Speedgoat Baseline in a Formula Student Racecar

GREEN TEAM
UNI STUTTGART

E0711-8

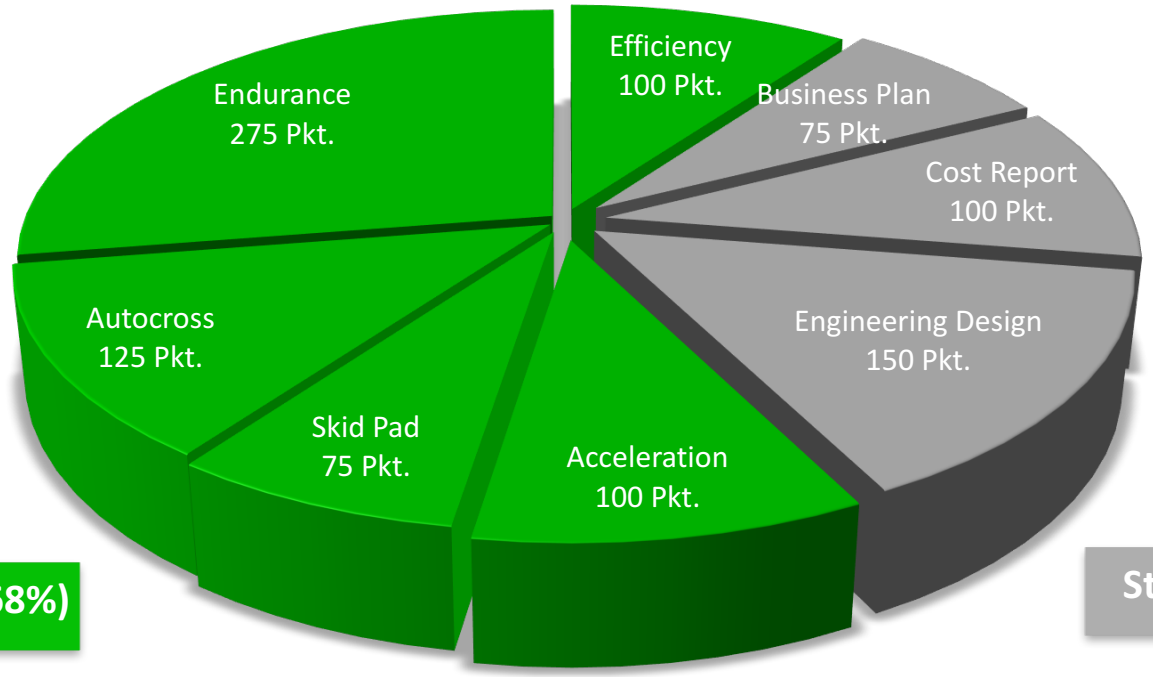
Formula Student

- International Engineering Competition

- 553 Teams Combustion
- 110 Teams Electric
- 17 Driverless

- Design, fabricate and compete with formula style race car

Competition overview



Dynamic Events (68%)

