Connecting Austria

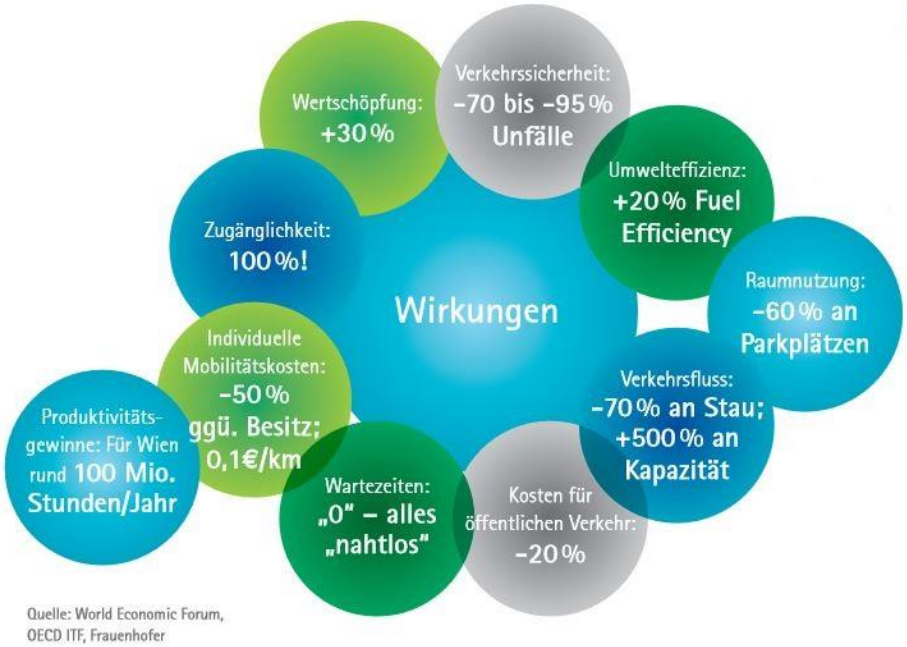
Lead project for connected, cooperative, automated driving

Connecting energy-efficient and semi-automated trucks
from the motorway to the city

Andreas Kuhn, ANDATA

A3PS Conference
November 2018

Expected Benefits from Automated Driving



Quelle: World Economic Forum, OECD ITF, Frauenhofer

Taken from the Austrian Roadmap for Automated Driving, 2016

WIEN ZWA
ZUKUNFT WIRD AUTOMATISIERT

- Sounding project for test field for automated driving 2016/2017
- ➢ Validation concept for automated driving functions

administered by
FFG
Austrian Research Promotion Agency

co-financed by
bmvit
Federal Ministry for Transport, Innovation and Technology

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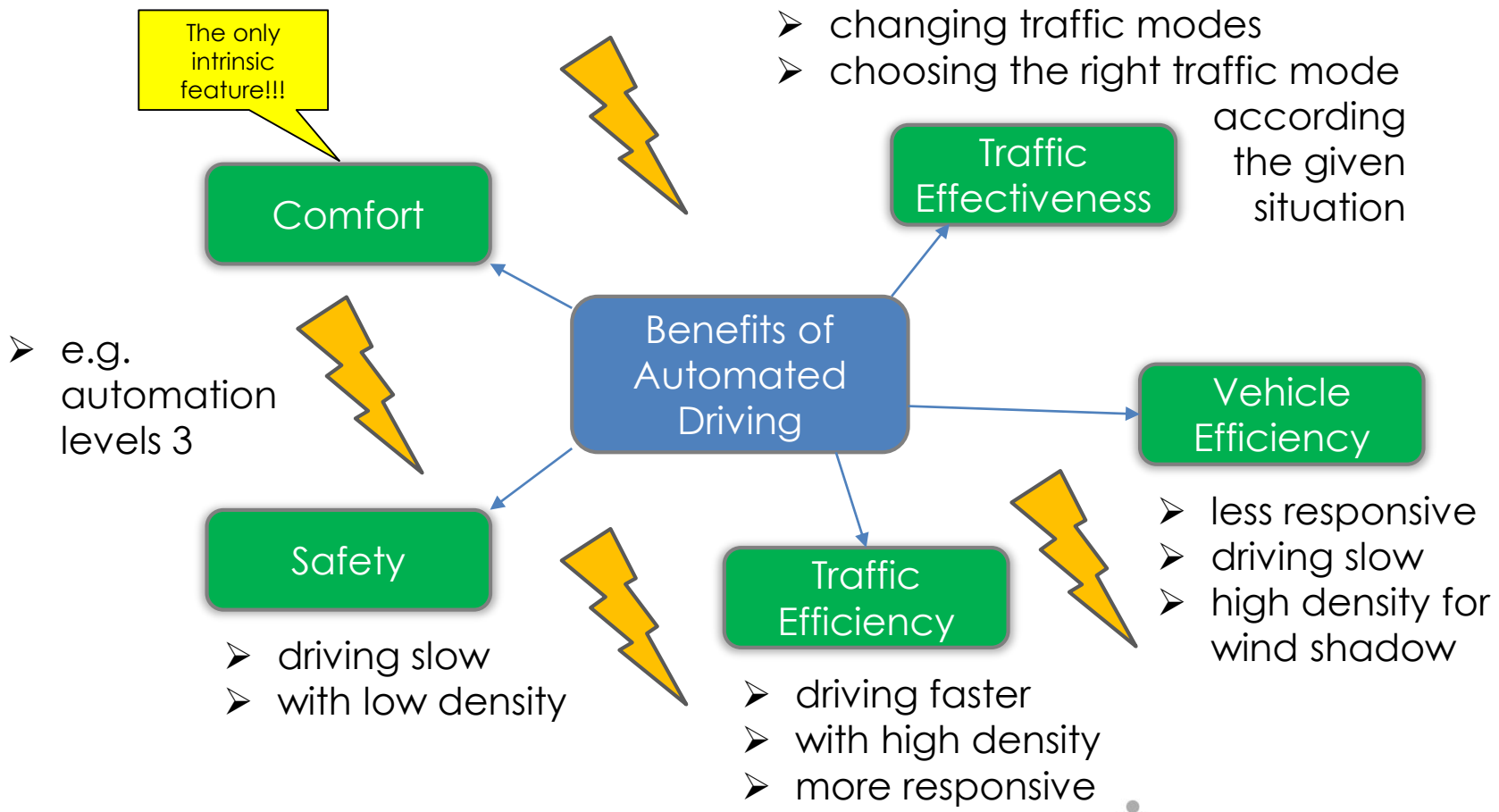
Expected Benefit Categories for Automated Driving



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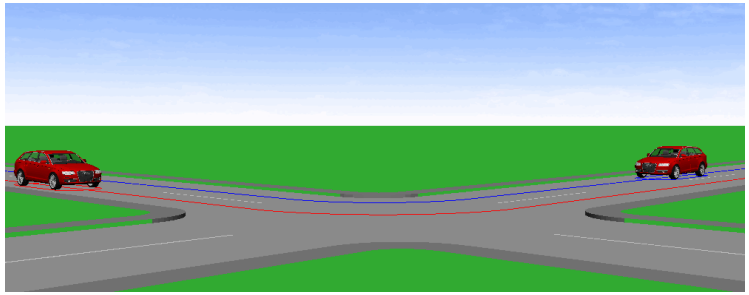
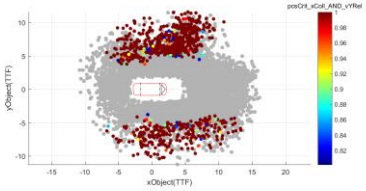
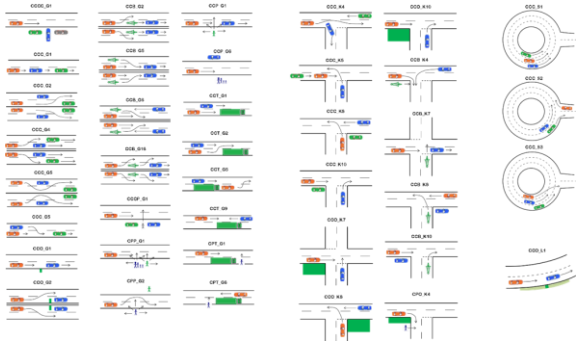
Methods of Choice in Development and Validation of Automated Driving Functions

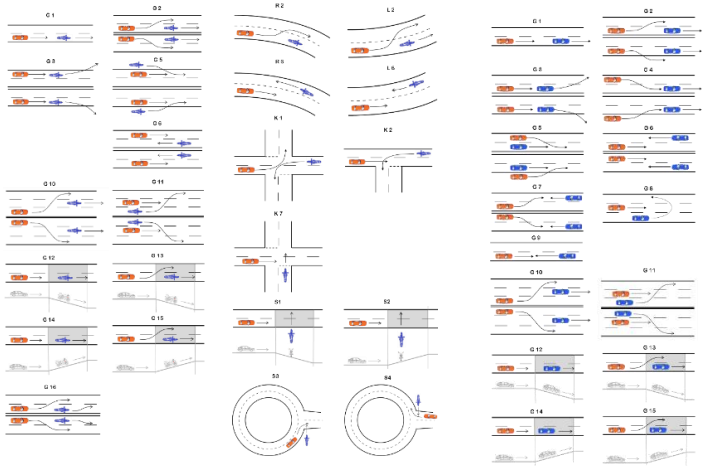
- Scenario-based Development
- Prospective Effectiveness Assessment
- Machine Learning & AI
- Integral and Holistic Top-Down Development Procedures

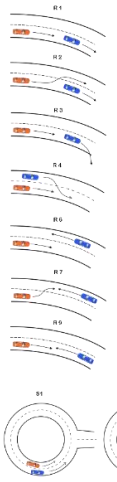
Scenario-Management and Development/Approval of Actions

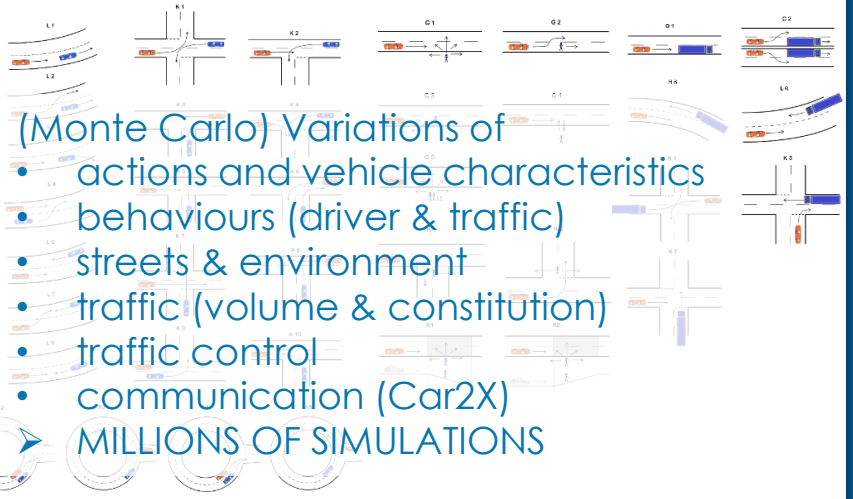












(Monte Carlo) Variations of

- actions and vehicle characteristics
- behaviours (driver & traffic)
- streets & environment
- traffic (volume & constitution)
- traffic control
- communication (Car2X)

MILLIONS OF SIMULATIONS

Comfort | **Safety** | Vehicle Efficiency | Traffic Efficiency | Traffic Effectiveness

