

# Speedgoat Baseline in a Formula Student Racecar



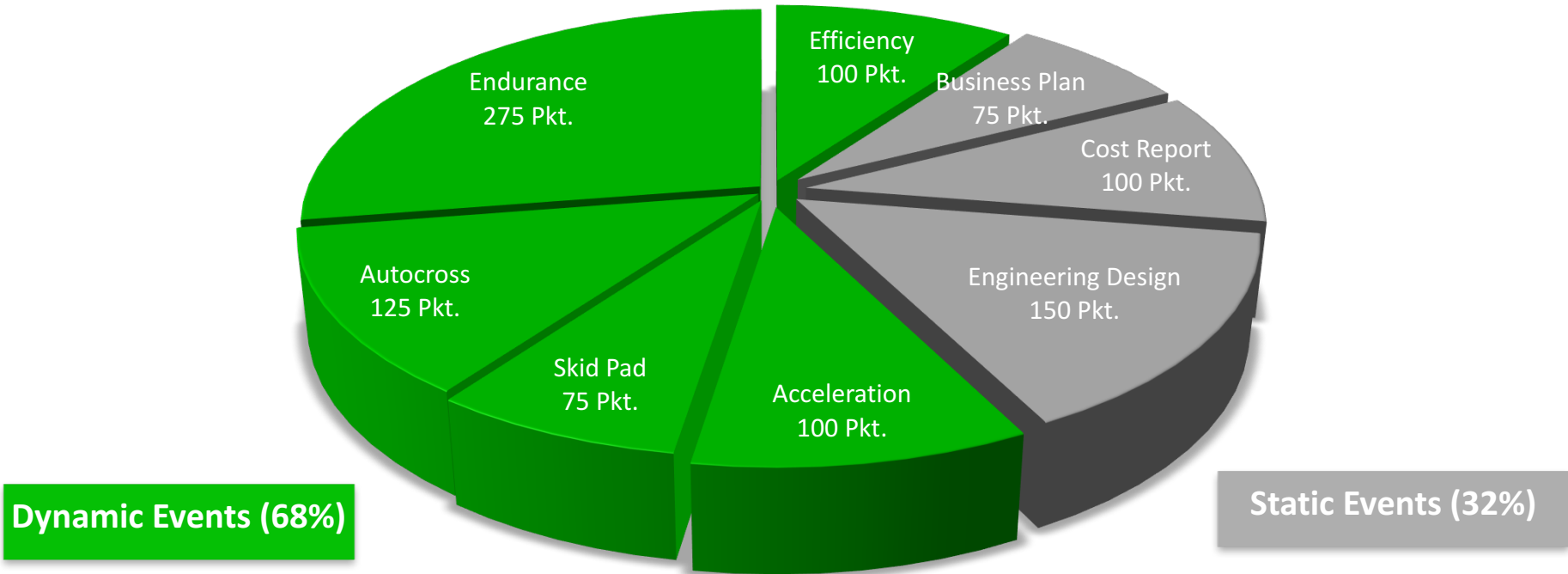


# Formula Student

- International Engineering Competition
- 553 Teams Combustion
- 110 Teams Electric
- 17 Driverless
- Design, fabricate and compete with formula style race car