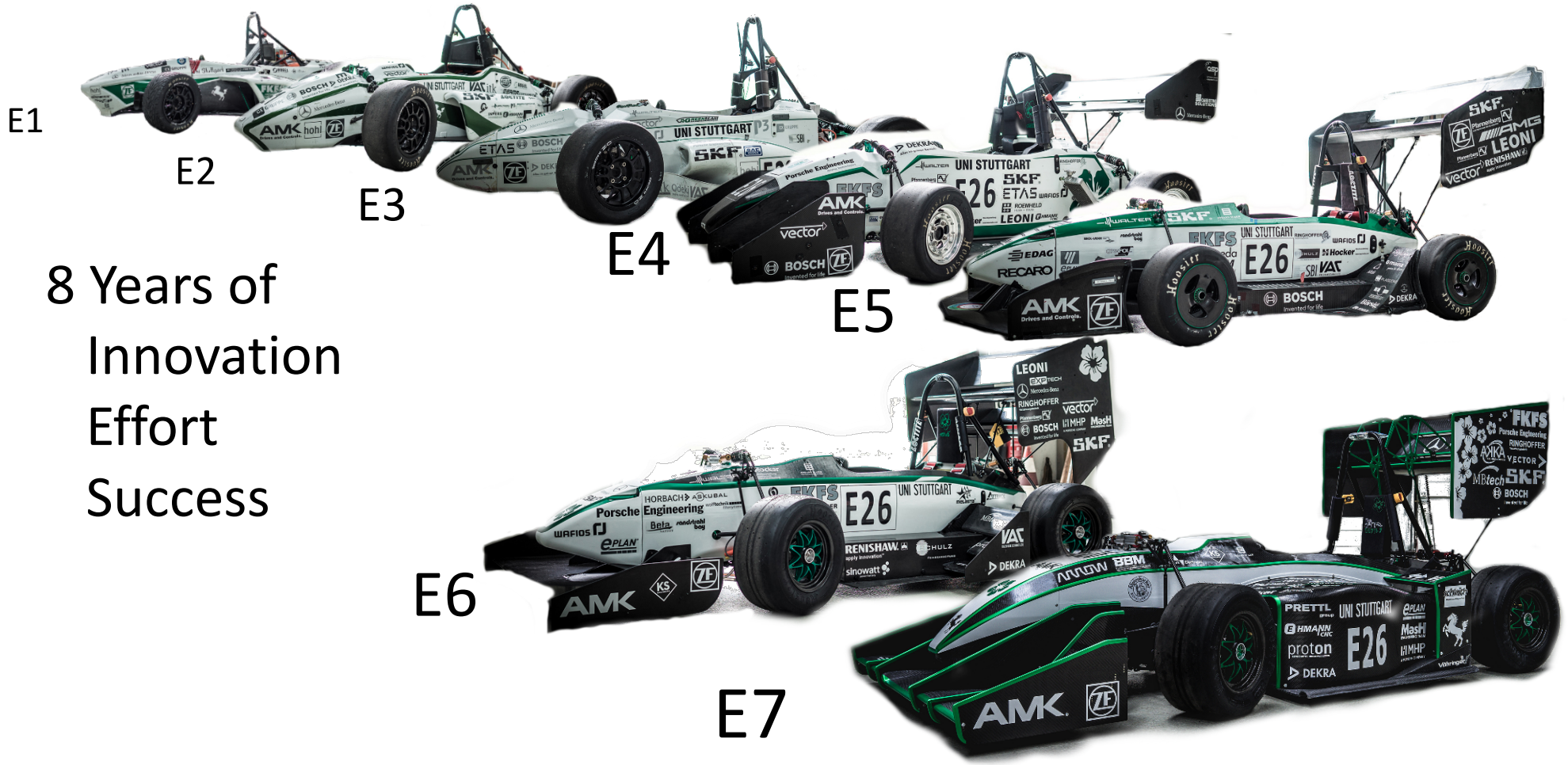
Static Events (32%)

GreenTeam Uni Stuttgart

- Founded 2009
- 40 future engineers from different fields of studies
- Competes in 4-5 international Formula Student competitions per year
- Currently 6th Place in World Ranking
- Achievements 2016
  - Formula Student Austria
    - 3. Place Overall
  - Formula Student Germany
    - 3. Place Overall
    - 2. Place Engineering Design