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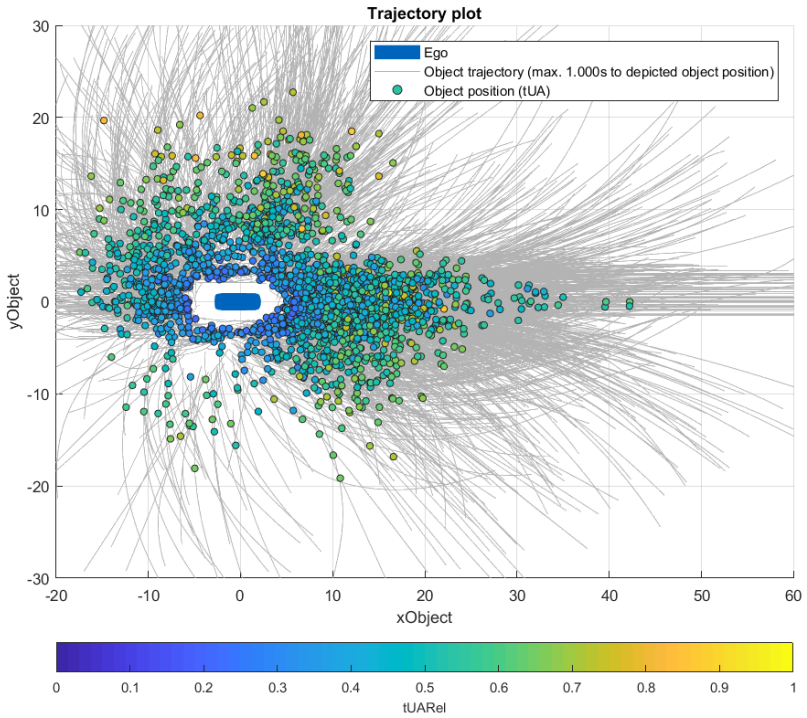
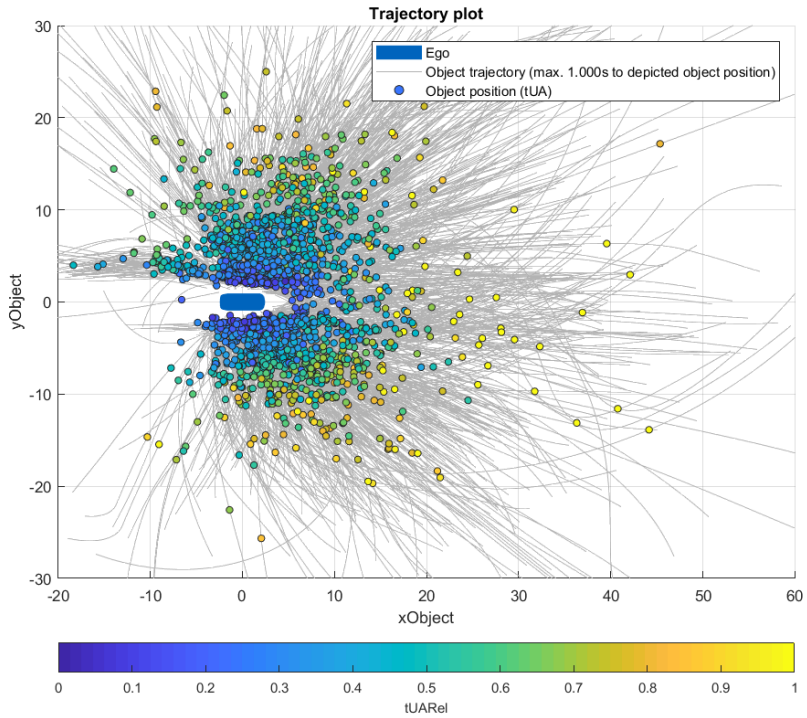
Calculation/Estimation of Criticality





Comfort | **Safety** | Vehicle Efficiency | Traffic Efficiency | Traffic Effectiveness

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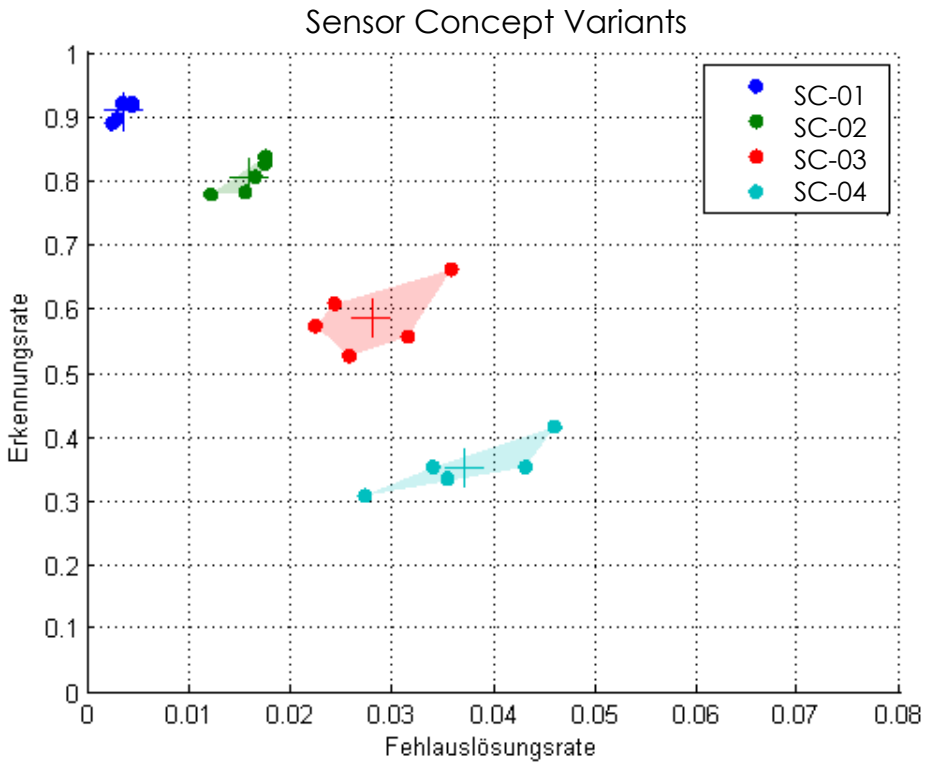
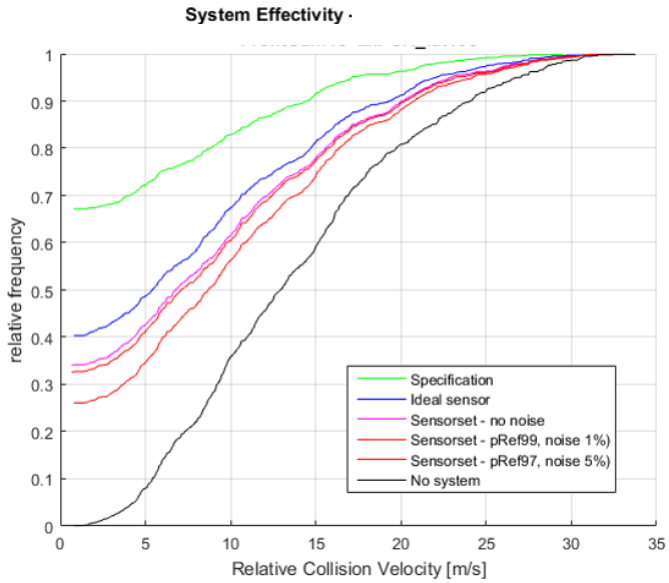
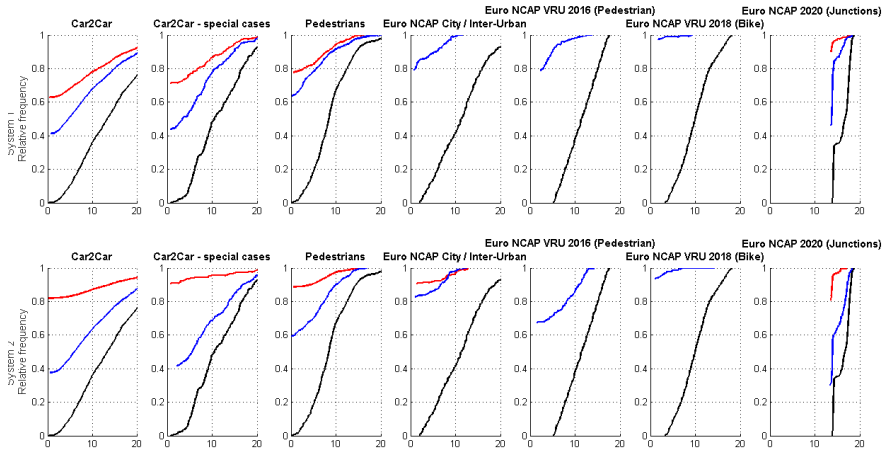
Detection Rates versus Misclassification for Algorithm



- Specification for necessary sensors and information (incl. V2X)

Prospective Effectiveness Assessment





Partially dramatic differences in effectiveness

- due to details in concept realization (i.e. wrt sensors and algorithms)
- due to situations in specified „field of effectiveness“

See:

- *On the Performance Evaluation of Integral Safety Systems*, Andreas Kuhn et.al., SafetyAssist 2013
- *Development Processes and Accompanying Performance Evaluations of Integral Automotive Safety Systems*, FISITA 2014

Connecting Austria

administered by FFG Promoting Innovation.
co-financed by bmvit Federal Ministry for Transport, Innovation and Technology

- Lead Project for Automated Driving in Austria
- Platooning as instrument for improved energy and traffic efficiency
- Development and assessment of cooperative, connected, (semi-)automated driving strategies
- 4 Principal Scenarios

Comfort | Safety | Vehicle Efficiency | Traffic Efficiency | Traffic Effectiveness

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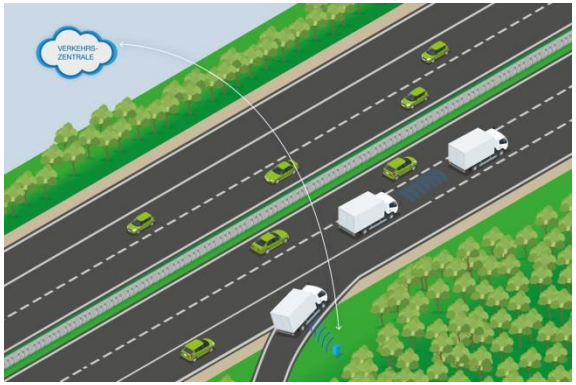
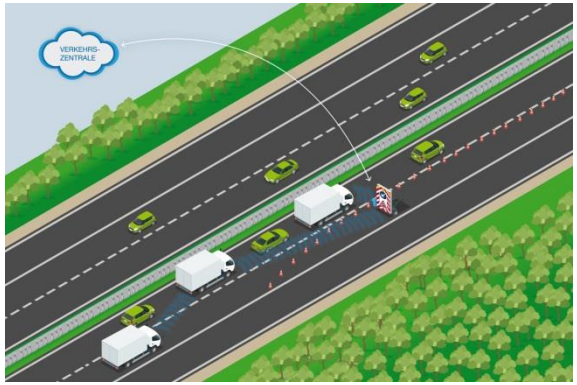
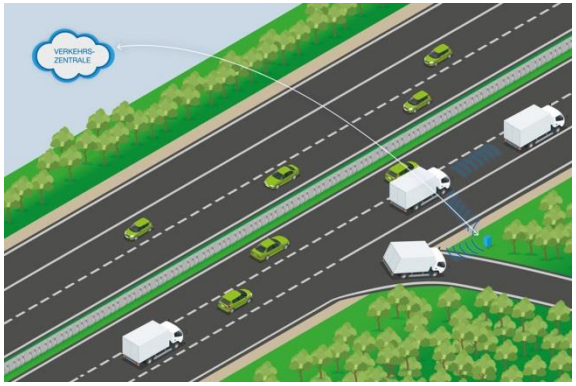
4 Principal Scenarios