# Competition overview

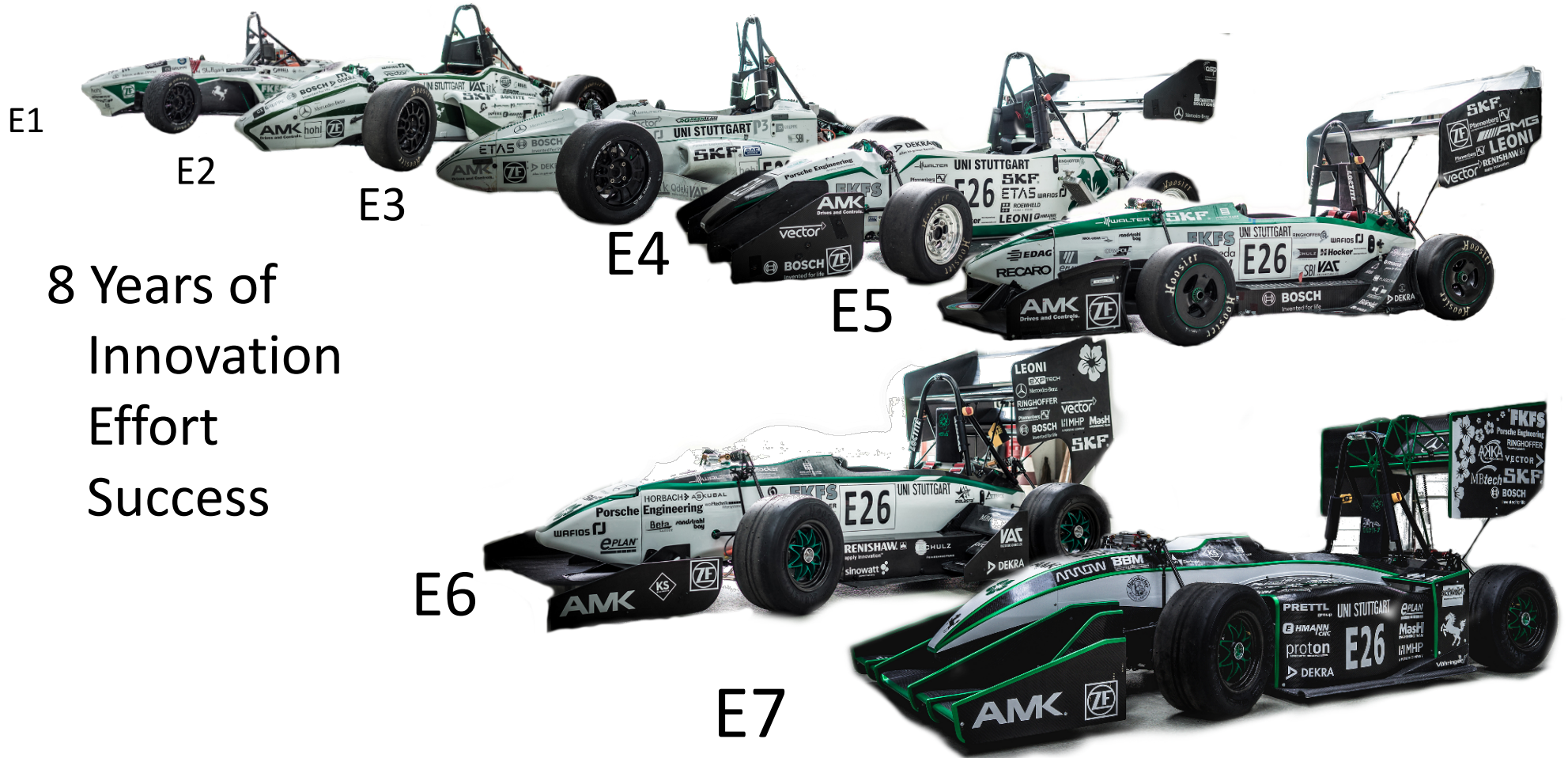


# GreenTeam Uni Stuttgart

- 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

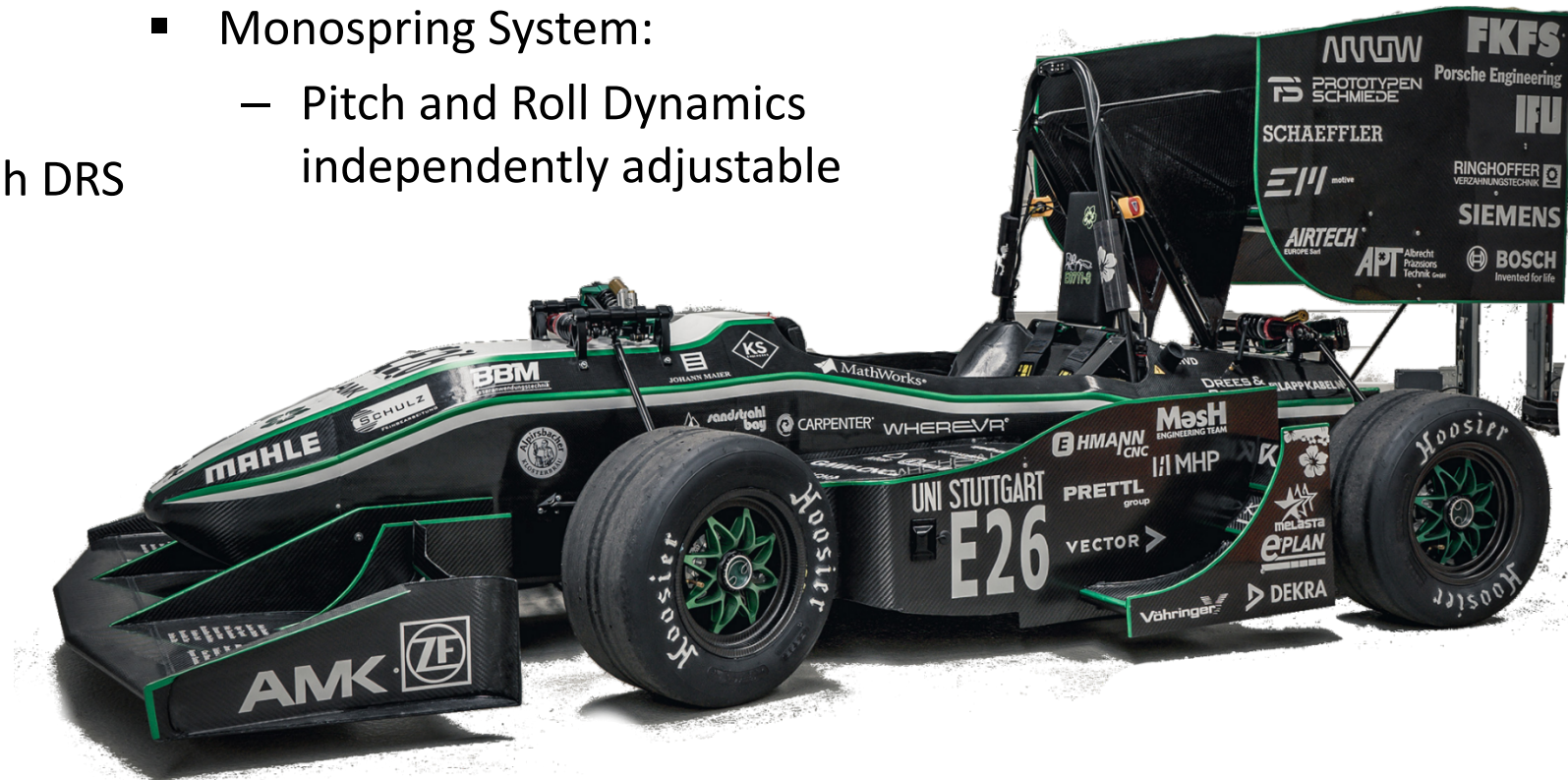


8 Years of  
Innovation  
Effort  
Success

# The E0711-8

## Highlights

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



