Young Researchers Seminar 2013

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Laboratoire d'Economie des Transports
Unité Mixte de Recherche du CNRS n° 5593
Université Lumière Lyon 2 - ENTPE

DLR Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

Developmental methodology for generic compilation of load cases for conceptual design of commercial vehicles

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ECTRI
European Conference of Transport Research Institutes

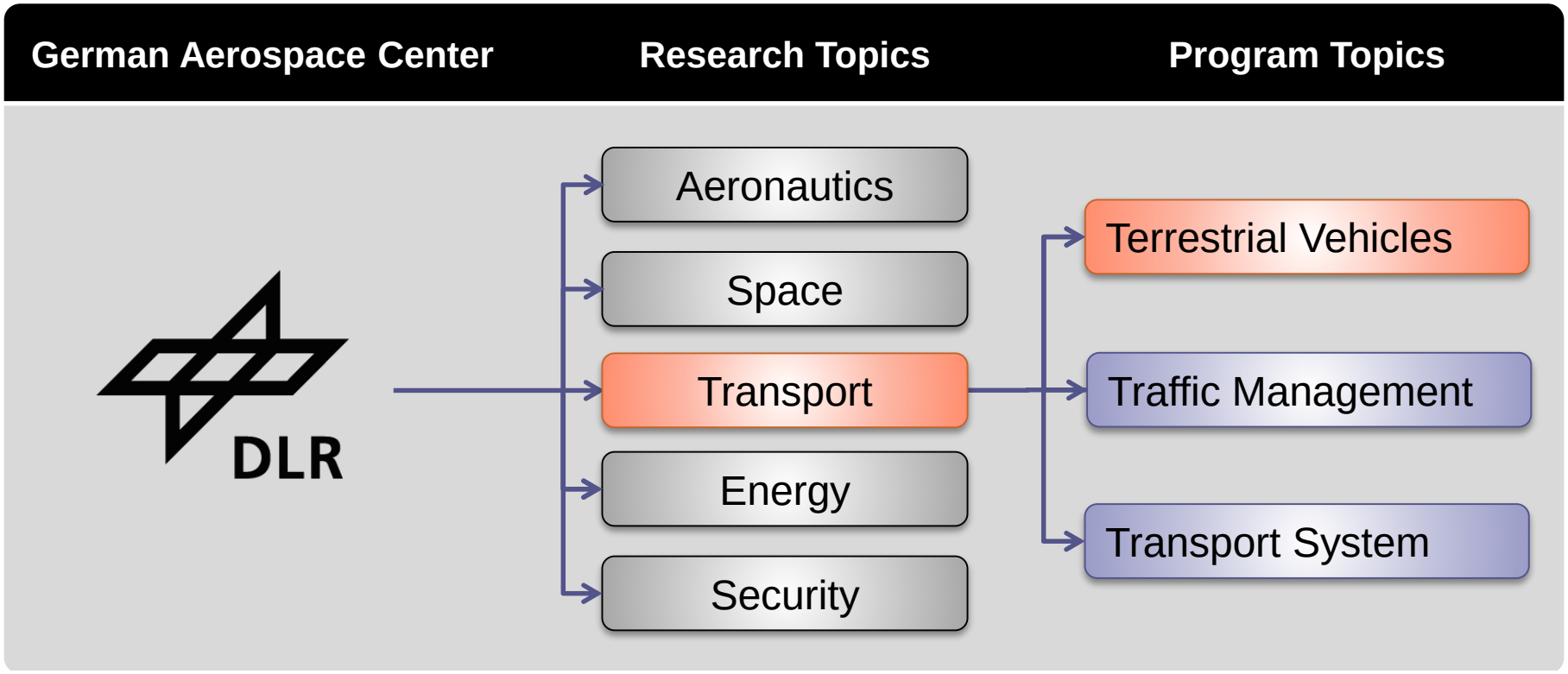
FERSI
Road Safety Research

Agenda

- Aerospace and transport vehicles?
- Introduction
- Research issue
- Approach
- Outlook

Aerospace and transport vehicles?

Line-up of German Aerospace Center in transport vehicle research?



Introduction

How can we develop more efficient commercial vehicles?

Goal:

- Special driving and load cycle for unique CVs

  based on **real driving cycle** and **real load cycle**

necessary to:

- Creating individual thermal and energy management

Introduction

Overview of different purposes of heavy duty commercial vehicles


Source: http://www.trucks-mercedes-benz.de


Source: http://www.daimler.com


Source: http://www.daf.eu



Source: http://www.man.eu


Source: http://www.trucks-mercedes-benz.de

- Driving Cycle on road
- Load Cycle
  e.g.: garbage collection truck
  basket crane truck

Introduction – state of the art

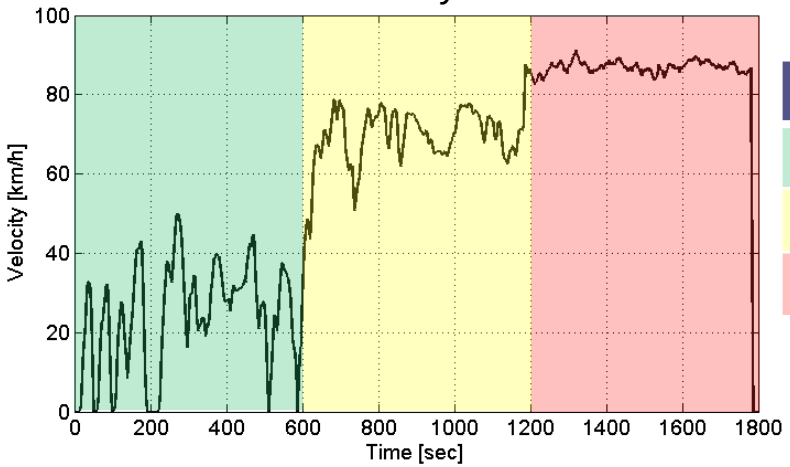
Emission standard test for truck

European Transient Cycle (ETC) and
Stationary Transient Cycle (ESC) used for emission certification of HD diesel engines