Former Cars of GreenTeam

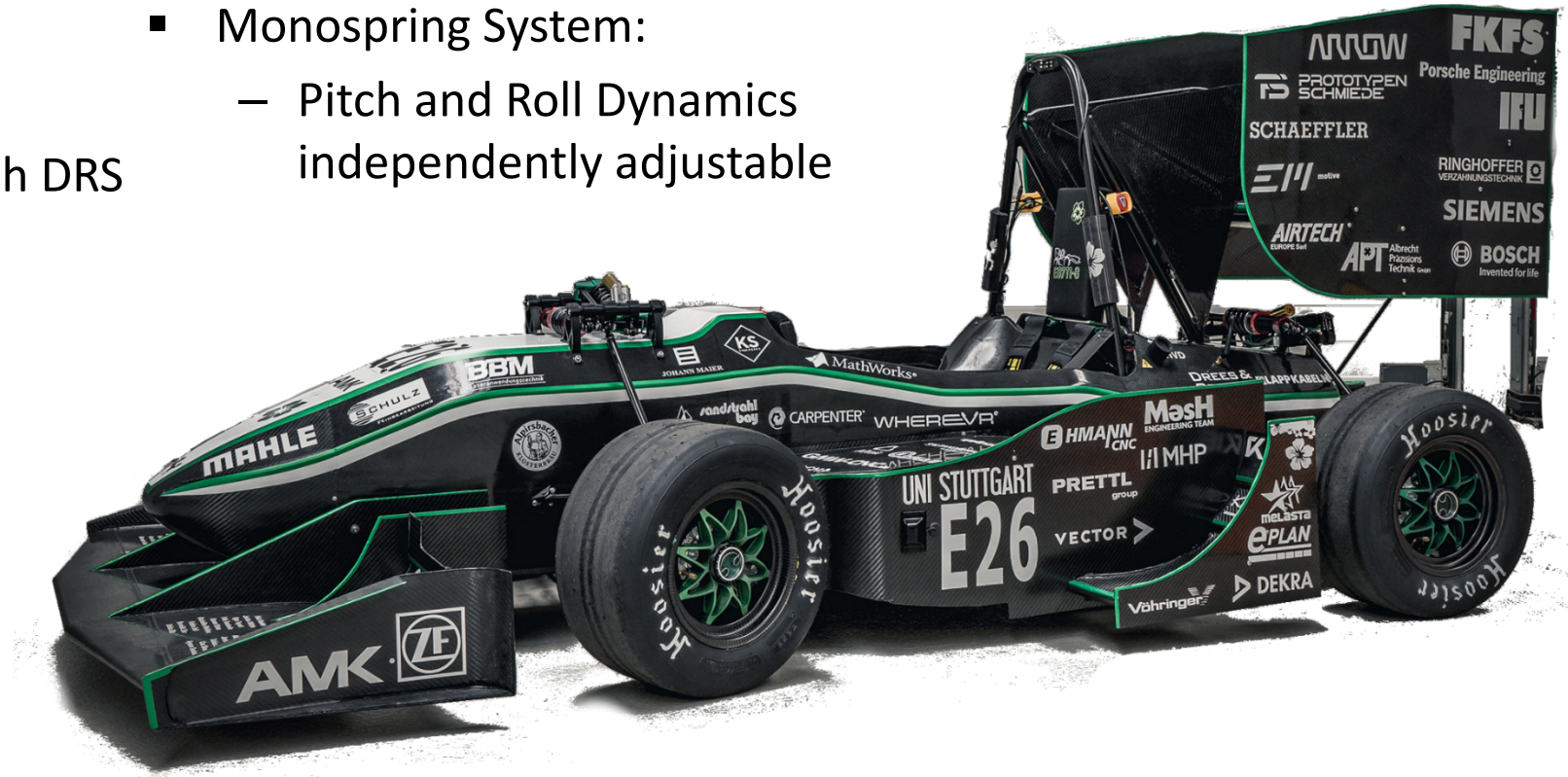
8 Years of
Innovation
Effort
Success



The E0711-8

Highlights

- 4x 35kW In-Wheel Motors
- 0-100 km/h < 2s
- Oil-cooled accumulator
- Aerodynamik Package with DRS
- Torque Vectoring
- Carbon Fiber Monocoque
- Monospring System:
  - Pitch and Roll Dynamics independently adjustable



Requirements Vehicle Dynamics ECU

Tasks / Responsibilites

- Torque Vectoring
- Traction Control
- Power / Recuperation Limit
- Sensorfusion / Drift correction
- Tire Load Estimation
- Etc.