# Requirements Vehicle Dynamics ECU

## Tasks / Responsibilities

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

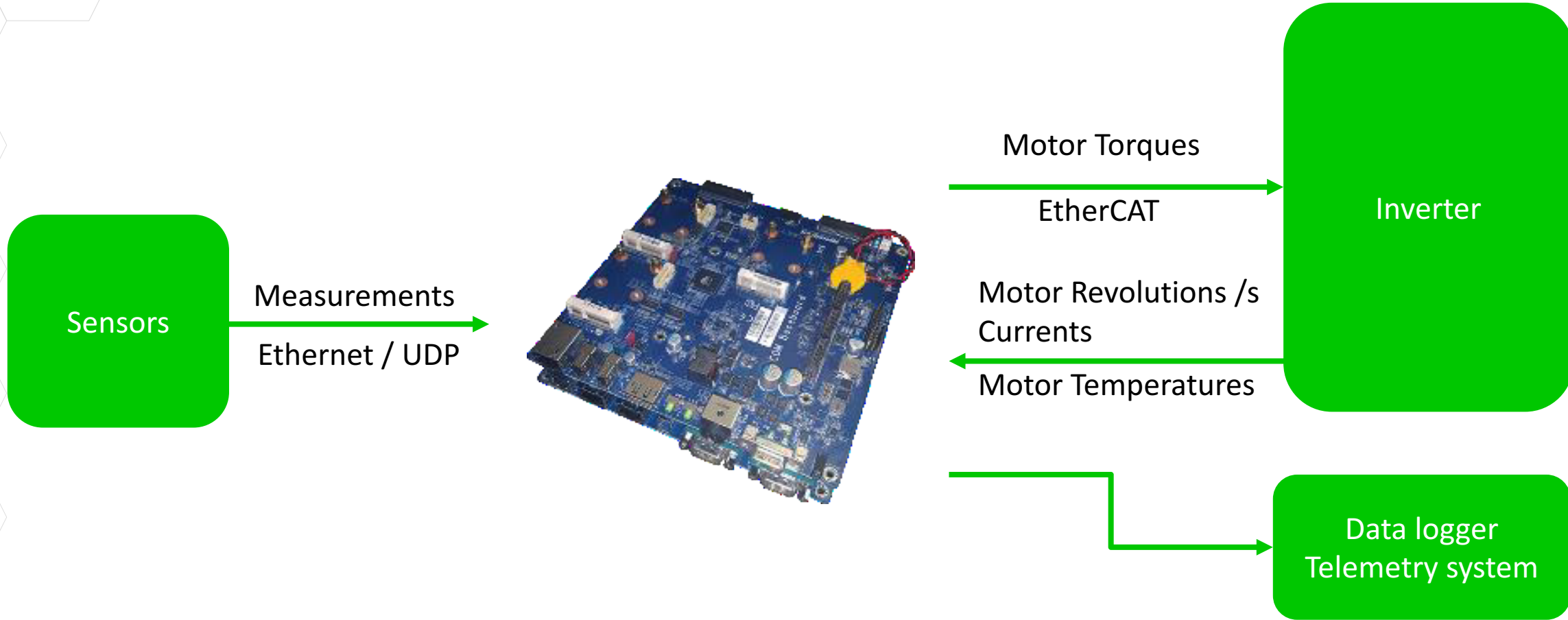
## Requirements

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