Two alternatives for verification:

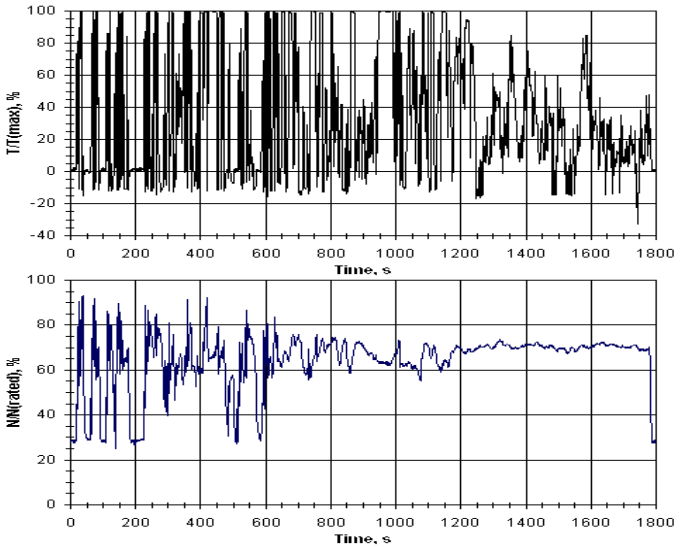
1) whole vehicle chassis dynamometer test (Vehicle Speed)
2) only engine dynamometer test (Engine Speed and Torque)

ETC chassis dynamometer



Legend
Urban
Rural
Motorway

ETC engine dynamometer



Literature research – state of the art

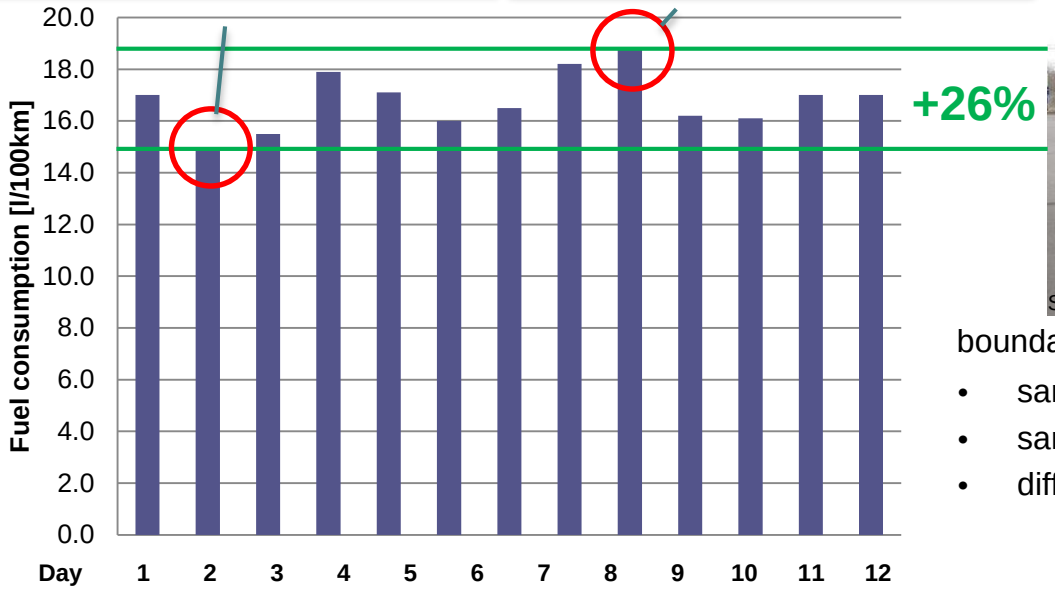
Methods for creating driving cycles used in other studies

- Own record of route (speed and gradient profile)
- Scaling of standard driving cycle e.g. NEDC or ARTEMIS
  - over speed: reducing of v_{max} and a_{max}
  - over time: reducing a_{max}
- Merging of existing cycles to a new individual cycle
- Combination of the previous points

Research issue – Example

Fuel consumption variation for real driving

Rural	Motorway
velocity: 50-90 km/h about 20 stops elevation: 112m – 273m 6.5t – 11t	velocity: constant 90 km/h no stops elevation: 99m – 460m 9.5 t