S1: Highway Entry



S2: Highway Danger Zones



S3: Highway Exit

S4: Controlled Intersection

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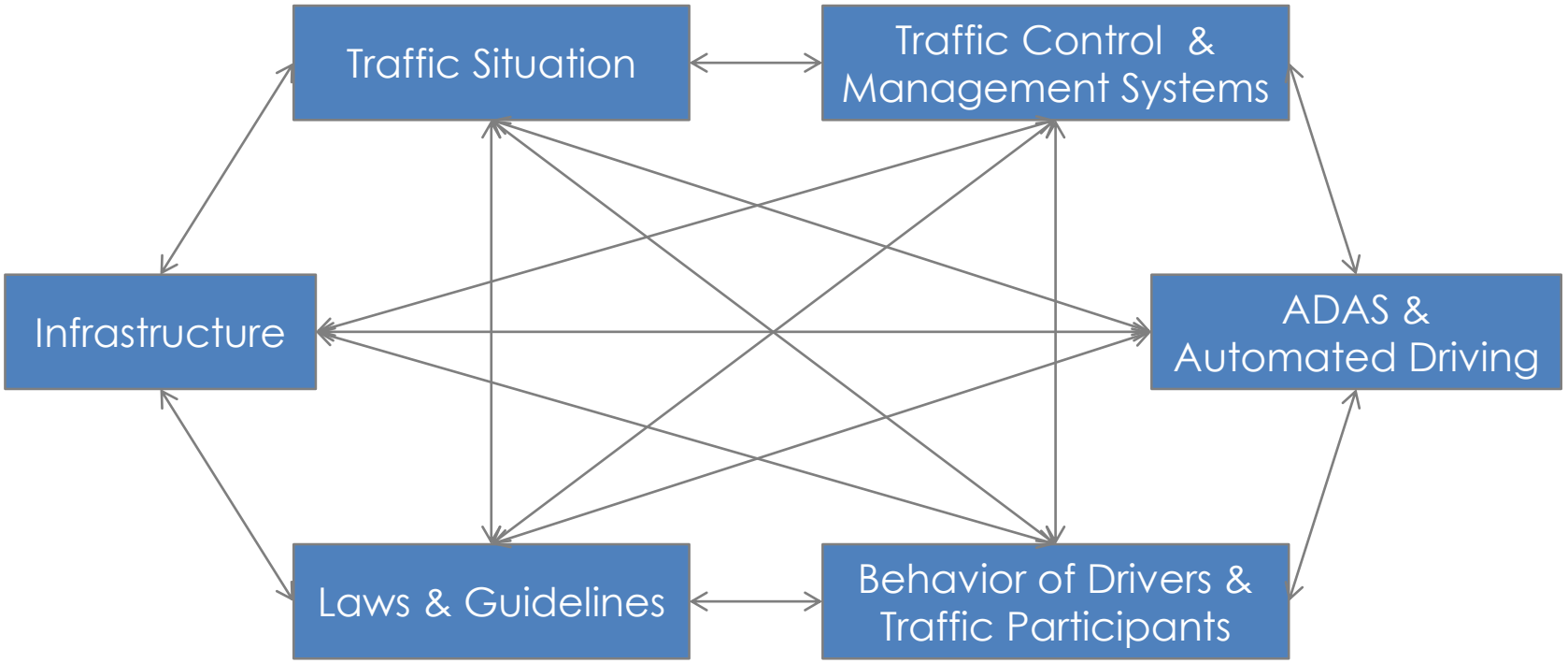
Main Entities with Effects on Automated Driving



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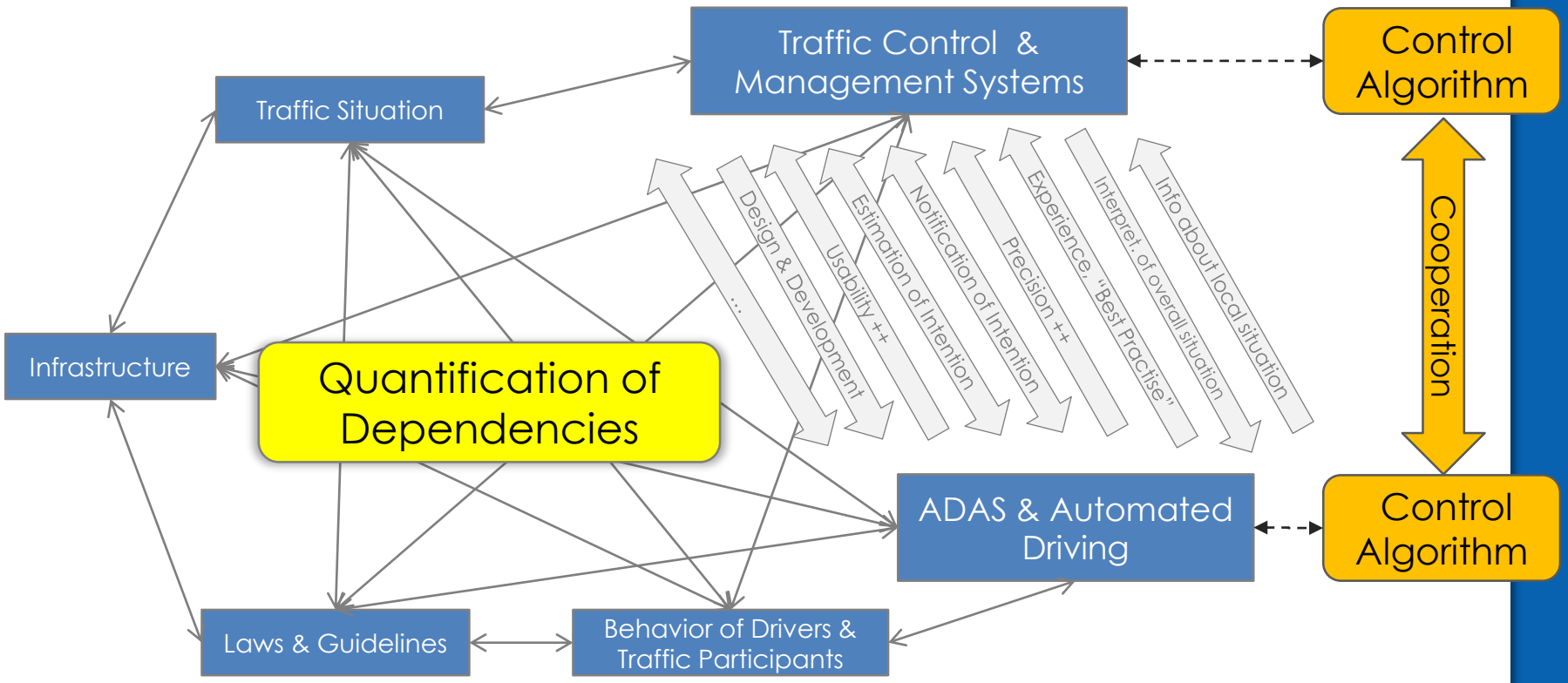
Main Entities with Effects on Automated Driving



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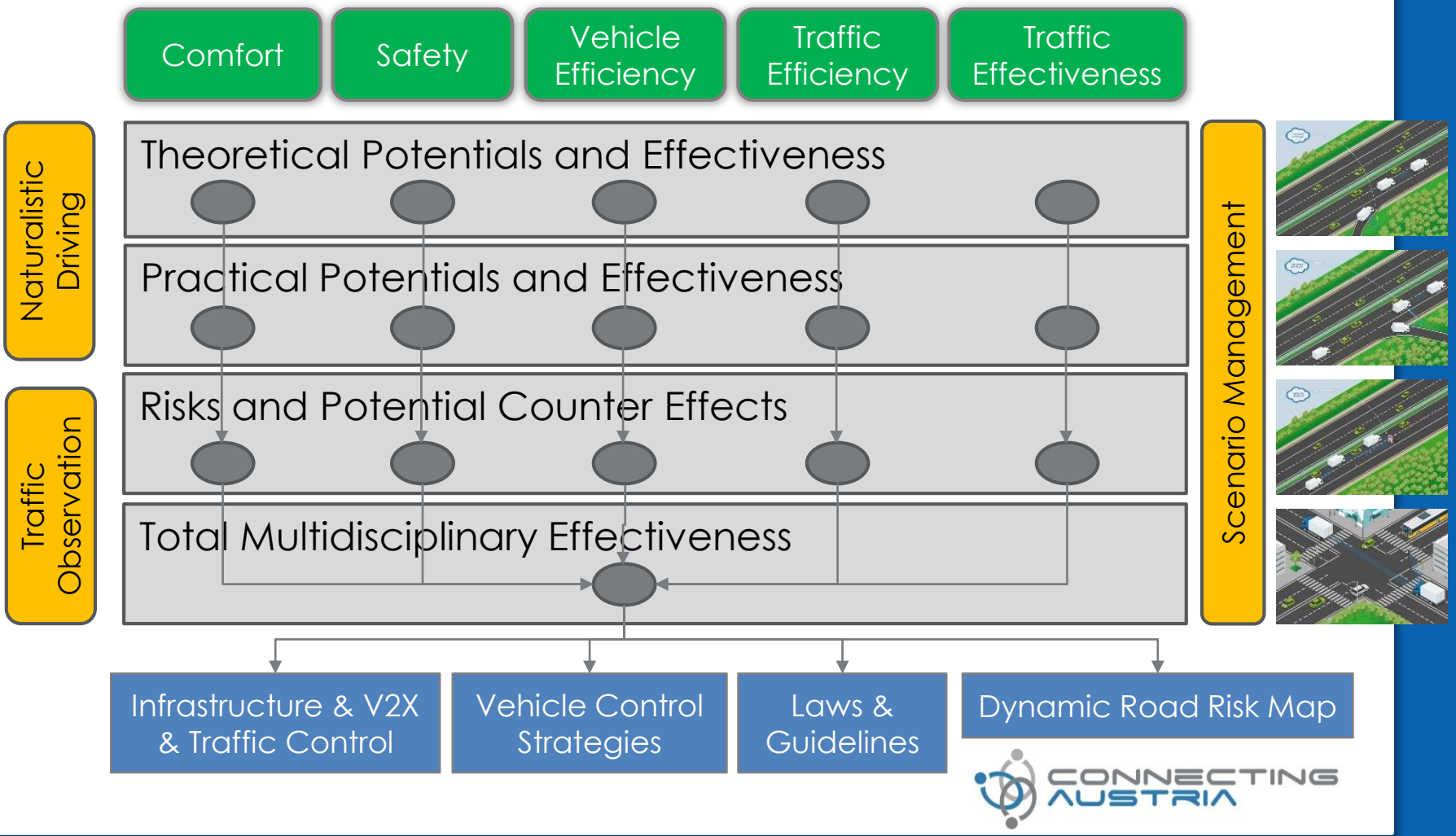
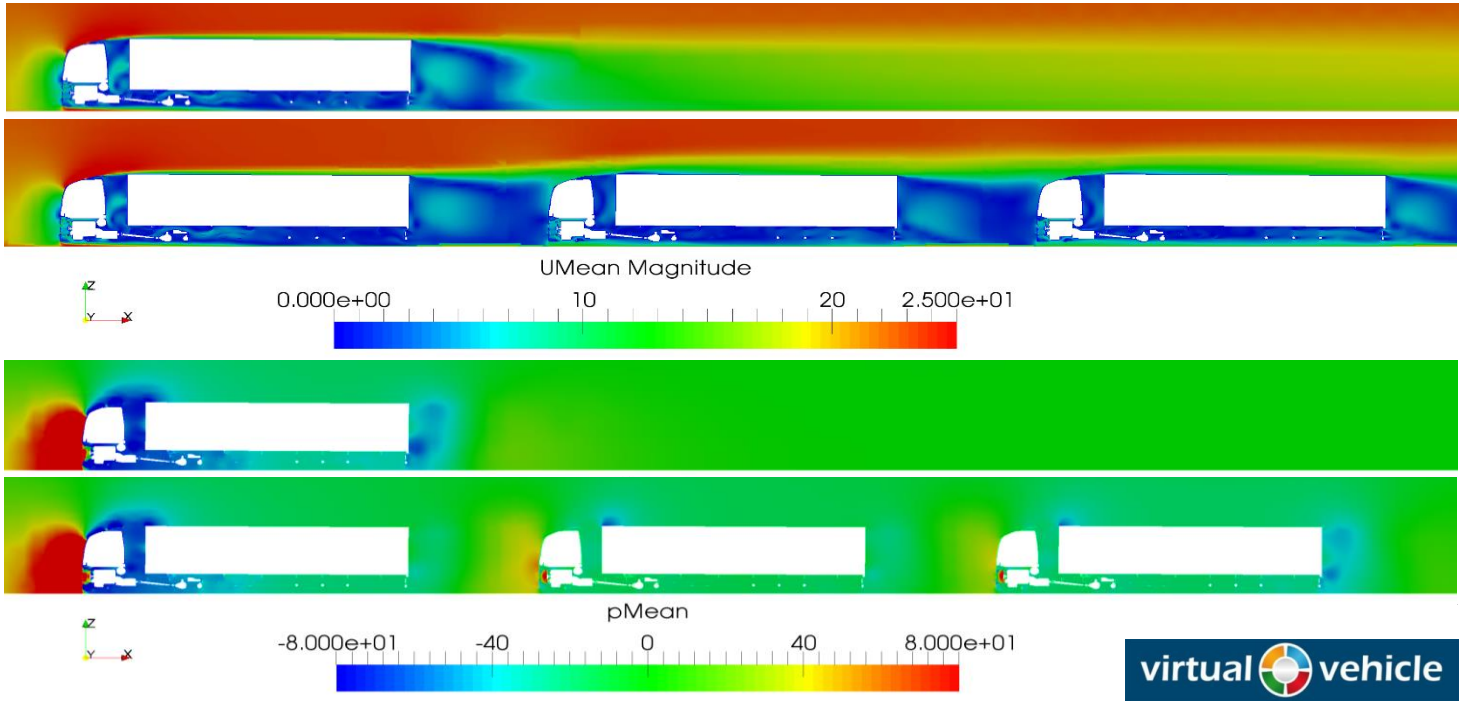
R&D Approach / Procedures