Requirements

- High processing power
- Fast optimization algorithms
- Rapid Prototyping
- Easy Integration
- Live Measurement
- Live Parametrization

Speedgoat Baseline

- Simulink Real-Time Target Machine
- Intel Quad Core CPU
- Interchangable IO-Cards
- Broad Range of I/Os and Protocols supported

- Full workflow support for Mathwork‘s Products

Speedgoat Baseline inside E0711-8

Sensors

Measurements

Ethernet / UDP

Motor Torques

EtherCAT

Motor Revolutions /s
Currents

Motor Temperatures

Inverter

Data logger
Telemetry system

Workflow Controller Development – Example Traction Control

1. Requirements

- Prevent excessive slip
- Use full potential of tires

2. System Analysis

- Elastic material
- External influences
- Nonlinear behaviour

3. Define controller

- Control Method
- Cycle time
- Estimated information needed?

Workflow Controller Development – Implementation and Simulation

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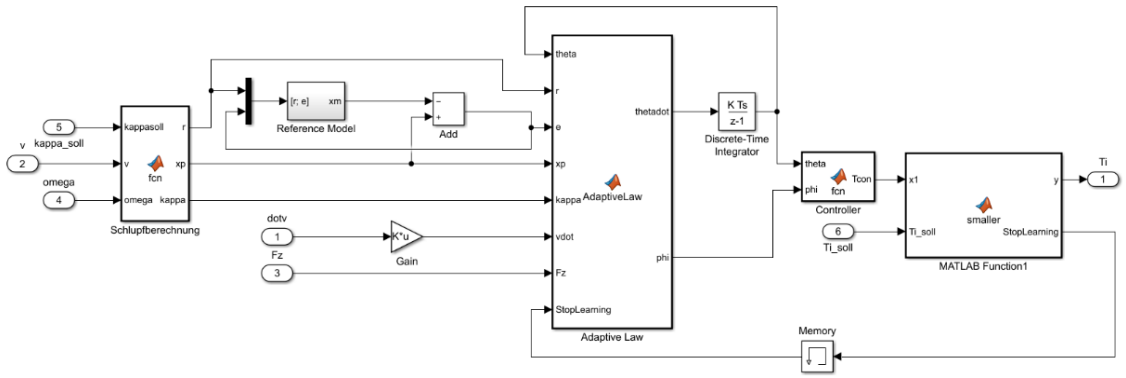
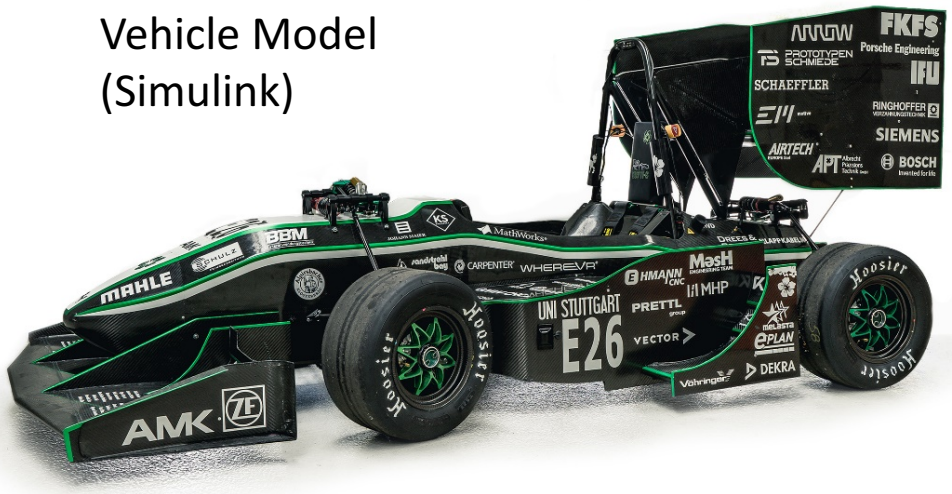
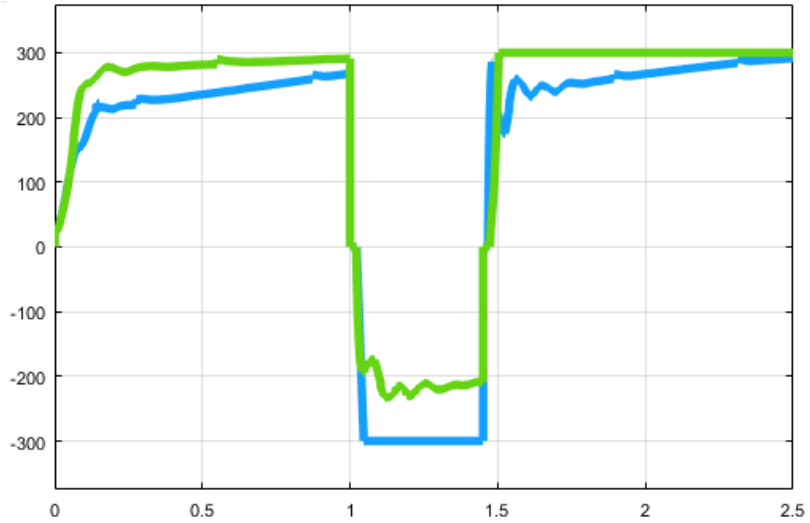
Traction Control Implementation