Source: http://www.mobile.de

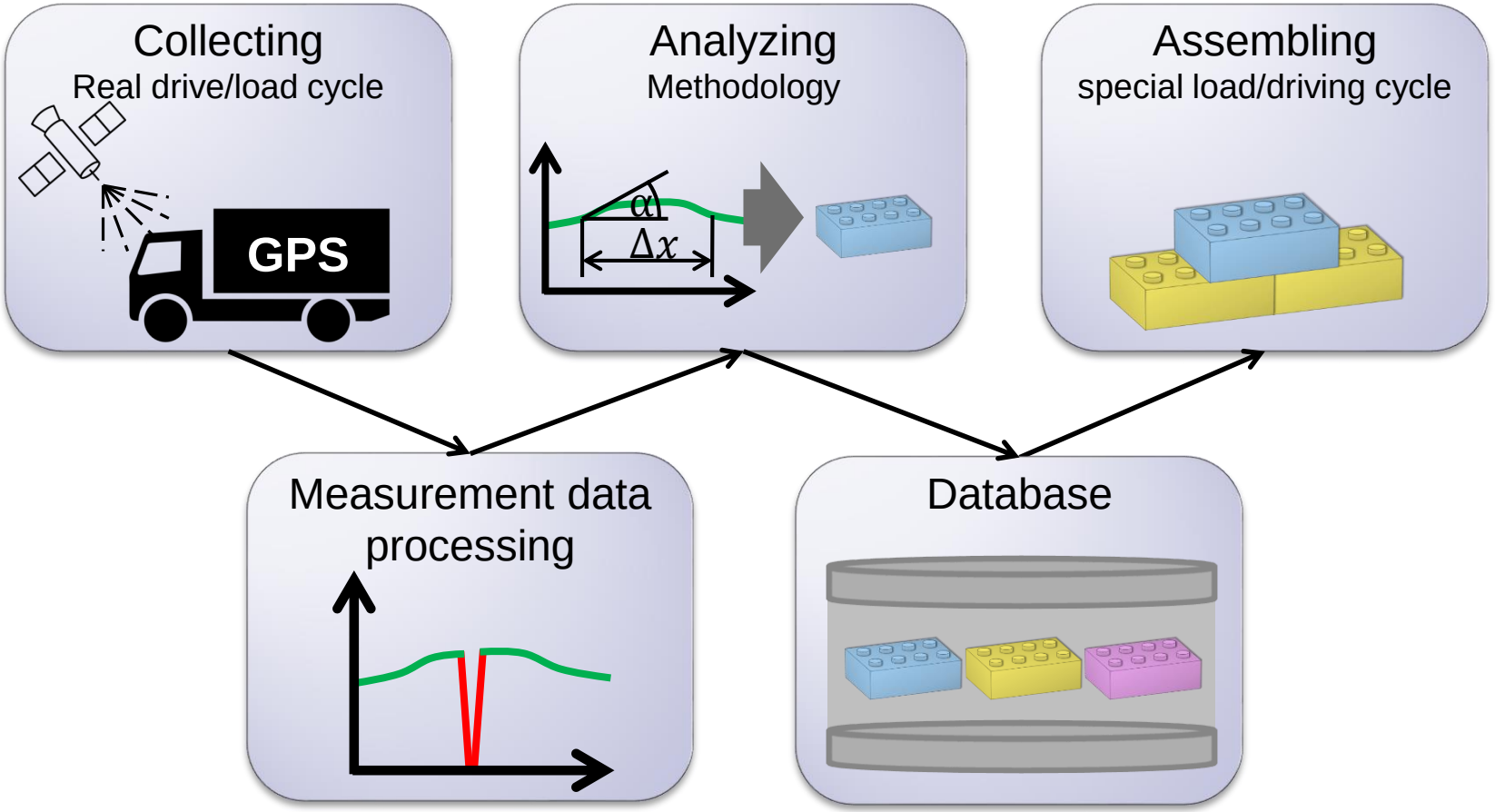
boundary conditions:

- same Vehicle (MAN TGL 210 151kW / 2400 min^{-1})
- same driver
- different routes

Conclusion: **detailed analysis is necessary!**

Approach

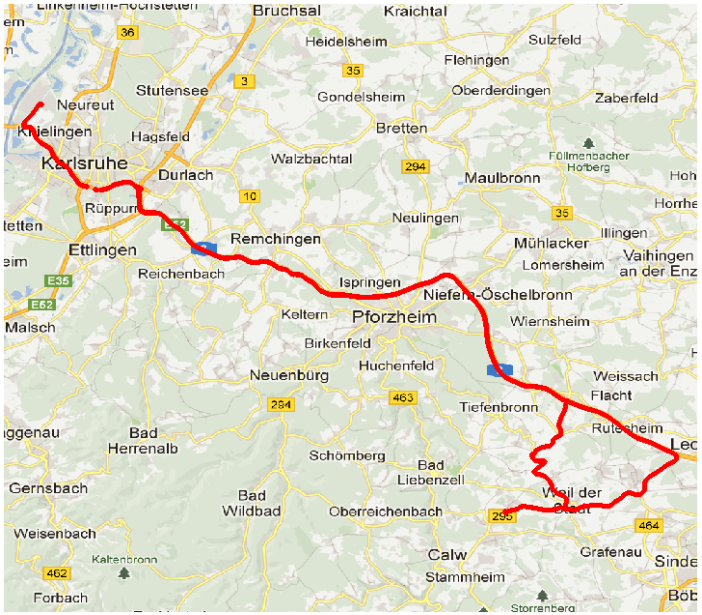
Generation of special reference load/driving profiles out of real load/driving cycles