Theoretical Potentials and Effects Due to Wind Shadow

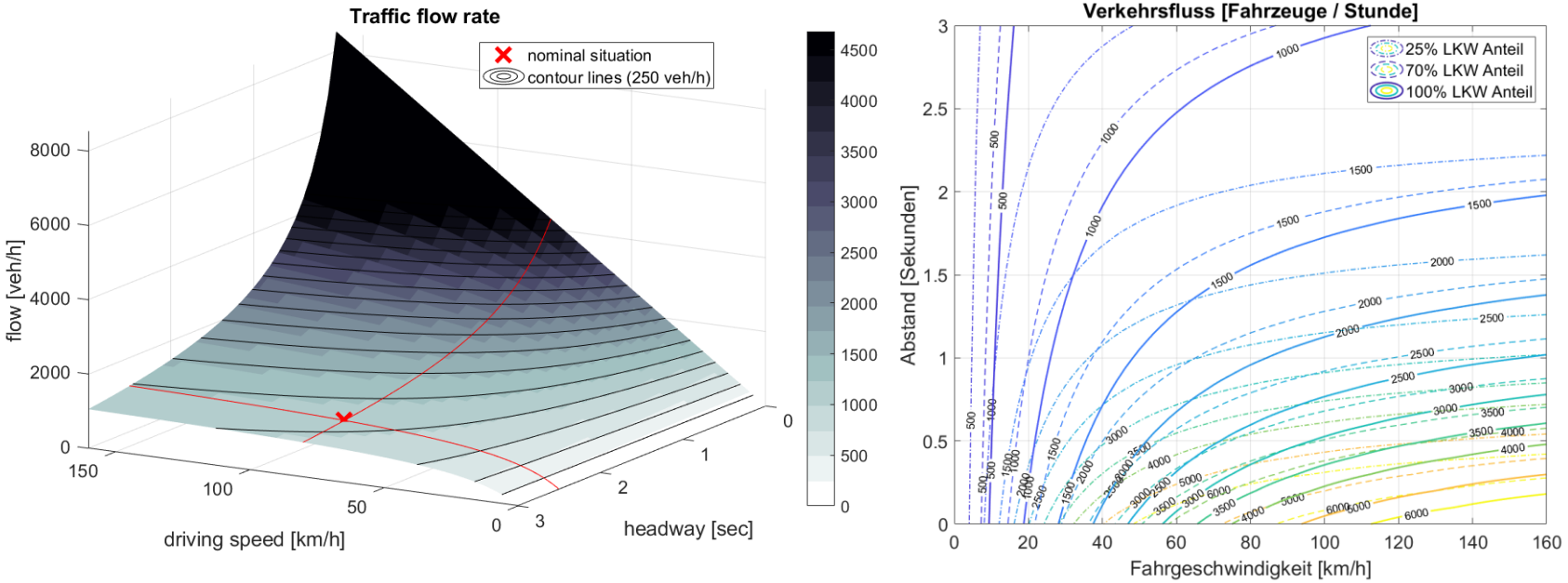
- Theoretical fuel savings due to reduced distances
- Evaluation for different distances and vehicle configurations
- Practical effectiveness e.g. including reduced cooling



virtual vehicle

What are the (theoretical/practical) potentials of platooning according traffic efficiency?

- What are the traffic advantages due to reduced distances in comparison to real traffic situations?
  - Evaluation of realistic traffic situations (together with ASFINAG)



- Theoretical potentials wrt traffic densities and flow rates

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Which traffic situations will result in additinal congestion?

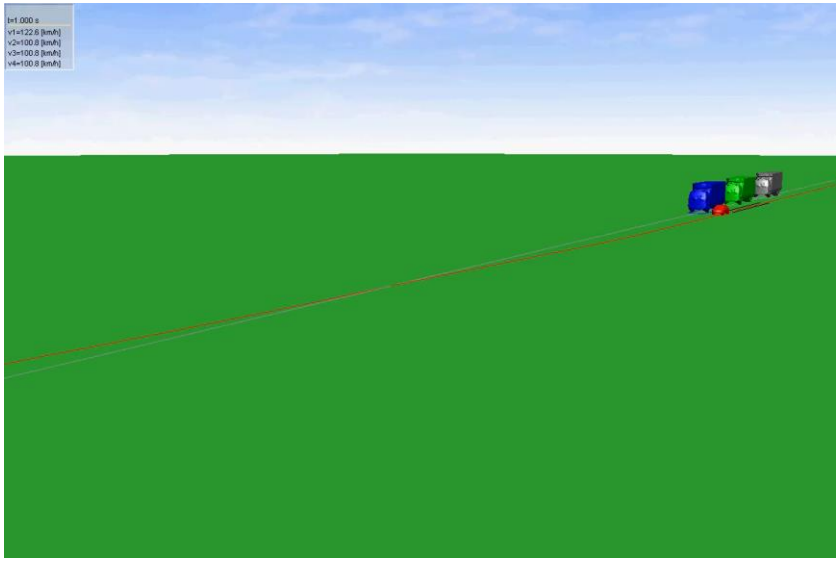
- Example
  - Elephant races: overtaking with few speed differences
  - Overtaking of long truck pelotons

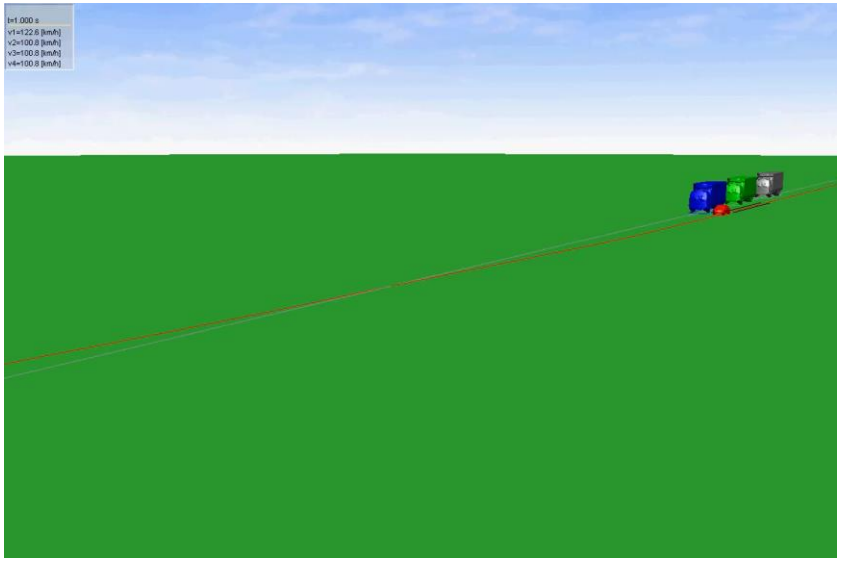
© https://www.bussgeldkataloge.de/elefantenrennen/

➢ Potential risks wrt traffic congestions

Different cooperative control strategies and their consequences

- Scenario based evaluation of different vehicle control strategies





- Potentials and risks of control and driving strategies for more safety and efficiency

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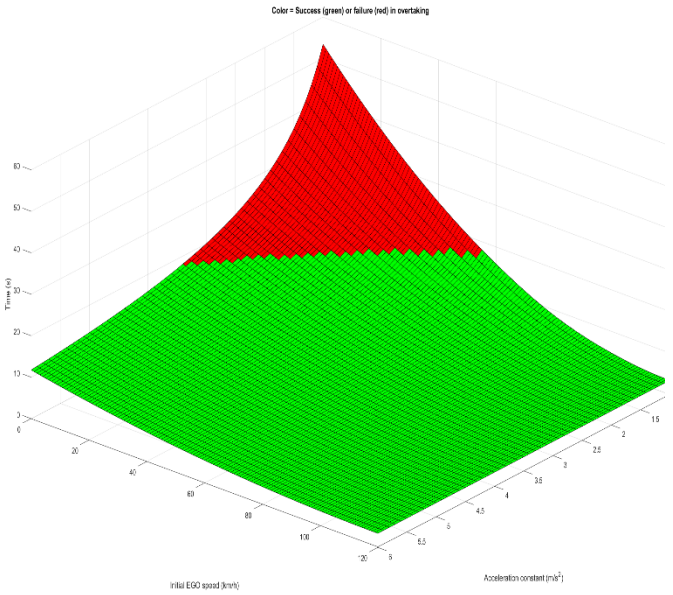
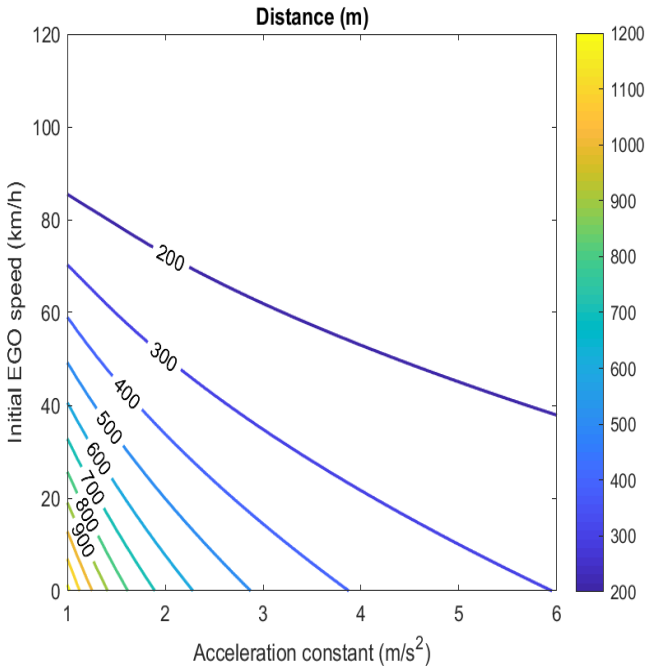
What are necessary lengths and durations for overtaking?

- When to begin/avoid overtaking for prevention of avoid weaving

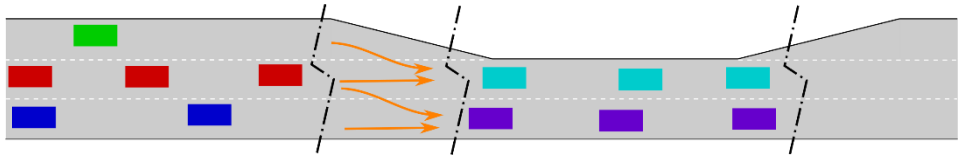


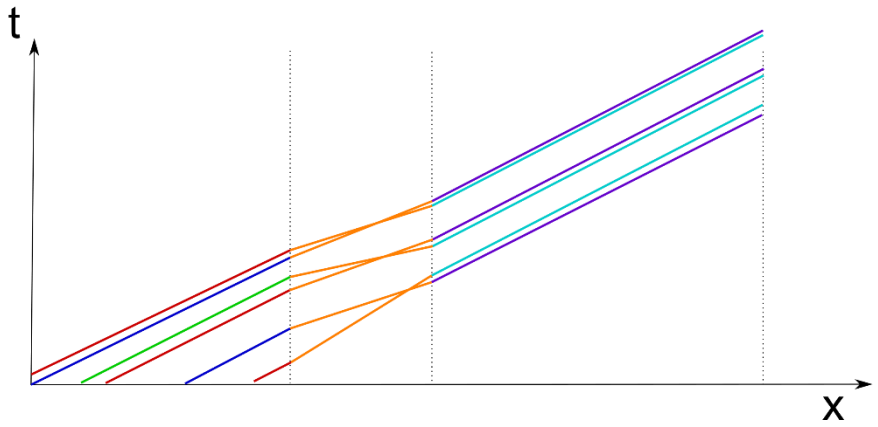


➢ Potential risks wrt safety

Advantages due to local and temporal compression?