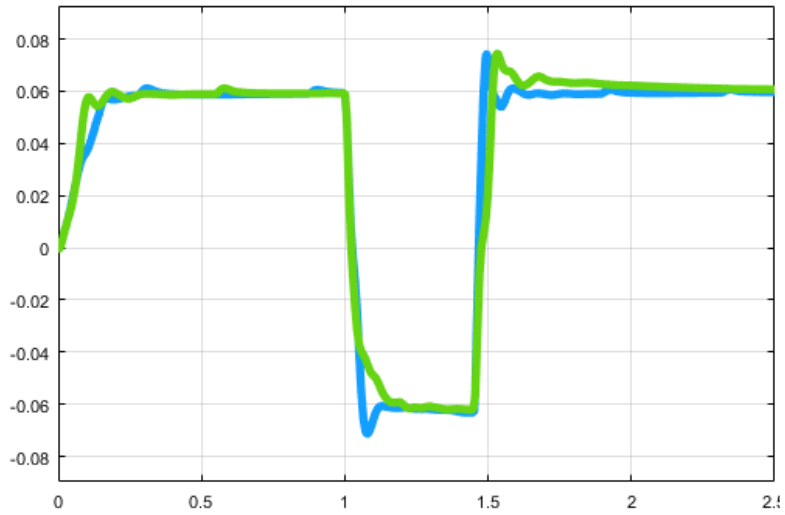


Vehicle Model (Simulink)





Torque Command



Wheel Slip

Workflow Controller Development - Application

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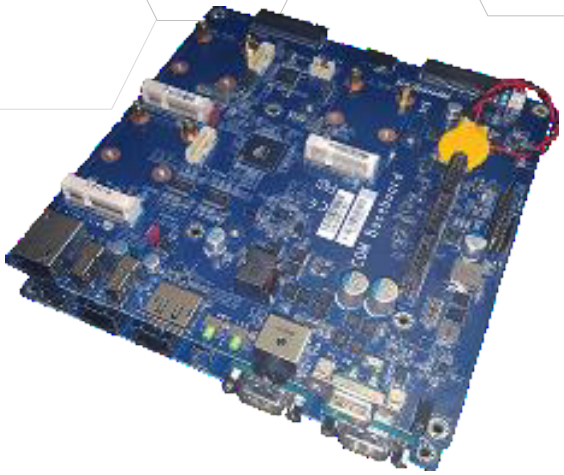
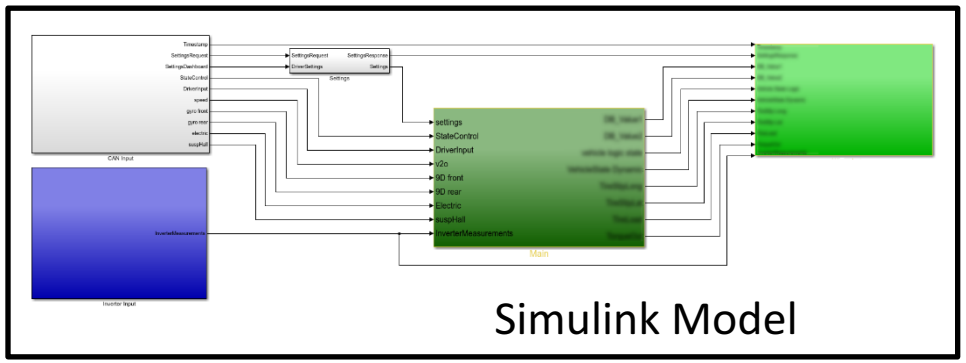


