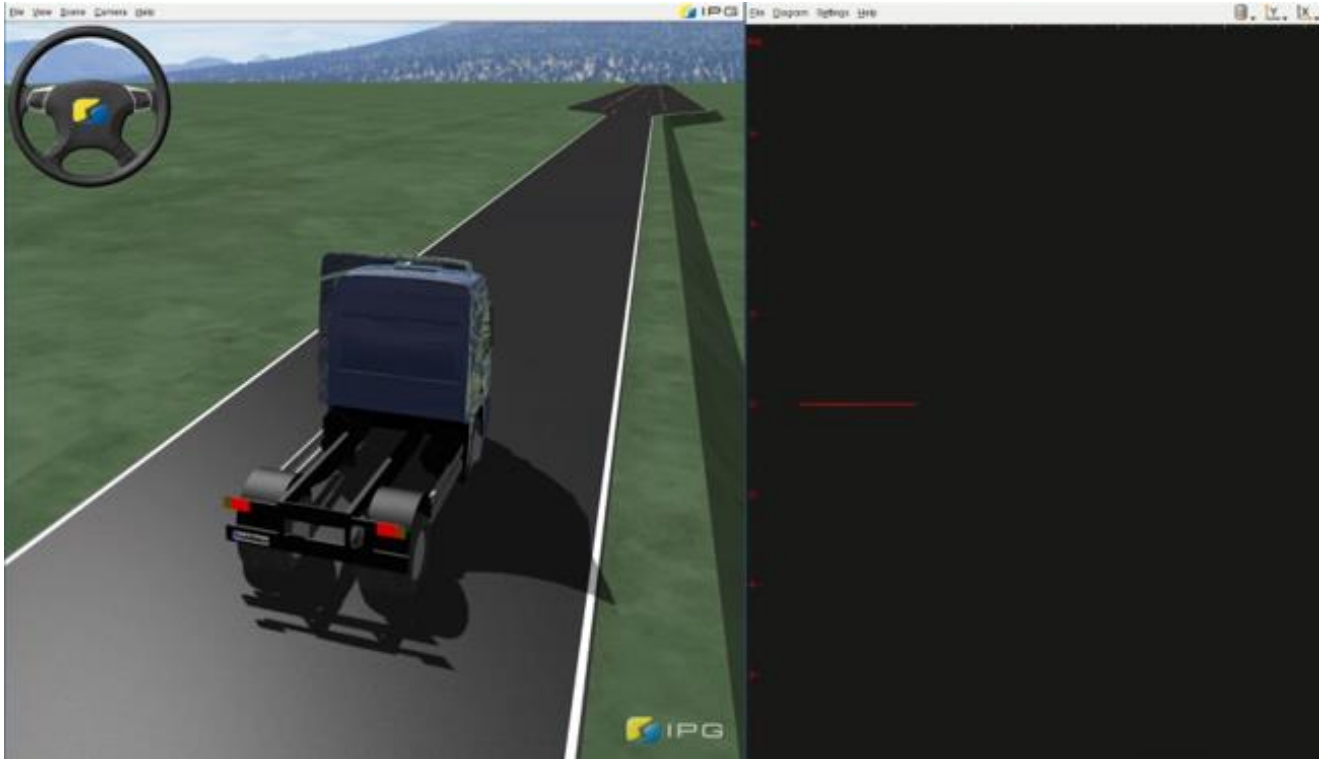
Source of CAD picture: Inova GmbH.

Selected Key Performance Measurement
Slalom Course

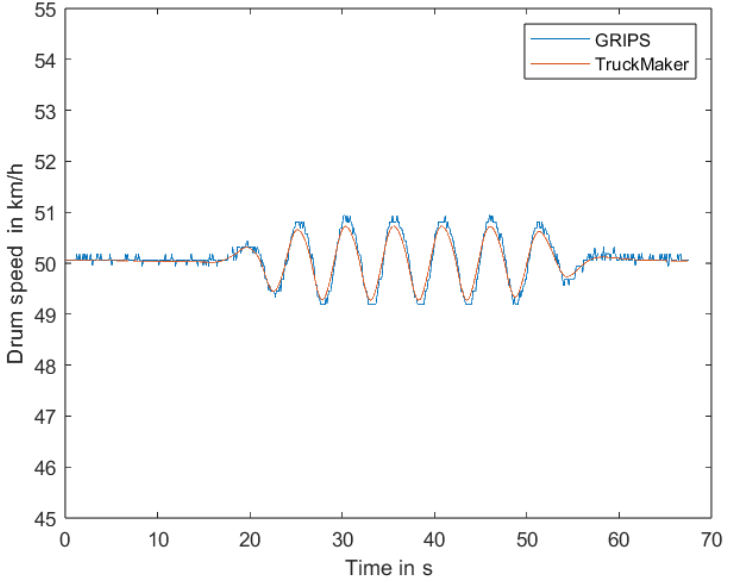
- Slalom course in TM: Slalom 36m
- Truck: Demo2AxleSemiTruck4x2_Actros
  - Without a trailer
  - Axle load on the front axle 46,6 kN
- Test tires used: 225/75 R 16 C
- Set parameters:
  - Speed v = 50 km/h
  - Suspension compression
  - Slip angle