# Speedgoat Baseline inside E0711-8



# Workflow Controller Development – Example Traction Control

## 1. Requirements

- Prevent excessive slip
- Use full potential of tires

## 2. System Analysis

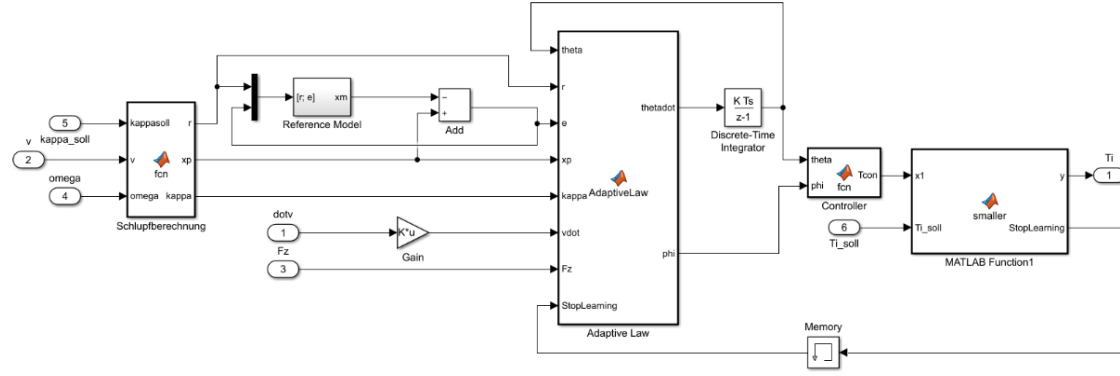
- Elastic material
- External influences
- Nonlinear behaviour