- Scenario
  - Lane reduction
  - Tunnels, construction sites, accidents
- Target
  - Efficient lane merge
  - Minimal lost time
  - Maximum safety
  - Avoidance of congestion
- Example:
  - Zip-Assistant System

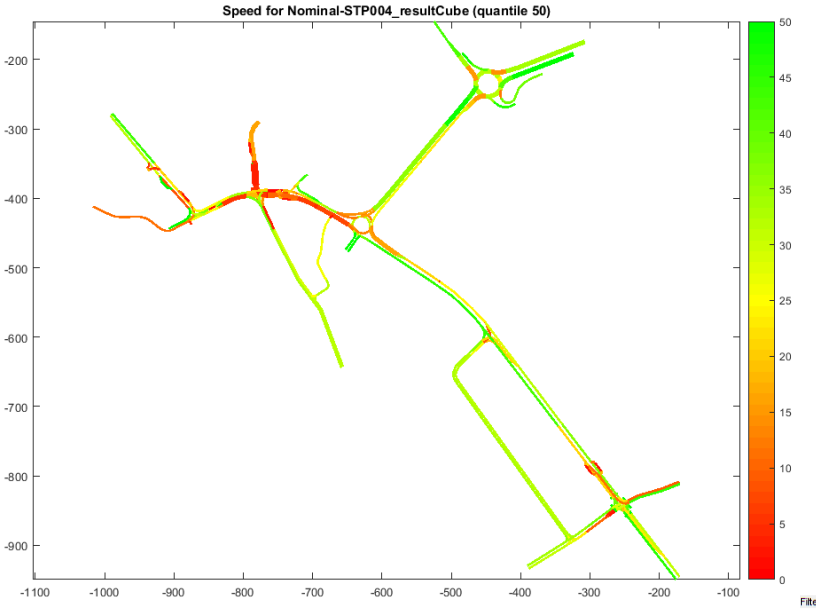


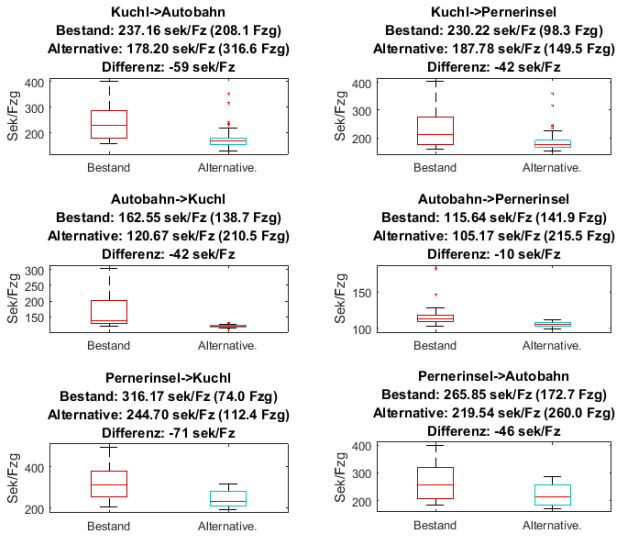


Traffic Micro Model of Hallein

- Scenario based evaluation of different traffic control strategies
- Extensively validated micro model of Hallein for evaluation of different control strategies and traffic situations

Traffic Analysis for Test Region Hallein





Simulation of different control strategies

- Variation of vehicle control actions
- Variation of traffic control actions
- at different traffic situations

Green time extension

Green time start assist

Local compression

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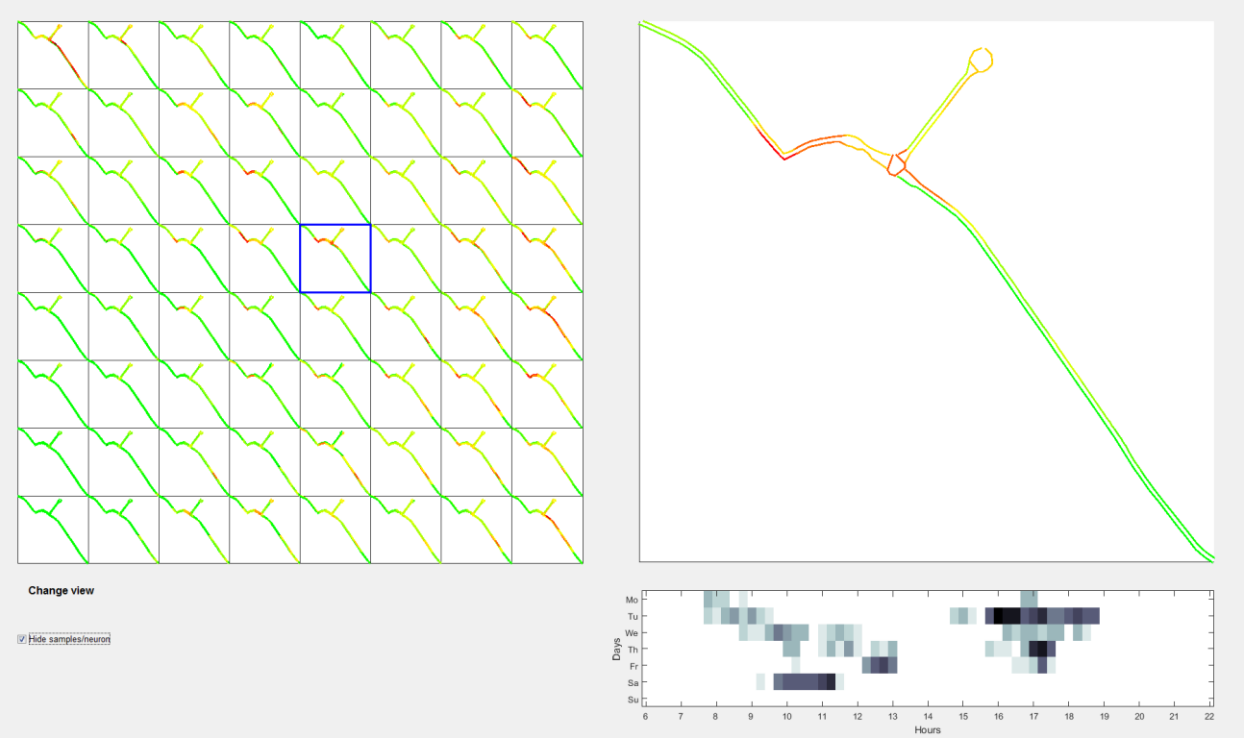
Evaluation of Traffic Situations with xFCD

- Automated detection of relevant traffic scenarios



➢ FCD evaluations and anomalies detection already running

Automated Object Detection

- Video-Tracking of all traffic participants

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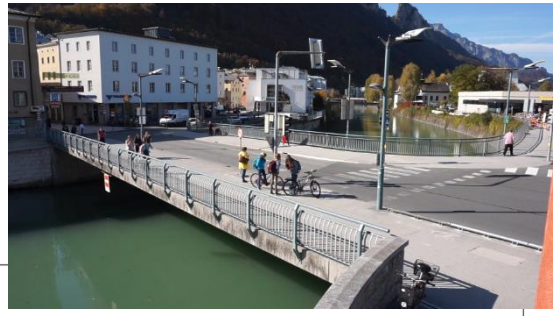
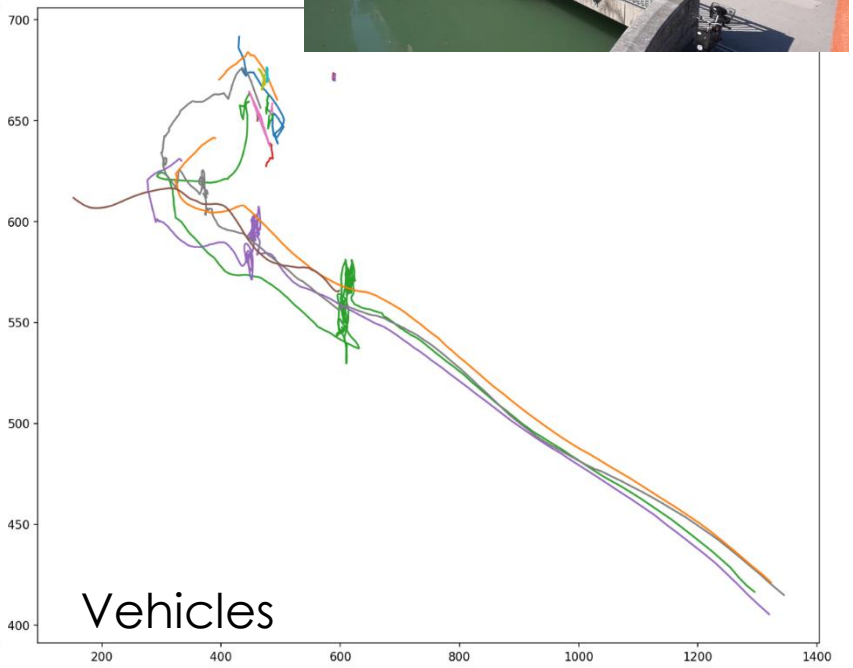
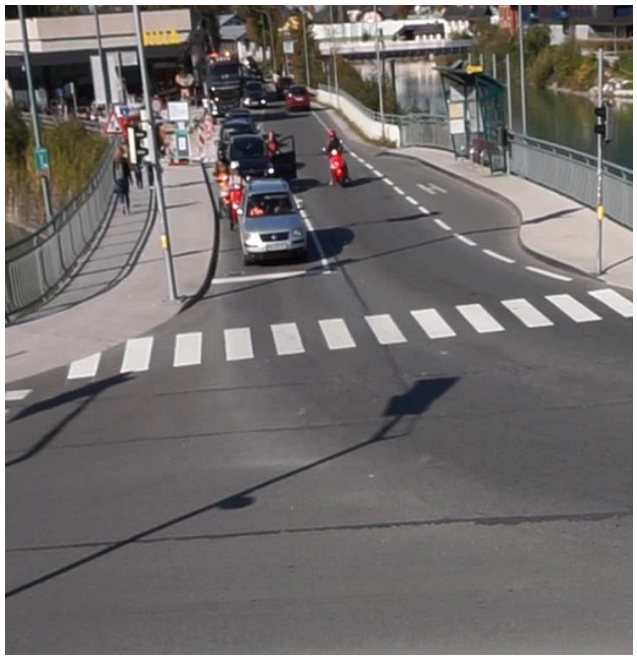
Automated Detection of Traffic Situations