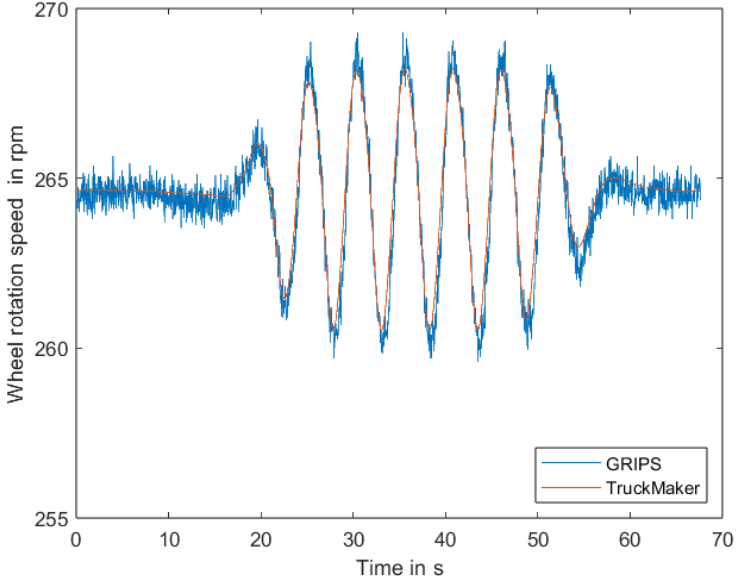


Selected Key Performance Measurement
Slalom Course



Test Results





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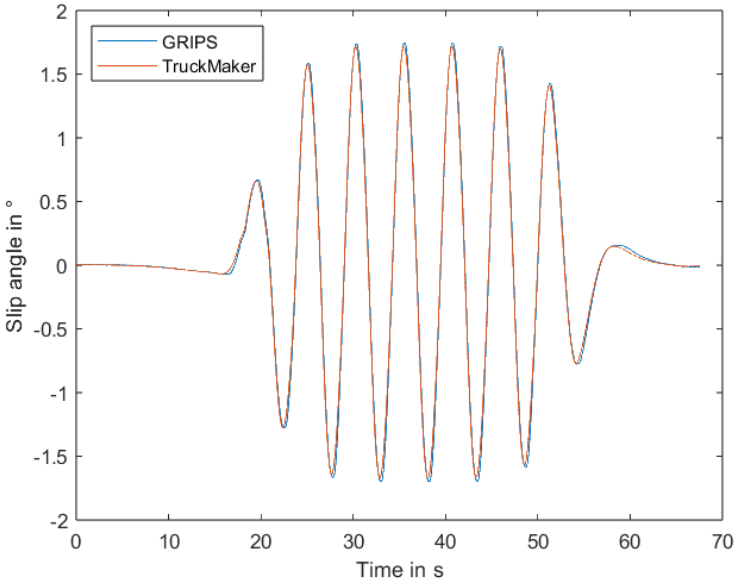

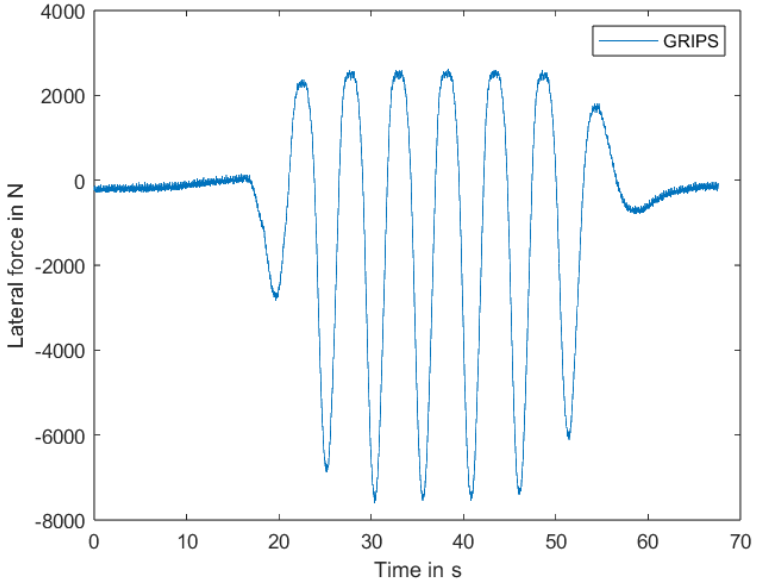

Conclusion

- The GRIPS tire test bench can be used with the driving simulation TruckMaker
- The influences of different tires and tire parameters on driving manoeuvres can be investigated quickly and easily using TiL
  - Reduced modelling and parameterisation effort
- Initial results illustrate the tire influence and behaviour

Thank you for your attention

Questions?

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- 3: IPG Automotive GmbH

Sources

[1] IAM-NET GmbH: Achtung: Neues Reifenlabel ab 05.2021 Pflicht !. URL https://www.iam-net.eu/cms/index.php/de/recht/gvo/104-eu-verordnung-reifenlabel.html (accessed 2024-08-23)

[2] Ersoy, M., Gies, S.: 2017. Fahrwerkhandbuch. Springer Fachmedien Wiesbaden, Wiesbaden. https://doi.org/10.1007/978-3-658-15468-4z

[3] IPG Automotive GmbH: Xpack4 | IPG Automotive. URL https://www.ipg-automotive.com/de/produkte-loesungen/hardware/xpack4/ (accessed 2024-08-20)