## 3. Define controller

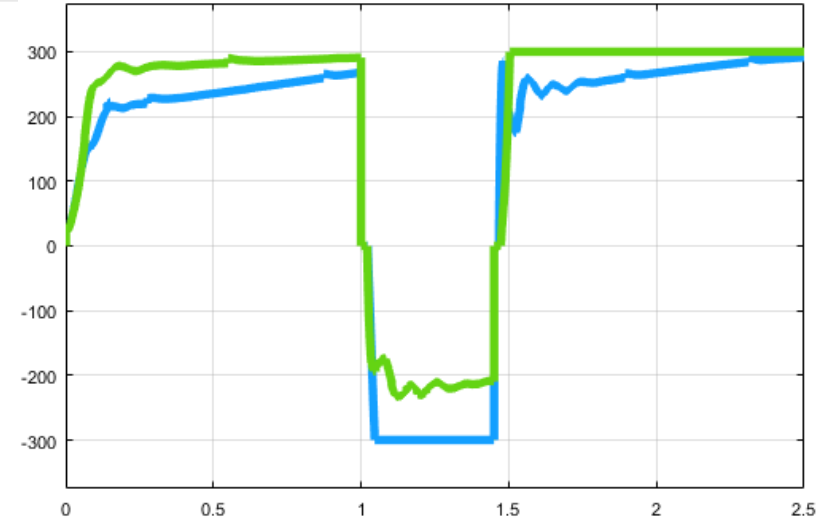
- Control Method
- Cycle time
- Estimated information needed?

# Workflow Controller Development – Implementation and Simulation

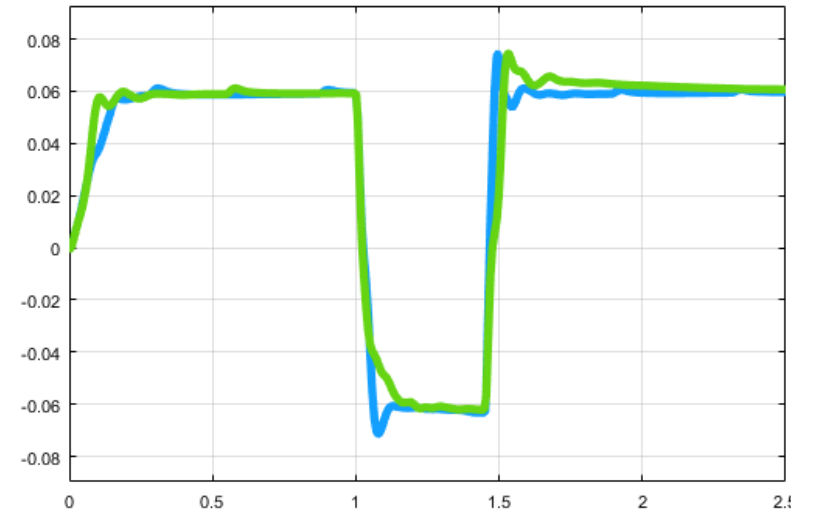
## Traction Control Implementation



## Vehicle Model (Simulink)

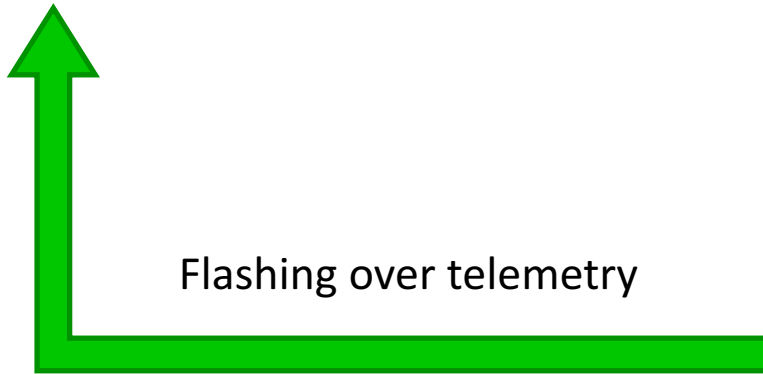
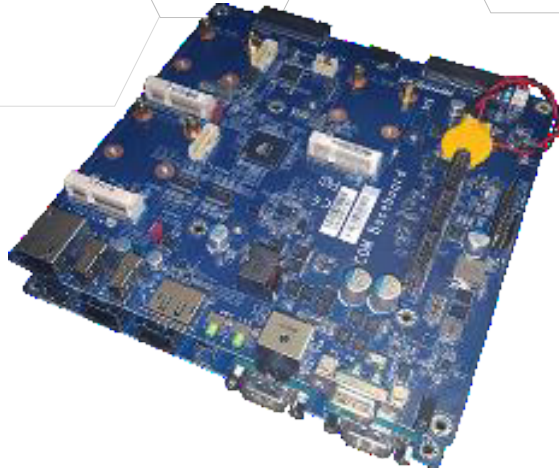