Flashing over telemetry

Code Generation



Simulink Model

Workflow Controller Development - Application

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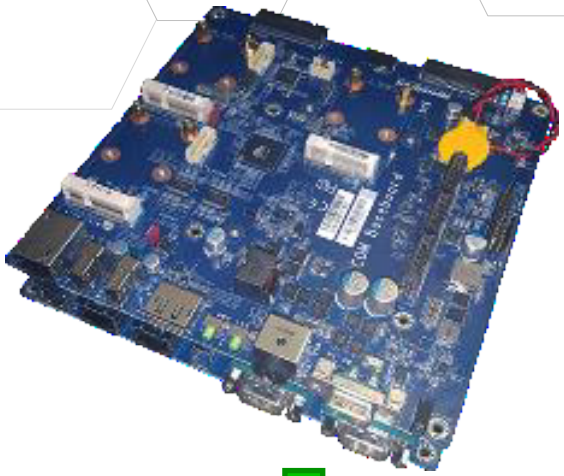
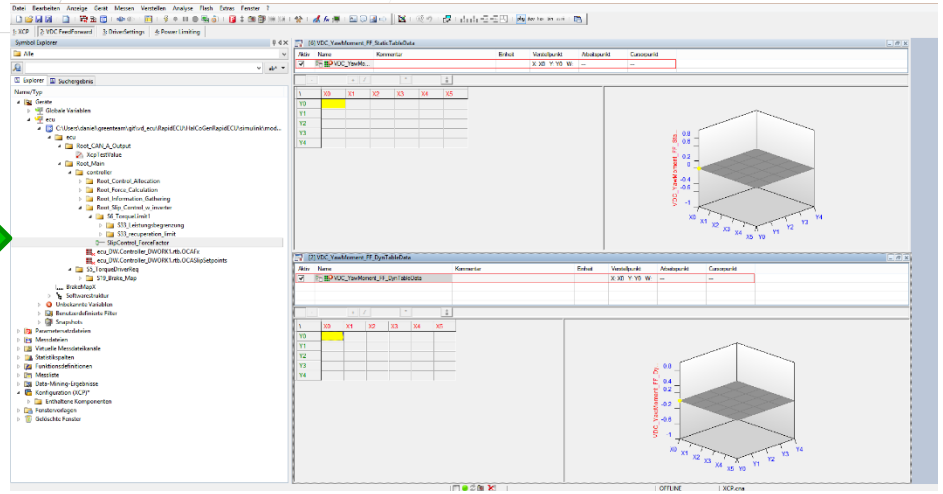


Parametrization
Measurement Data



Protocol: XCP over Wifi

Data Logger

Replay to Simulink Modell

For Deeper Analysis
And Debugging

- Video: First Testing of Traction Control

Conclusion und Outlook

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- Why Speedgoat baseline?
  - Sufficient computing power
  - Connectivity
  - Packaging
  - Simulink Integration
- Plans for Future
  - Use as motor controller
  - Smaller version for more specialised application