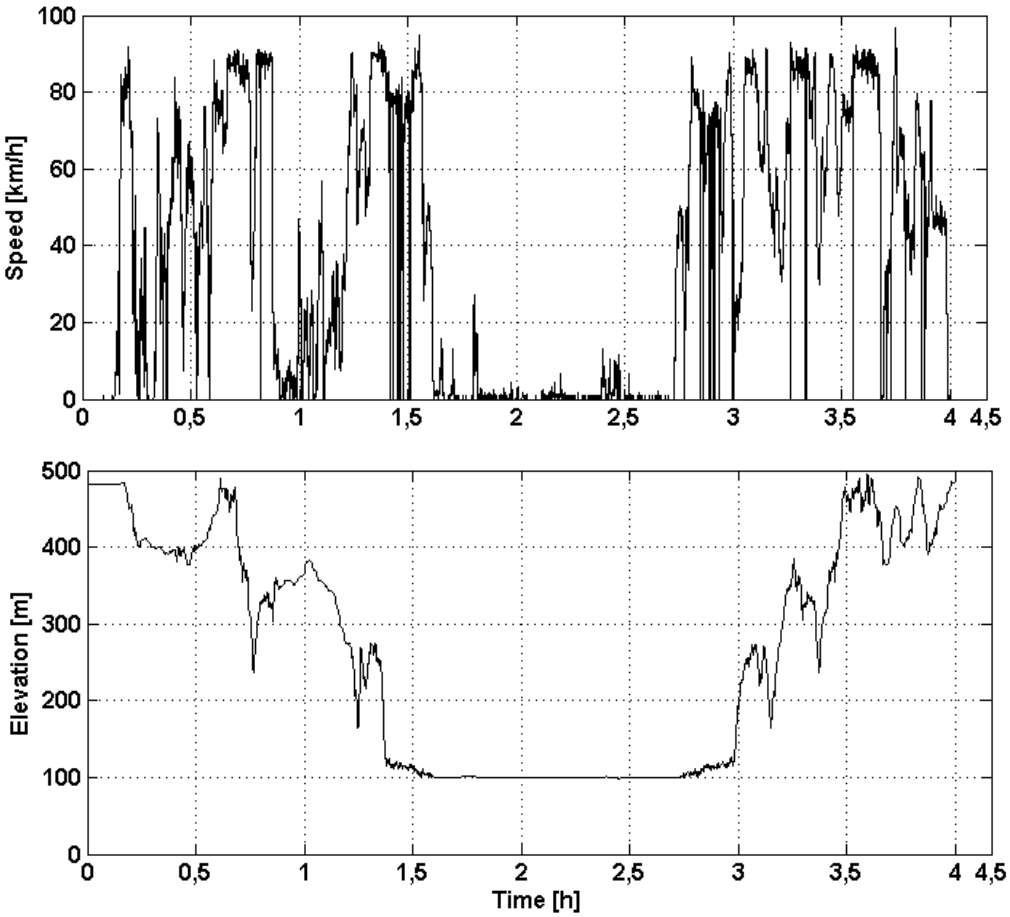


Approach – Example of real drive

Real drive of a tank truck from Simmozheim to Karlsruhe and back

- Length 153 km
- Time 4 h





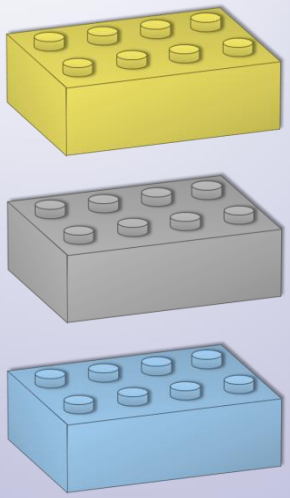
Methodology for analyzing driving cycles

Analyzing of real driving cycles and its components for filling up the database

Analyzing Information

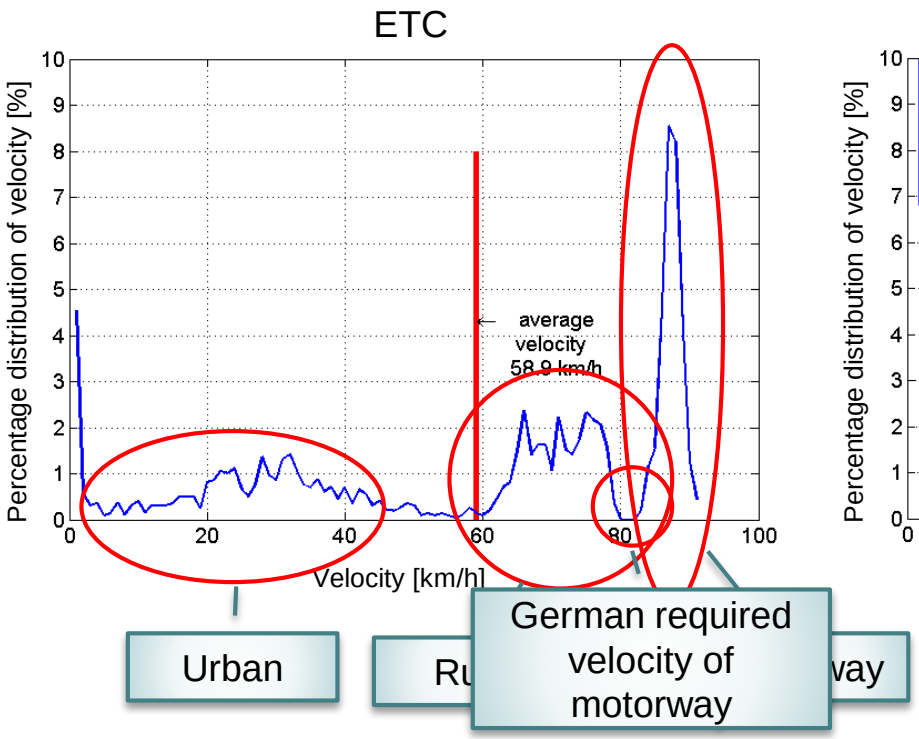
- Working and driving load case
- Distribution of speed over vehicle speed
- Distribution of slope over vehicle slope
- Stop-and-go behavior
- Length and duration of acceleration and barking
- Qualitative characteristic of purpose
- *… will be continued*

