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

Dynamic Events (68%)

Static Events (32%)

Efficiency 100 Pkt.
Business Plan 75 Pkt.
Cost Report 100 Pkt.
Engineering Design 150 Pkt.
Acceleration 100 Pkt.
Skid Pad 75 Pkt.
Autocross 125 Pkt.
Endurance 275 Pkt.

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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
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

- 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?
Vehicle Model (Simulink)

Traction Control Implementation

Torque Command

Wheel Slip
Workflow Controller Development - Application

Flashing over telemetry

Simulink Model

Code Generation
Workflow Controller Development - Application

Parametrization Measurement Data

Protocol: XCP over Wifi

Data Logger
Replay to Simulink Modell

For Deeper Analysis And Debugging

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- 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
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

- Data Logger
- Measurement Data
- Protocol: XCP over Wifi
- Replay to Simulink Modell
- For Deeper Analysis And Debugging
Workflow am Beispiel Traktionskontrolle – Applikation

Simulink Model

Code Generation

Flashing over telemetry

Parametrization
Measurement Data

Protocol: XCP over Wifi