Special Thanks to Speedgoat and Mathworks for the Support

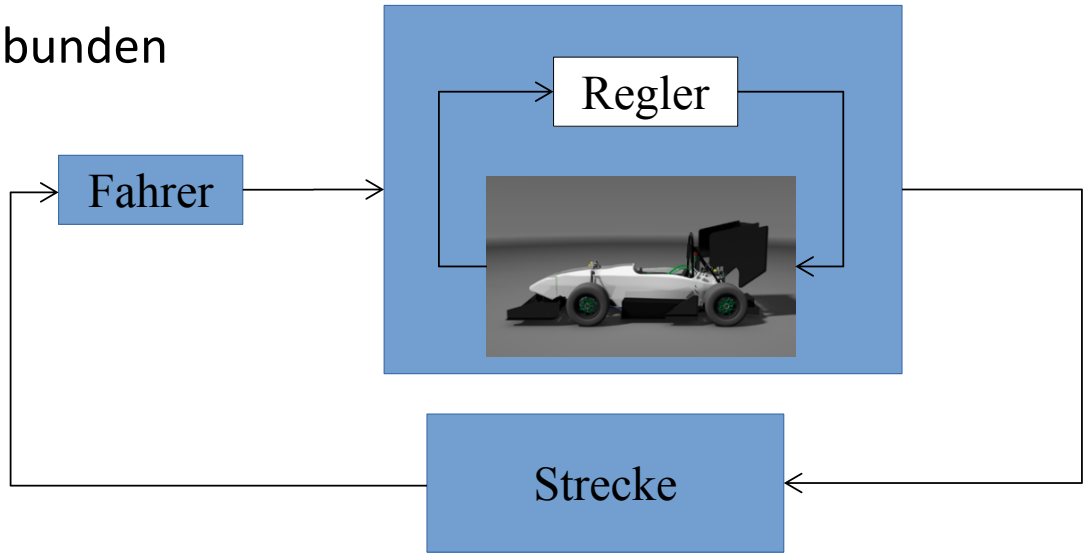

AMK
Drives and Controls.
BOSCH
Invented for life
Mercedes-Benz
FKFS
manz
passion for efficiency
PROTOTYPEN SCHMIEDE
Universität Stuttgart
motive
Porsche Engineering
RINGHOFFER
VERZAHNUNGSTECHNIK
SIEMENS
ZF
Albrecht Präzisions Technik GmbH
DEKRA
EHMANN CNC
ePLAN
GRÜNDERSCHIFF
JOHANN MAIER
KIE
KS
MAHLE
MathWorks
melasta
MaSH
ENGINEERING TEAM
MHP
A PORSCHE COMPANY
PRETTL
SCHAEFFLER
SCHULZ
VECTOR
WAFIOS
WHEREVR
AIRTECH
EUROPE Sarl
AXALTA
BBM
BOMATEC
CARPENTER
DREES & SOMMER
EDAG
GRAU
EXPTECH
GMW-CNC
KE-TEC GmbH
KISTLER
measure. analyze. innovate.
Listemann Technology AG
RENISHAW
apply innovation
SBI
Vähringer

More Information on GreenTeam Uni Stuttgart e.V

http://greenteam-stuttgart.de

Workflow – ca. 3 Folien

- Workflow Reglerentwicklung – vom Konzept zum fahrenden Auto
- Nur Simulink
  - Theoretische Konzeption
  - Implementierung als Simulinkmodell
  - Simulation an selbstentwickeltem Fahrzeugmodell
- Mit Speedgoat
  - Regler wird in Speedgoat-Modell eingebunden
  - Flashen ins Fahrzeug über WLAN
  - Live-Telemetrie (Scopes, Setzen von Parametern)
  - Mit Bildmaterial vom Einsatz