- Video tracking with continous trajectories across intersections





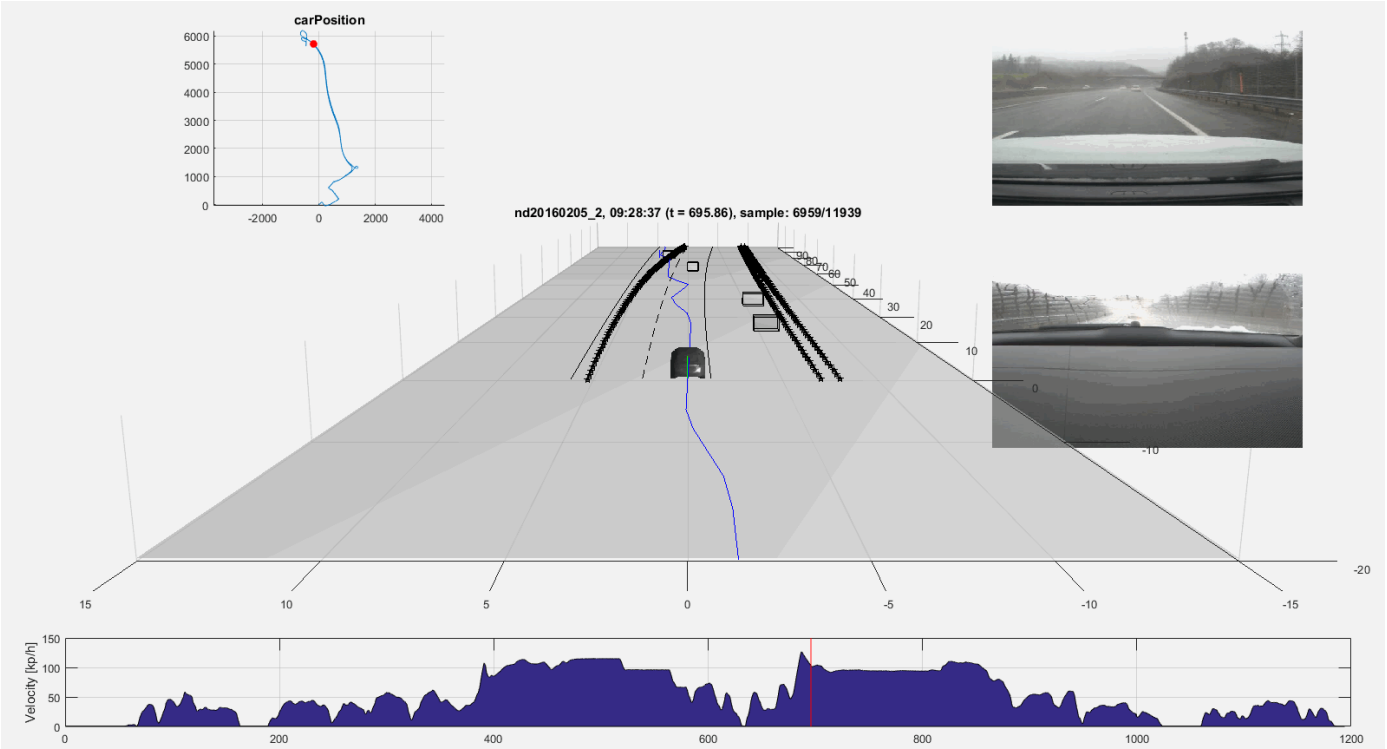
Automated Detection of Anomalies and Dangers



Driving at wrong lane

Diagonal crossing of intersection

Data Acquisitions from Fleet and In-Vehicle Data (Naturalistic Driving)



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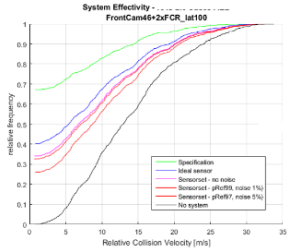
Solution Concept for Development/Validation Automated Driving and Traffic Automation

Scenario Management
Scenario Catalog

Variation of Systems/Components
Variation of Situations / Conditions
Variation of Actions
Variation of Behaviours



Traffic
Vehicles

- Simulations
- Naturalistic Driving
- Connected Mobility
- Test Fields

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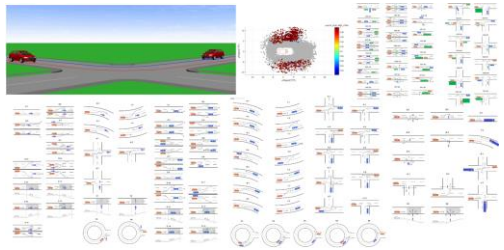
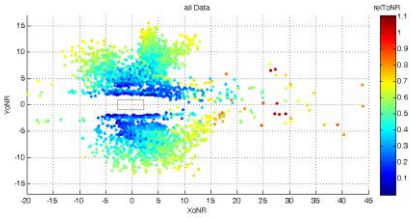
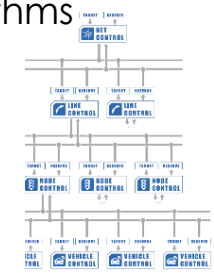
The Data Cube(s) for Vehicle and Traffic Automation

- Artificial Intelligence
- Big Data Analytics
- Robustness Mngt
- Complexity Mngt
- Effectiveness Rating
- Reference Systems
- System-of-Systems
- Conflict Analysis
- Cond. Probabilistics
- Var. Labellings

- Quick Identification and Resolution of Requirement Conflicts
- System Understanding
- Conform Specification of Components
- Realistic Performance Ratings
- Best Control Algorithms







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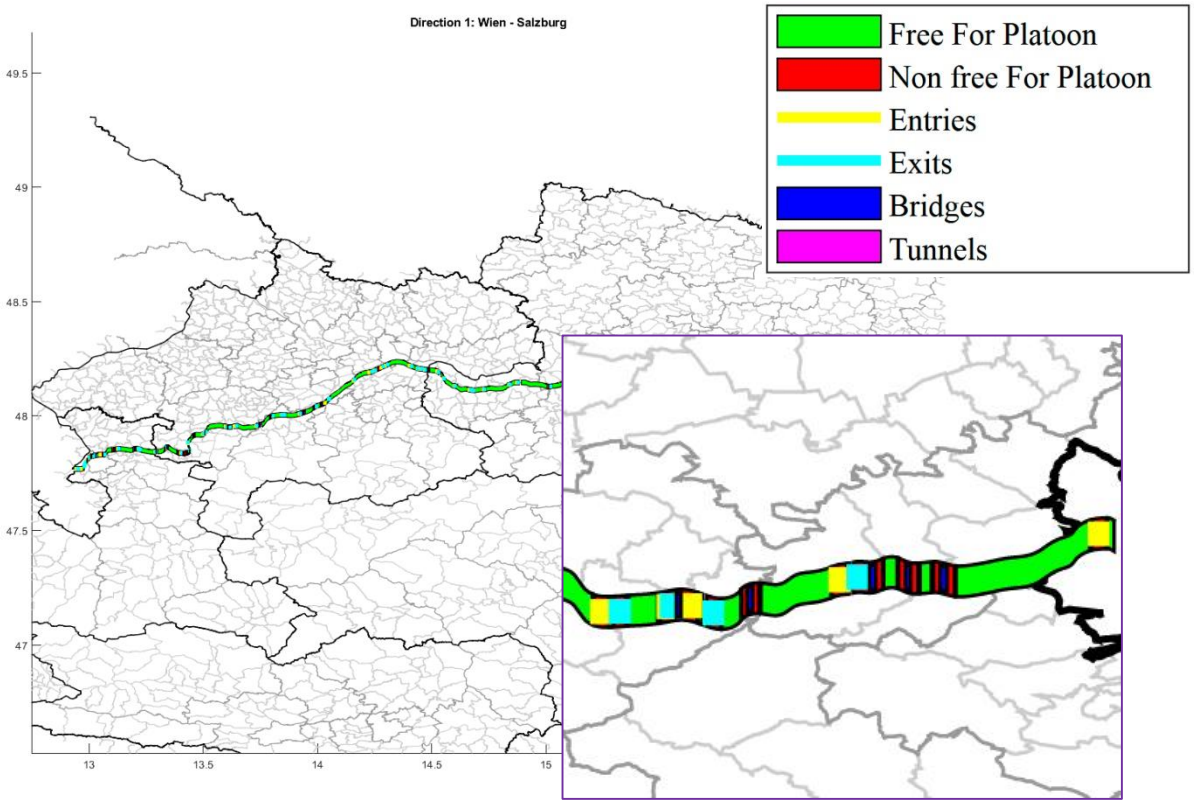
Dynamic Risk-rated-map

Adaptive wrt
- local conditions
- traffic situation
- weather
- temporal incidents
- …



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Summary and Conclusions

- Connecting Austria: lead project for connected, cooperative, automated driving
- Scenario-based development of platooning strategies and control policies
- Focus on infrastructure aspects and safe traffic/vehicle efficiency
- Carry on validation concept from WienZWA
- Preparing next steps for Car2X
- Open for 3rd party Platooning Tests

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Thank you

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administered by FFG Promoting Innovation.

co-financed by bmvit Federal Ministry for Transport, Innovation and Technology

13 Project Partners

ANDATA ARTIFICIAL INTELLIGENCE LABS

AC AUTOMOBIL CLUSTER

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HiTec marketing

IESTA

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SIEMENS Ingenuity for life

swarco SWARCO FUTURIT Verkehrssignalsysteme Ges.m.b.H.

TD TRANSDANUBIA

virtual vehicle

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Projektdaten

- Projektdauer: 36 Monate
- Projektstart: 01/01/2018
- Projektbudget: 4,3 MEuro
- Projektförderung (bmvit): 2,5 MEuro
- www.connecting-austria.at
- Projektleiter: Dr. Wolfgang Schildorfer, mailto: connecting-austria@hitec.at

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Technisch inhaltlicher Hintergrund

- Ausgangssituation
- Ergebnisse aus WienZWA

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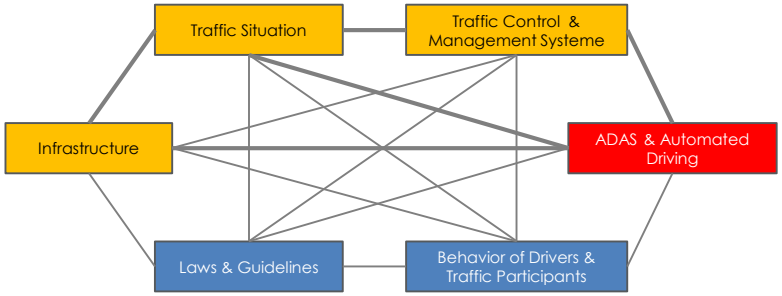
Example of „Misinformation(?)“ about Traffic Situation



What‘s going wrong?

- TMC-Message?
- C-ITS-Message?
- Internet?
- Data fusion algorithm of car?
- Policy of message provider?
- Typing error of operator in traffic management center?
- Error of algorithm for traffic prediction?
- Misinterpretation of C-ITS codes?
- …

Consequences for automated car?

- Stop?
- Reroute?
- Gain confidence? Ask for confirmation?
- Eyes (/ears) shut and go for it?
- …

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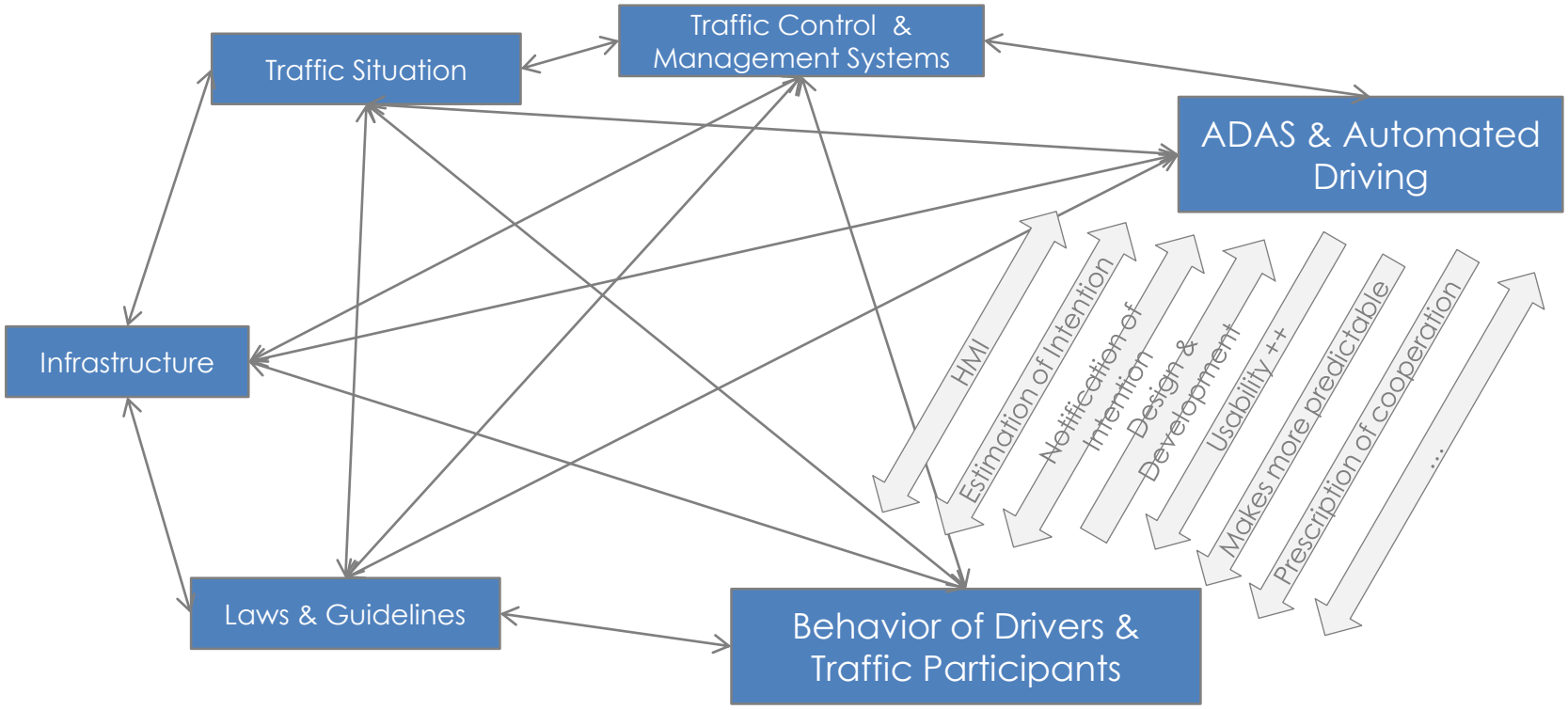
Main Entities with Effects on Automated Driving