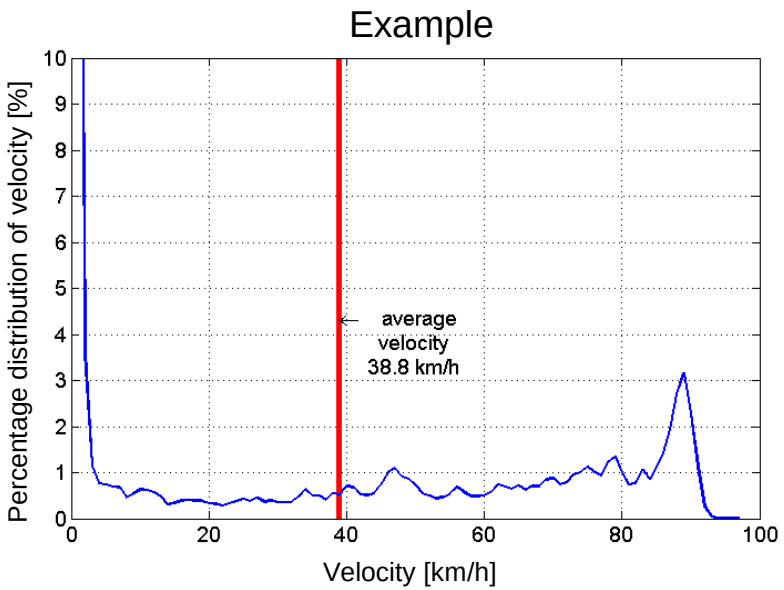
Database



Preliminary Results

Percentage distribution of speed over vehicle speed



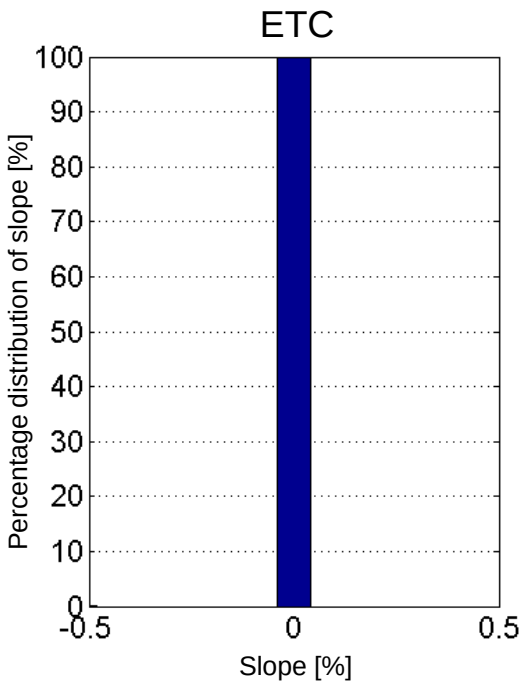


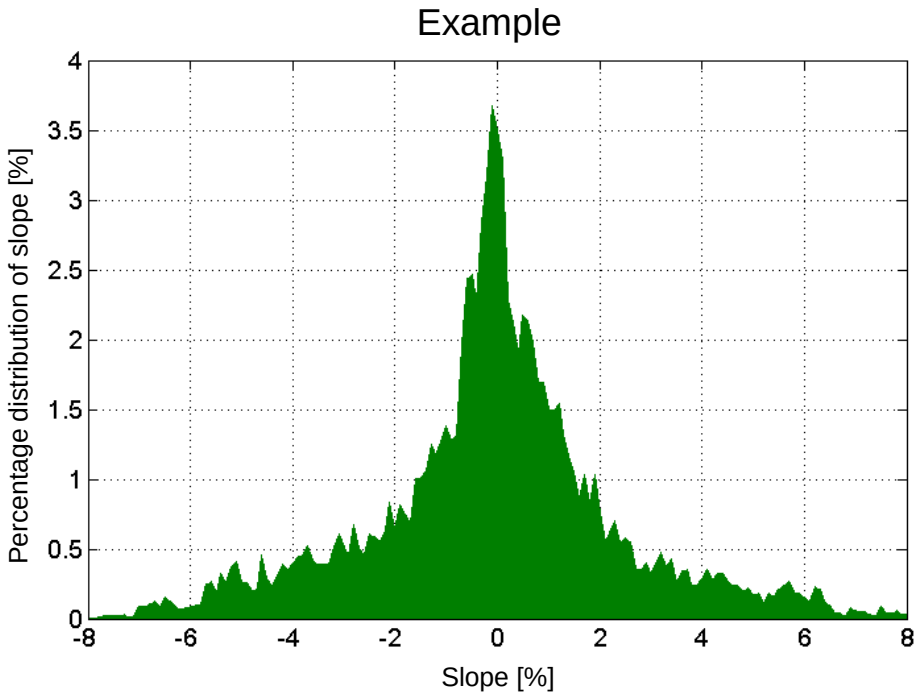
Conclusion:

