Please cover the shaded area with a picture.

(24,4 x 7,6 cm)

eCAL Simulink Toolbox

MathWorks Automotive Conference EXPO 2021
Continental Group Structure
Effective January 1, 2020

Automotive Technologies  Rubber Technologies  Powertrain Technologies

Autonomous Mobility and Safety (AMS)  Vehicle Networking and Information (VNI)  Tires  ContiTech  Vitesco Technologies
Automotive Technologies

Automotive Central Functions

A Purchasing  A SCM  A Manufacturing  A Sales  A IT  A Quality  Finance Controlling  Human Relations  Communications

 Autonomous Mobility and Safety  Holistic Engineering and Technologies  Vehicle Networking and Information

About myself

› 2017 – present
    › Team Lead, Base Software Development and Integration, Research & Advanced Engineering, Continental

› 1997 – 2017
    › Leading eCAL middleware core development for AD systems
    › Senior Expert “Human Machine Interfaces”
    › Anti-lock braking system for EMB
    › Various other research projects..

› 1997
    › Diploma Electrical Engineering
      Technical University Dresden / Germany
# eCAL Simulink Toolbox

<table>
<thead>
<tr>
<th></th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>eCAL</td>
</tr>
<tr>
<td>3</td>
<td>eCAL Toolbox</td>
</tr>
<tr>
<td>4</td>
<td>Conclusion</td>
</tr>
</tbody>
</table>
Autonomous Driving – The Challenge

- Radical changes to some aspects of driving
- From partially automated to fully automated driving
- Requires new sensor technologies and high-performance computer systems
- Cluster intelligence, formed from the vehicle fleet on the road
- Large quantities of data must be transmitted extremely reliably inside and outside the vehicles
- Cluster connectivity: The Internet will become the car’s sixth sense.
Autonomous Driving – it's all about data processing

Stereo Camera
Mono Camera
Multi Function Mono Camera with Lidar
Short Range Lidar
Short Range Radar
Surround View
Long Range Radar
Mono Camera
Multi Function Mono Camera with Lidar
Middleware main requirements

› performance
  › ethernet and shared memory instead classic vehicle bus systems
  › message transport with minimal latency and high data throughput

› new in-vehicle cloud / domain architecture
  › heterogenous network of different hardware, operating systems, computing languages
  › publish / subscribe pattern
  › built-in support for different modern message serialization formats

› development tools for monitoring, recording, replay, system start
## eCAL Simulink Toolbox

1. Motivation
2. eCAL
3. eCAL Toolbox
4. Conclusion
Architecture

Application Layer

Interface Layer

Service Layer

Message Layer

Transport Layer

OS Layer

HW Layer

User Applications

eCAL Monitor

eCAL Player

eCAL Recorder

eCAL API (C / C++ / Python / Rust)

TimeSync, Logging, Monitoring

Google Protobuf (Flatbuffers, Cap'nProto, MsgPack, JSON ..)

UDP Multicast / Shared Memory

Windows / Linux / QNX / macOS

x86 / arm

Google Protobuf

Flatbuffers, Cap’nProto, MsgPack, JSON ..
Data driven design – Run & Record

Node One:
- Mono Camera
- GPS Position
- Wheel Ticks

Node Two:
- Frame grabber
- Position Estimation
- Lane Marker Detection

Common Components:
- Vehicle Localization
- eCAL Recorder

Output:
- Driving Function
- HDF5 Recording
Data driven design – Replay & Test

HDF5 Recording

eCAL Player

NODE ONE

Lane Marker Detection

Vehicle Localization

eCAL Monitor

NODE TWO

Driving Function

Control Image
## eCAL Simulink Toolbox

<table>
<thead>
<tr>
<th></th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Motivation</td>
</tr>
<tr>
<td>2</td>
<td>eCAL</td>
</tr>
<tr>
<td>3</td>
<td>eCAL Toolbox</td>
</tr>
<tr>
<td>4</td>
<td>Conclusion</td>
</tr>
</tbody>
</table>
Development diversity

HDF5 Recording

PC ONE

Lane Marker Detection

Vehicle Localization

PC TWO

eCAL Player

eCAL Monitor

Control Image

Driving Function

PC ONE

PC TWO

20 April 2021
Rex Schilasky, © Continental AG
Model-based development with eCAL

HDF5 Recording

eCAL Player

PC ONE

Lane Marker Detection

Vehicle Localization

Driving Function

Control Image

PC TWO

eCAL Monitor
Model-based development with eCAL

Simulink Live View

Image Decoding

Image Filtering

Line Detection

Video Overlay

Lane Marker Detection

Simulink Live View

Image

Decoding

Simulation

Publisher

Subscriber
Simulink blockset for eCAL
Lane Marker Detection Model
Lane Marker Detection Model – Live Demo

Please insert Schilasky_Rex_Continental_Slide19.mp4 here.
eCAL Simulink Toolbox

1 Motivation
2 eCAL
3 eCAL Toolbox
4 Conclusion
Conclusion

› eCAL provides high performance interprocess communication for rapid prototyping
› eCAL is open source software ([https://github.com/continental/ecal](https://github.com/continental/ecal))
› eCAL Simulink toolbox opens a wide range of new applications
› eCALize your Simulink based development!
Thank you for your attention