Torque Command

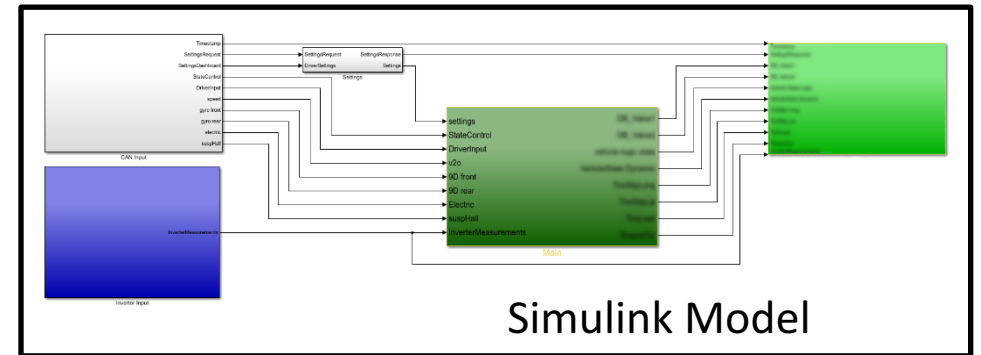


Wheel Slip

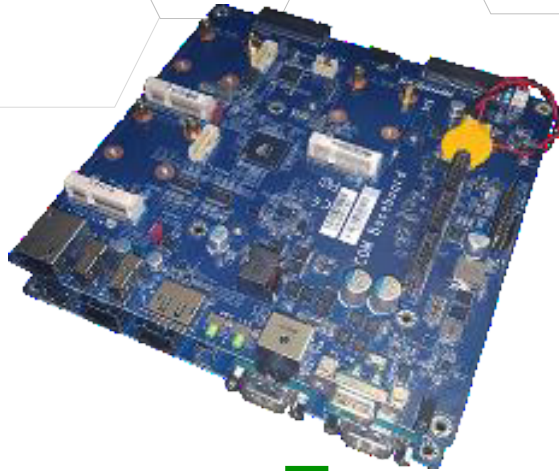
# Workflow Controller Development - Application



## Code Generation



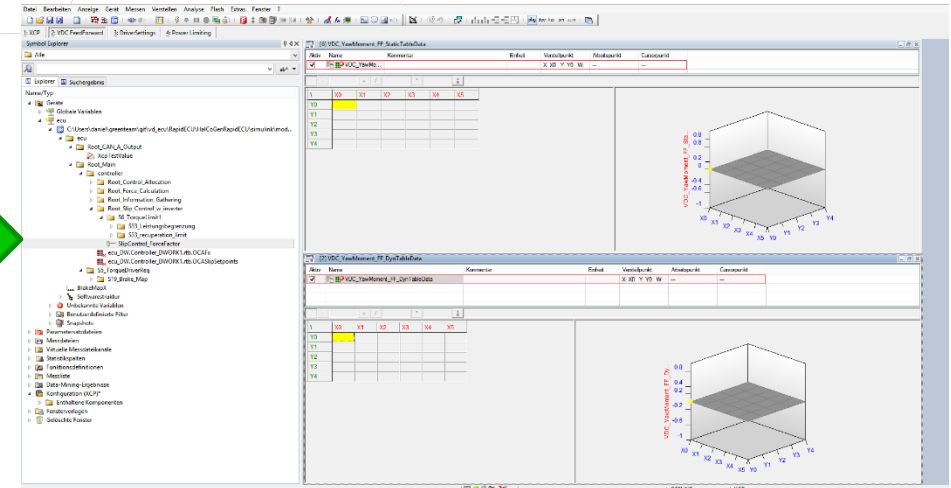
# Workflow Controller Development - Application