ETC provide good distribution of velocity, but most in the three areas of urban, rural and motorway

Preliminary Results

Distribution of slope over vehicle slope





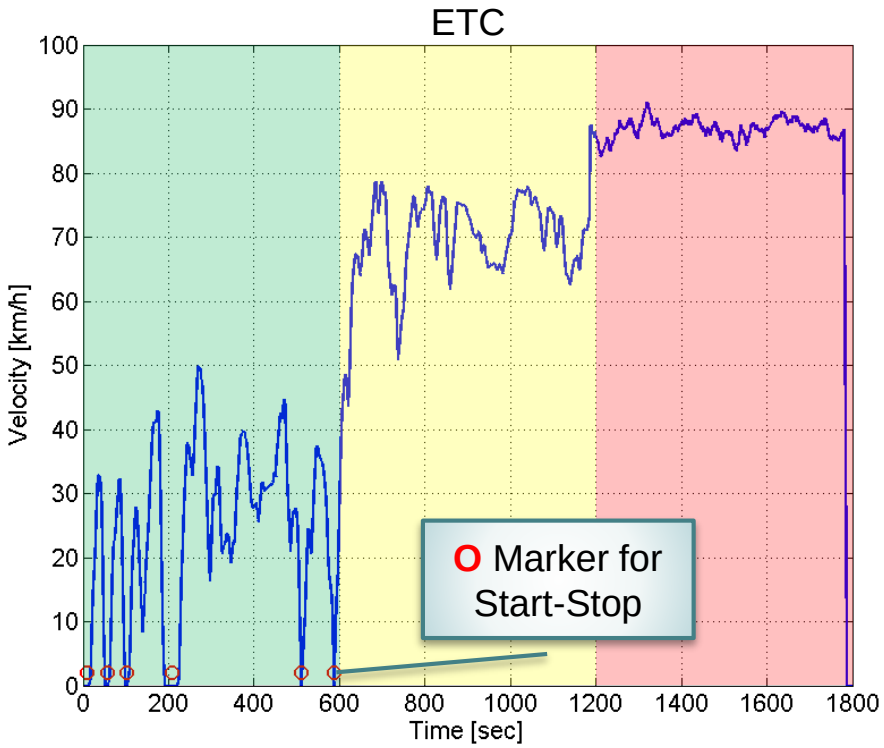
Conclusion:

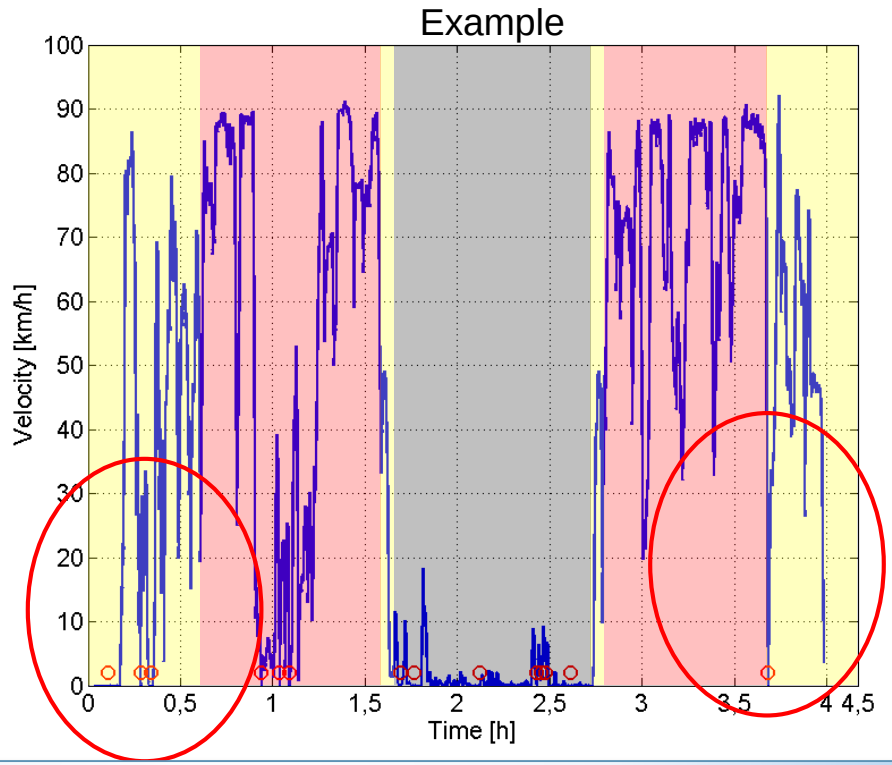
The slope of the track is one of the most important information, that is missing in the standard driving cycle