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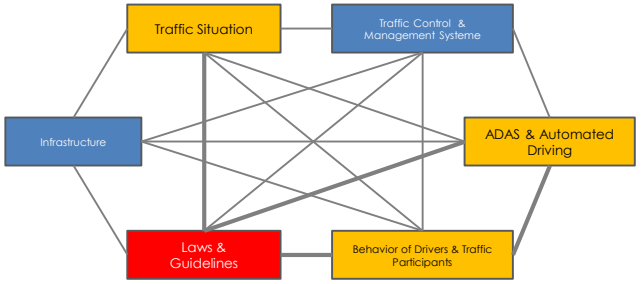
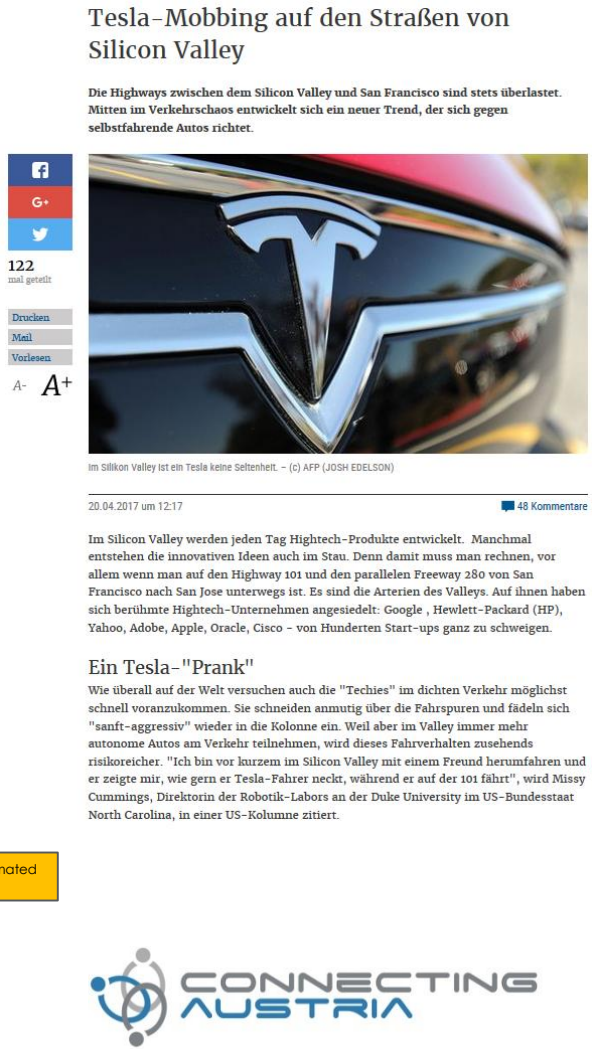
Laws of Robotics aka Asimov‘s Laws

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

- Automated cars must be very conservative and defensive!
- Will other traffic participants compensate to take individual, singular advantage?

- Singapur‘s solution: FINES for non-cooperative bahaviour





Tesla-Mobbing auf den Straßen von Silicon Valley

Die Highways zwischen dem Silicon Valley und San Francisco sind stets überlastet. Mitten im Verkehrschaos entwickelt sich ein neuer Trend, der sich gegen selbstfahrende Autos richtet.

122 mal getelt

Drucken
Mail
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A- A+

Im Silikon Valley ist ein Tesla keine Seltenheit. – (c) AFP (JOSH EDELSON)

20.04.2017 um 12:17 48 Kommentare

Im Silicon Valley werden jeden Tag Hightech-Produkte entwickelt. Manchmal entstehen die innovativen Ideen auch im Stau. Denn damit muss man rechnen, vor allem wenn man auf den Highway 101 und den parallelen Freeway 280 von San Francisco nach San Jose unterwegs ist. Es sind die Arterien des Valleys. Auf ihnen haben sich berühmte Hightech-Unternehmen angesiedelt: Google , Hewlett-Packard (HP), Yahoo, Adobe, Apple, Oracle, Cisco - von Hunderten Start-ups ganz zu schweigen.

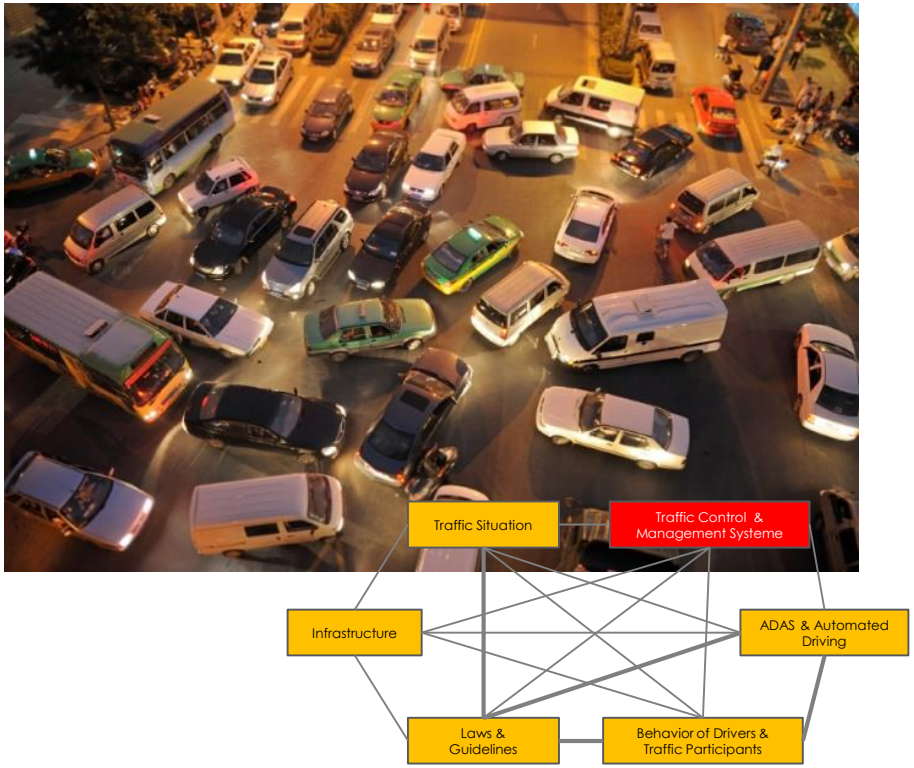
Ein Tesla-"Prank"

Wie überall auf der Welt versuchen auch die "Techies" im dichten Verkehr möglichst schnell voranzukommen. Sie schneiden anmutig über die Fahrspuren und fädeln sich "sanft-aggressiv" wieder in die Kolonne ein. Weil aber im Valley immer mehr autonome Autos am Verkehr teilnehmen, wird dieses Fahrverhalten zusehends risikoreicher. "Ich bin vor kurzem im Silicon Valley mit einem Freund herumfahren und er zeigte mir, wie gern er Tesla-Fahrer neckt, während er auf der 101 fährt", wird Missy Cummings, Direktorin der Robotik-Labors an der Duke University im US-Bundesstaat North Carolina, in einer US-Kolumne zitiert.

CONNECTING AUSTRIA

Who takes over responsibility and coordination?

Thought experiment: crowded situation at intersection with automated, self driving vehicles



Nothing different than today!

- Somebody has to take the lead and control
- Traffic control cannot be avoided and skipped

But:

- Self driving cars can be trained to be cooperative
- Traffic control must be refactored/redesigned to take advantage
- **Automation of traffic control**

CONNECTING AUSTRIA

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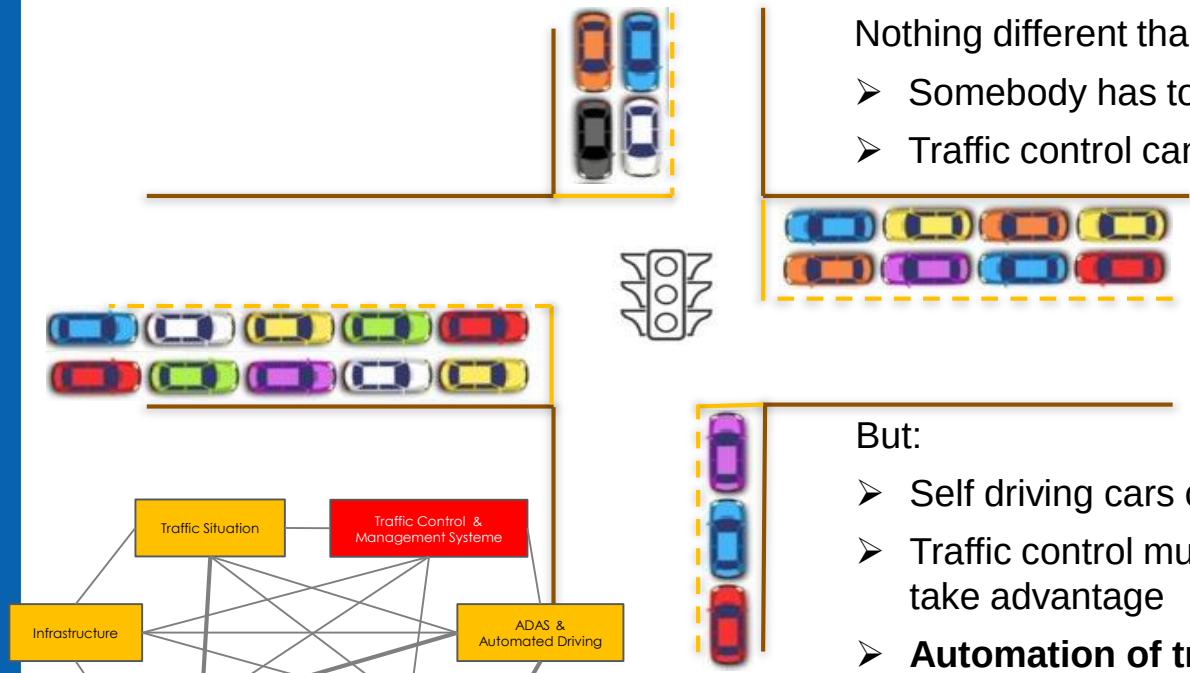