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

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

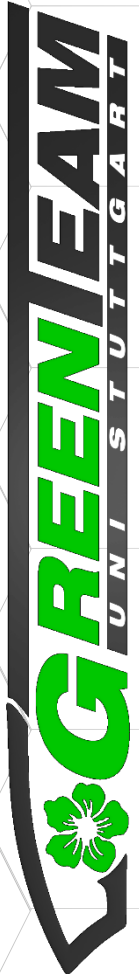


Special Thanks to Speedgoat and Mathworks for the Support





E0711-8

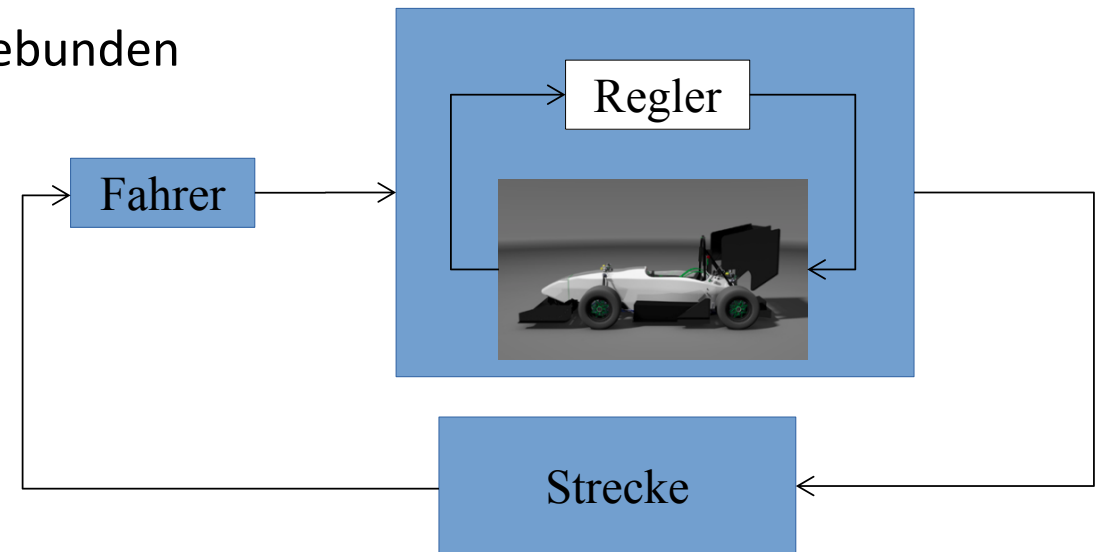


More Information on GreenTeam Uni Stuttgart e.V

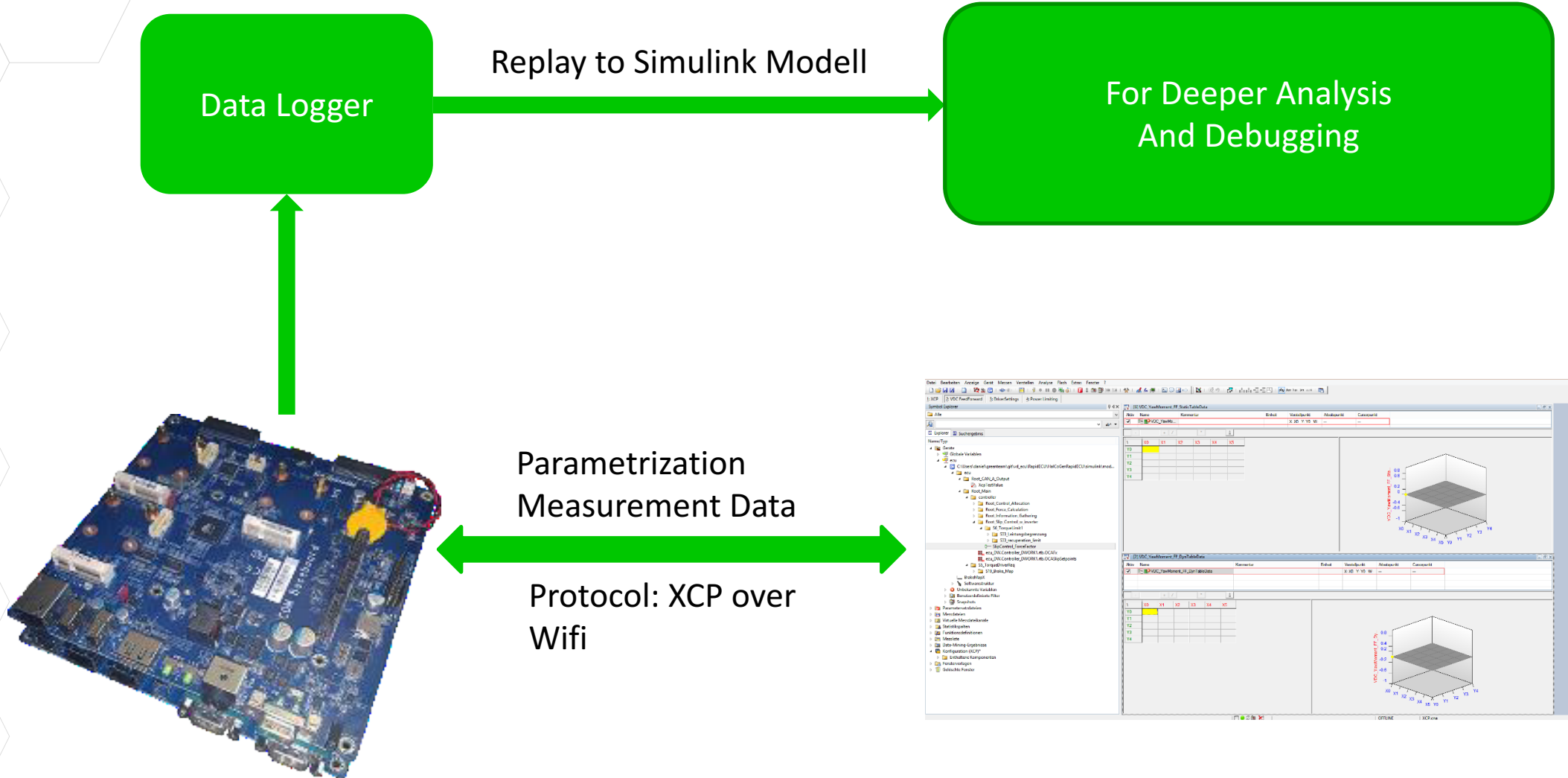
<http://greenteam-stuttgart.de>

# Workflow – ca. 3 Folien

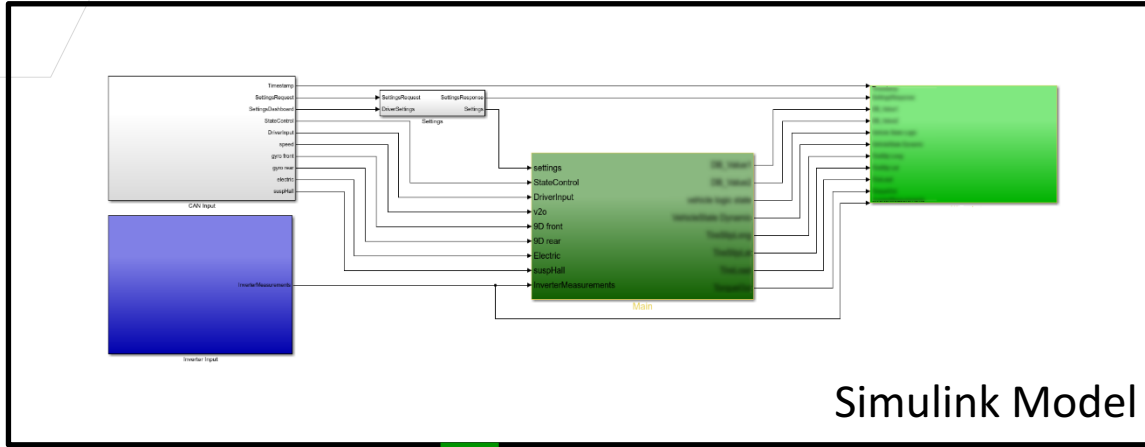
- Workflow Reglerentwicklung – vom Konzept zum fahrenden Auto
- Nur Simulink
  - Theoretische Konzeption
  - Implementierung als Simulinkmodell
  - Simulation an selbstentwickeltem Fahrzeugmodell
- Mit Speedgoat
  - Regler wird in Speedgoat-Modell eingebunden
  - Flashen ins Fahrzeug über WLAN
  - Live-Telemetrie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



# Workflow Controller Development – On-Track-Testing and Analysis



# Workflow am Beispiel Traktionskontrolle – Applikation



Code Generation

Flashing over telemetry



Parametrization  
Measurement Data

Protocol: XCP over  
Wifi