Preliminary Results

Analyzing Start-and-Stop for a real and the standard driving cycle

Legend
Urban
Rural
Motorway
Working





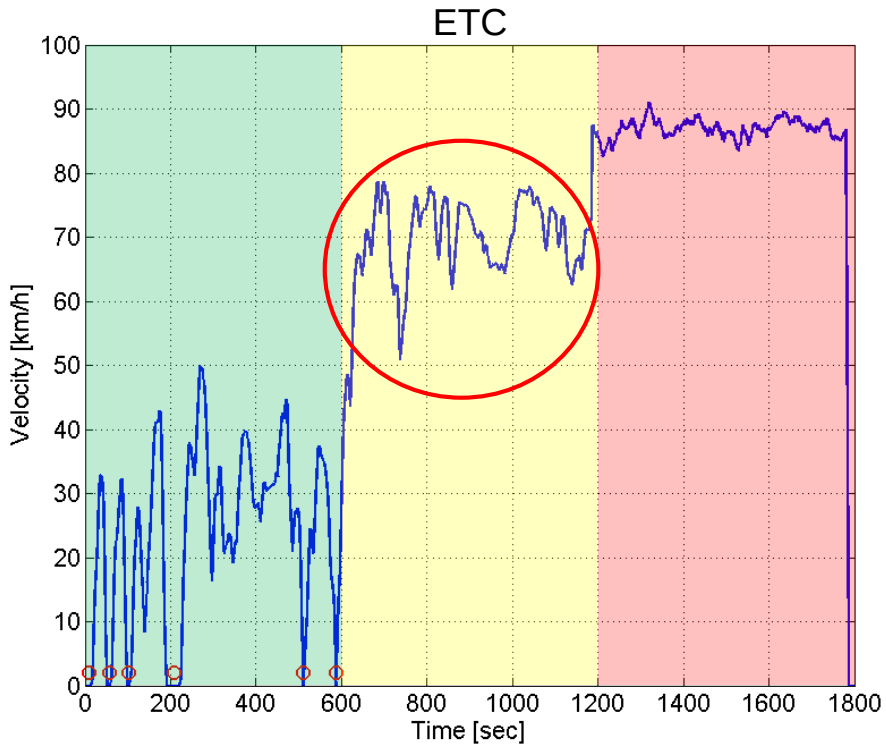
Conclusion:

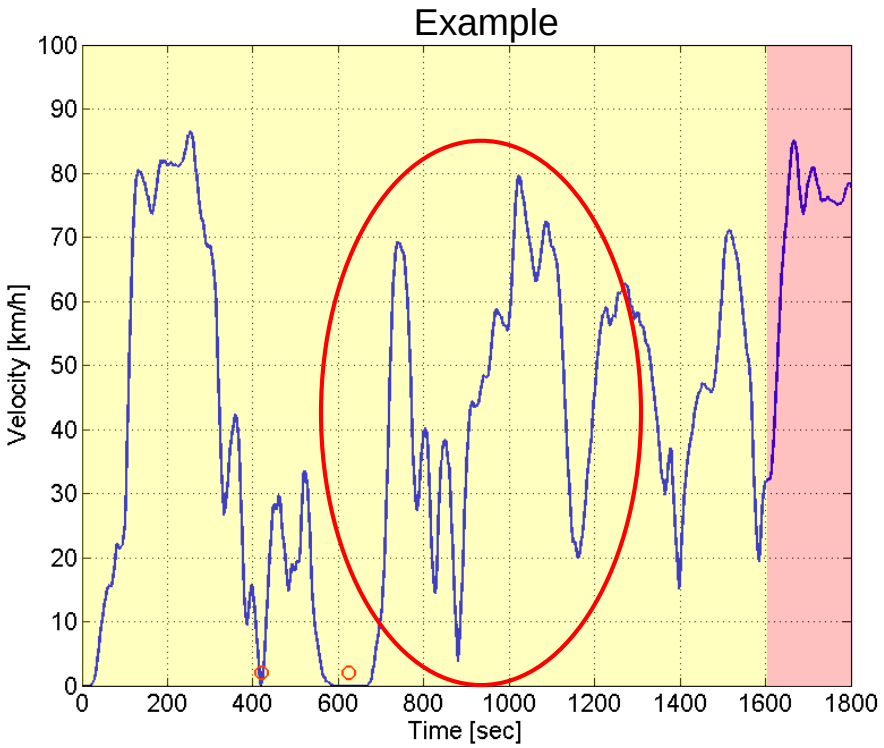
The rural and motorway part of ETC has no stops. The reality shows that there have to been some.