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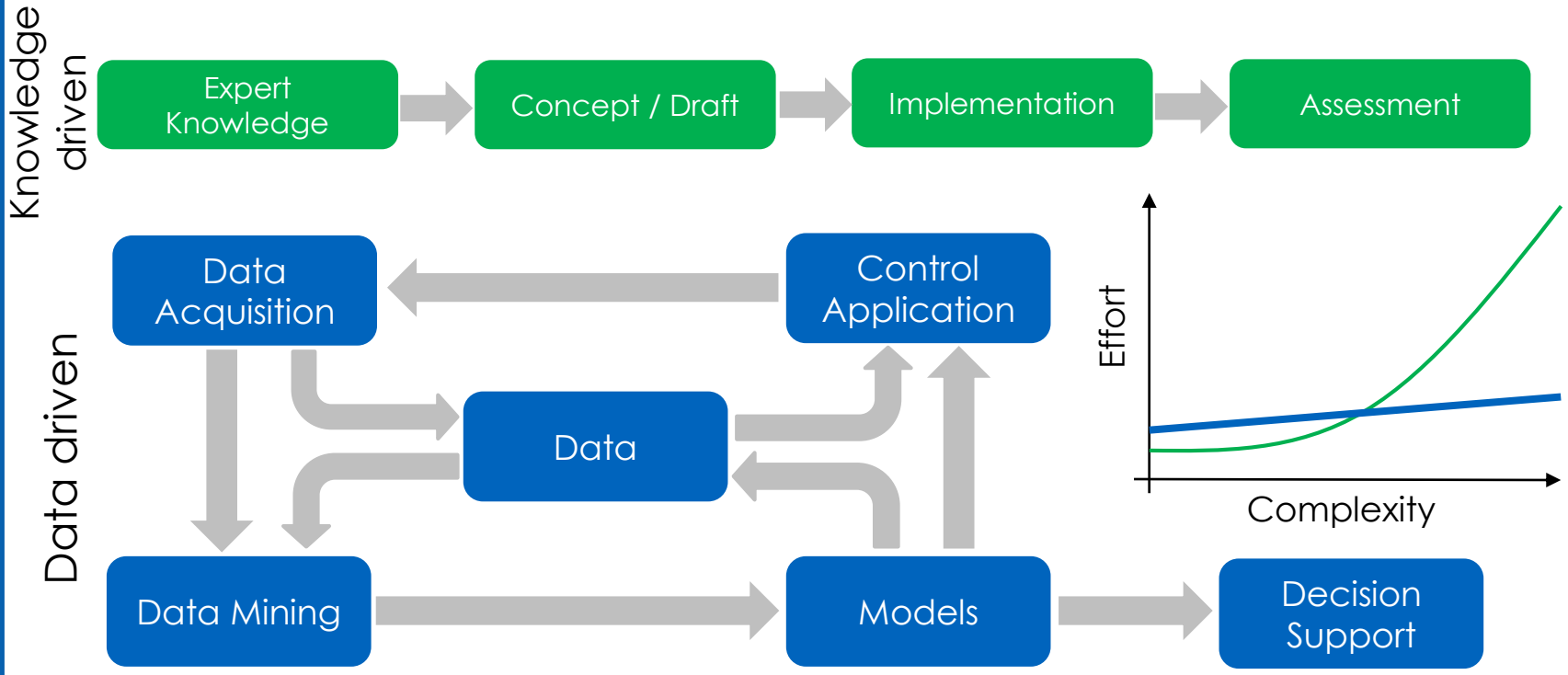
Data Driven and Evidence Based Development Procedure

- Overwhelming complexity requires new development and testing paradigms



- Open test fiels as common playground for all disciplines

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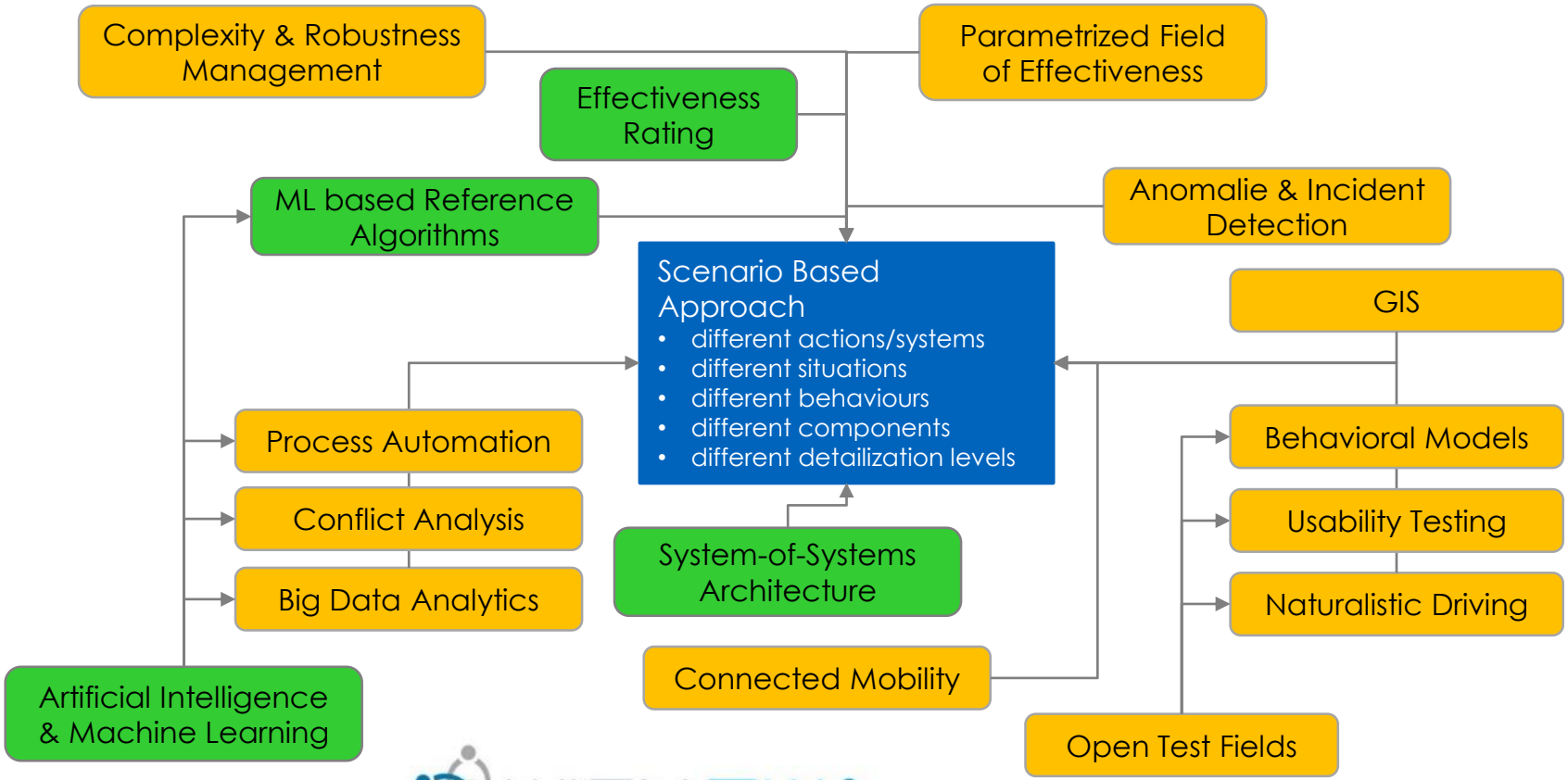
Dependent Methods for Automated Driving Development



WIEN ZWA
ZUKUNFT WIRD AUTOMATISIERT

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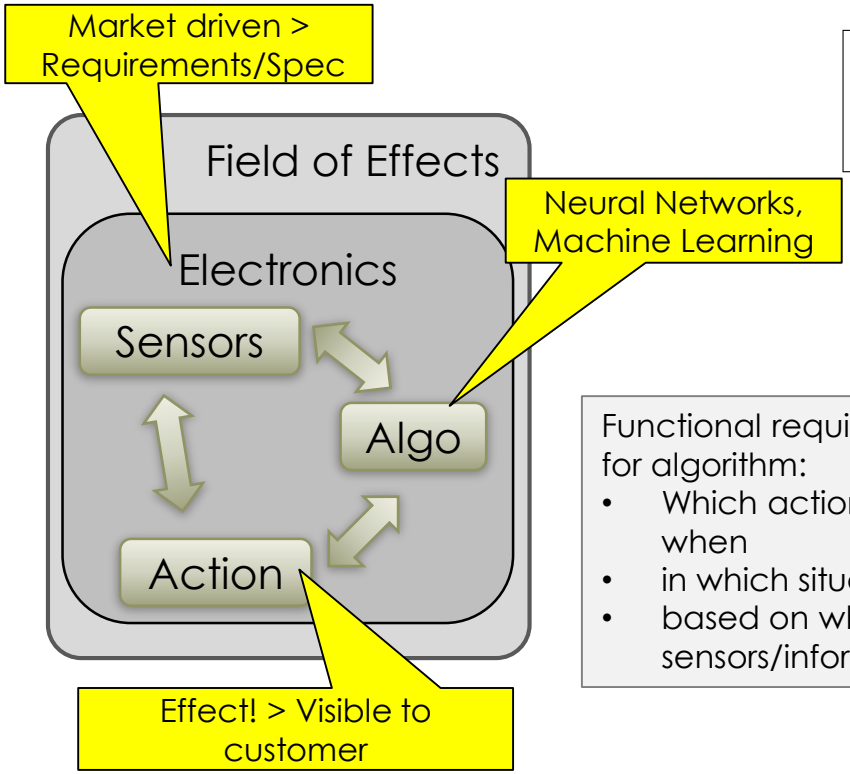
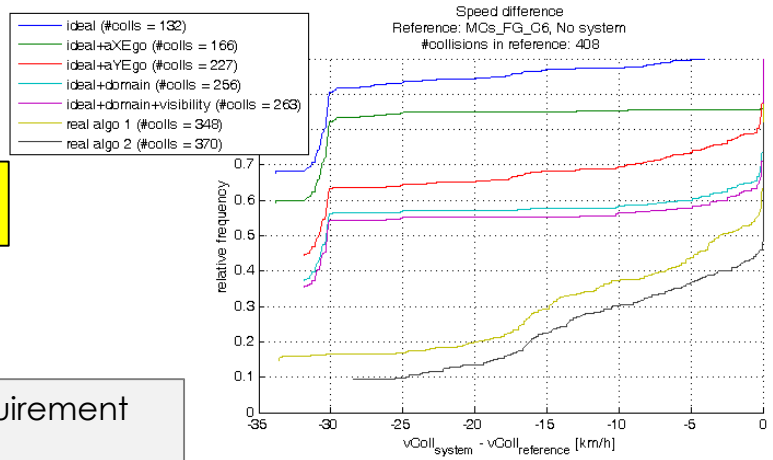
Evaluation and Rating of the Systems and Components

- Evaluation of effectiveness accompanying the product development process





Functional requirement for algorithm:

- Which action to take when
- in which situations
- based on which sensors/information

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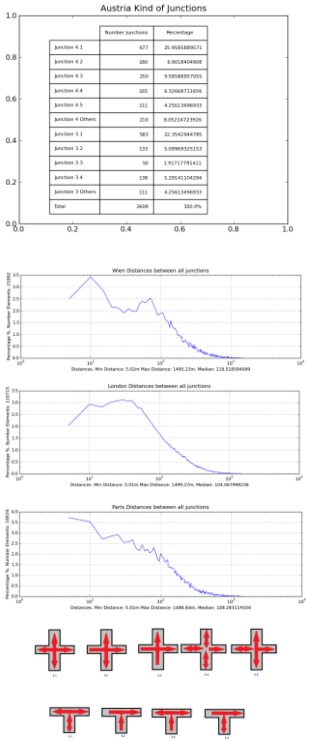
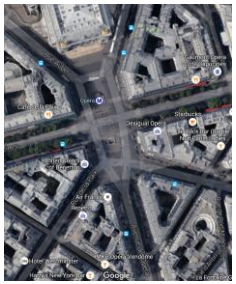
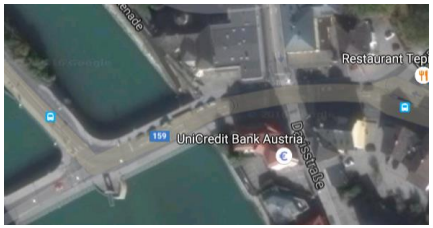
Scenario Management and Automated Design/Development of According Actions







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