Workflow Controller Development – On-Track-Testing and Analysis

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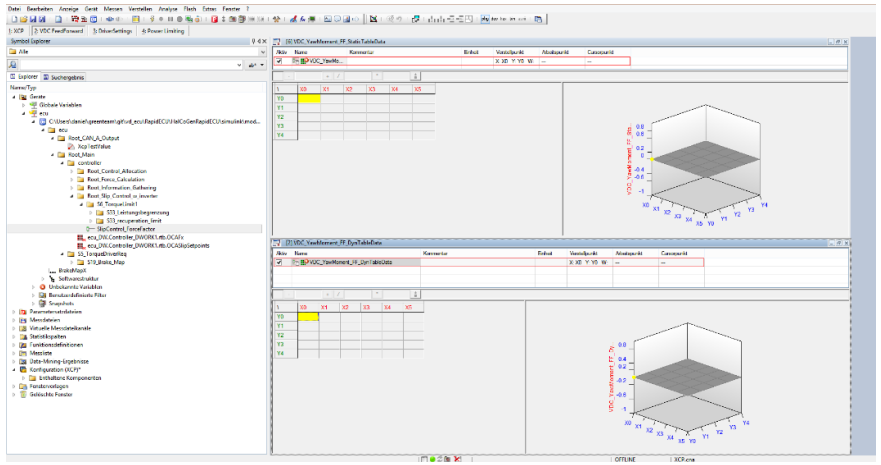
Data Logger

Replay to Simulink Modell

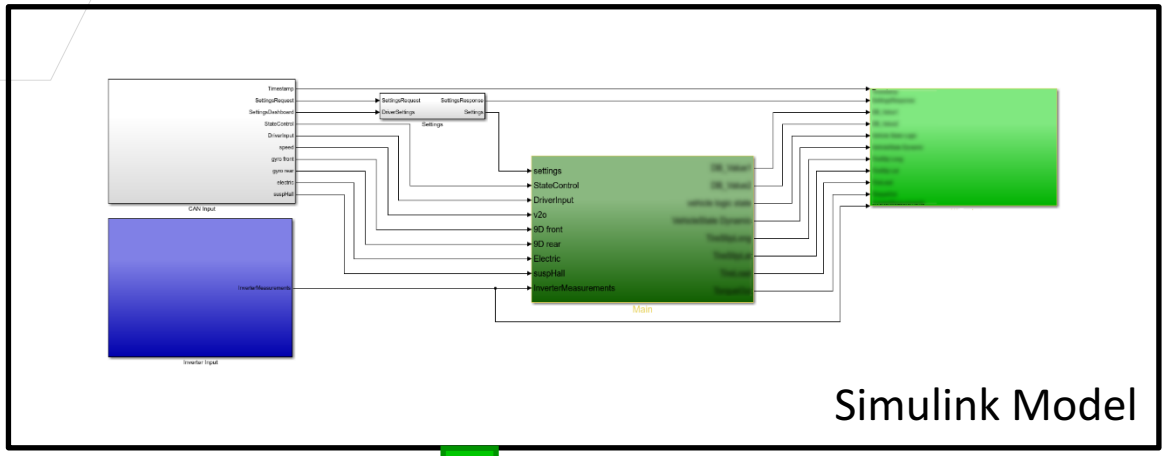
For Deeper Analysis
And Debugging

Parametrization
Measurement Data

Protocol: XCP over
Wifi



Workflow am Beispiel Traktionskontrolle – Applikation



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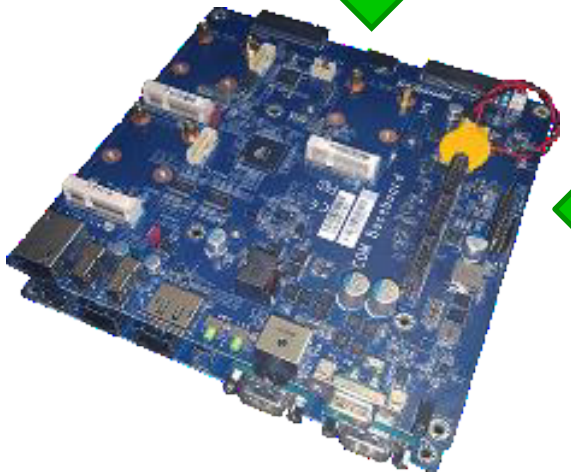

Parametrization
Measurement Data

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