Preliminary Results

Rural: Influence of intersections for a real and the standard driving cycle

Legend
- Urban
- Rural
- Motorway
- Working



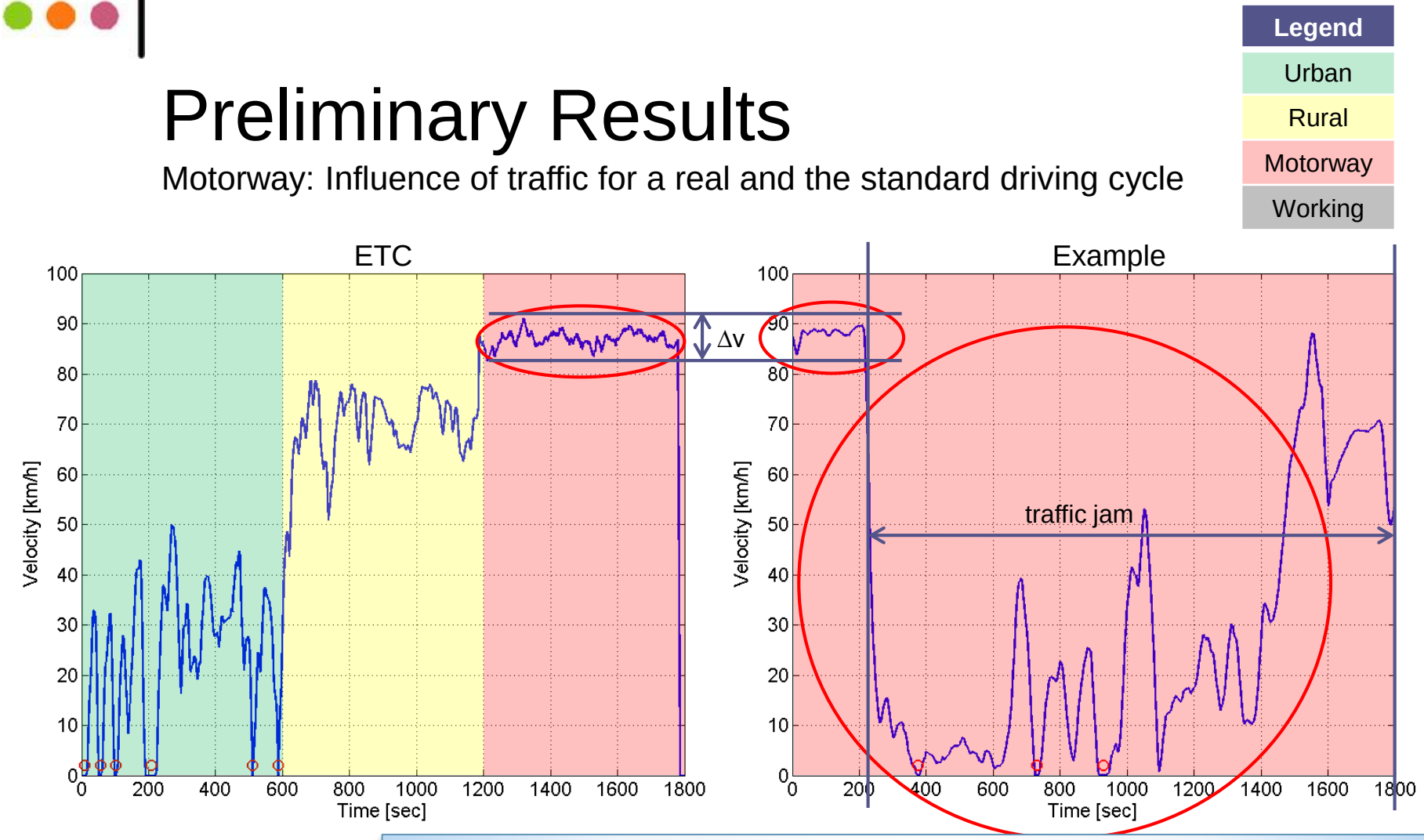


Conclusion:

ETC: 600 sec without stopping. In Germany a lot of traffic lights and intersections commit to stop or brake.

Preliminary Results

Motorway: Influence of traffic for a real and the standard driving cycle



Conclusion:

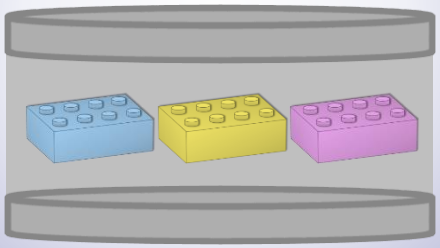
The motorway part of ETC is like the real driving cycle but it covers no traffic disruptions

Outlook – Final assembling of load and driving cycles

Build a special reference load/driving cycle with the deposited fraction of the database

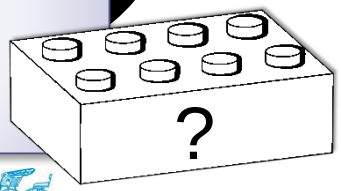
Database

Include fraction of real load/driving cycle with characteristic parameters



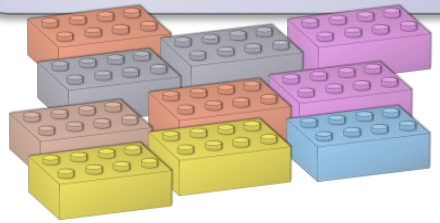
Customer survey

- Classification of load/driving profile
- Type of Vehicle
- Tour information



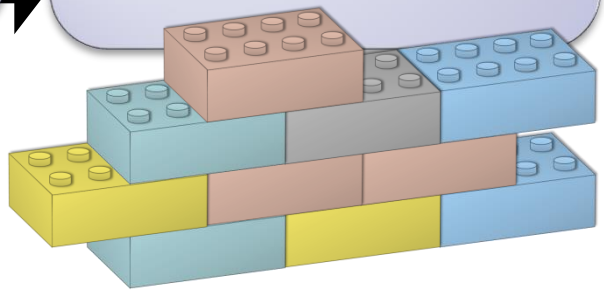
Fitting fractions from database

- How many fractions ?
- Which fractions ?
- What sequence ?



Final assembling

- Combination of blocks
- Generation load/driving profile

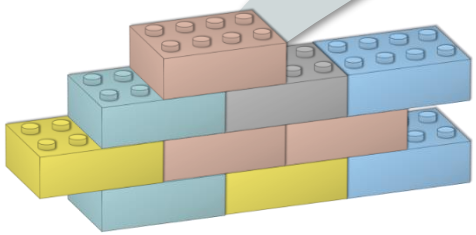


Outlook

How can we develop more efficient commercial vehicles?

Special Load Case

for unique purposes of CVs



Energy Management

- Powertrain
- Electric components
- Control strategy

Thermal Management

- Climatisation
- Exhaust
- Heat losing

Proof of Concept

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Thanks for your attention!

Questions?

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