

Felix Fahrenkrog

Detroit
September 11th, 2014

Adapt//Ve

*Automated Driving Applications and
Technologies for Intelligent Vehicles*

Evaluation of Automated Driving

ITS World Congress 2014






// Content

- Test and Evaluation
- AdaptIVe: SP „Evaluation“
 - Technical Assessment
 - Safety Impact Assessment



// Test and Evaluation

Selection of Tools and Methods

Tool	Application			 WORLD
Field Operational Test	<ul style="list-style-type: none"> Impact assessment in reality Assessment of behaviour/components/systems 	R	R	R
Controlled Field	<ul style="list-style-type: none"> Assessment of components and systems Assessment of driver behaviour 	R	R	R \ V
Dynamic Driving Simulator	<ul style="list-style-type: none"> Assessment of driver behaviour Human machine interaction 	R	V	V
Simulation	<ul style="list-style-type: none"> Virtual layout and assessment Potential impact assessment 	V	V	V

R: Real, V: virtual

// Adaptive Project

- **Duration:** January 1, 2014 - June 30, 2017
- **Coordinator:** Volkswagen Group Research
- **Consortium:** 29 partners from 8 countries - France, Germany, Greece, Italy, Spain, Sweden, The Netherlands, United Kingdom; including 11 OEMs, 4 suppliers, 11 research institutes and universities, and 3 SMEs
- **Research Budget:** EUR 25 million

Legal issues, terminology



Automated driving close distance manoeuvring



Strategies for human-vehicle integration



Automated driving in urban environment



New evaluation methods, impact assessment

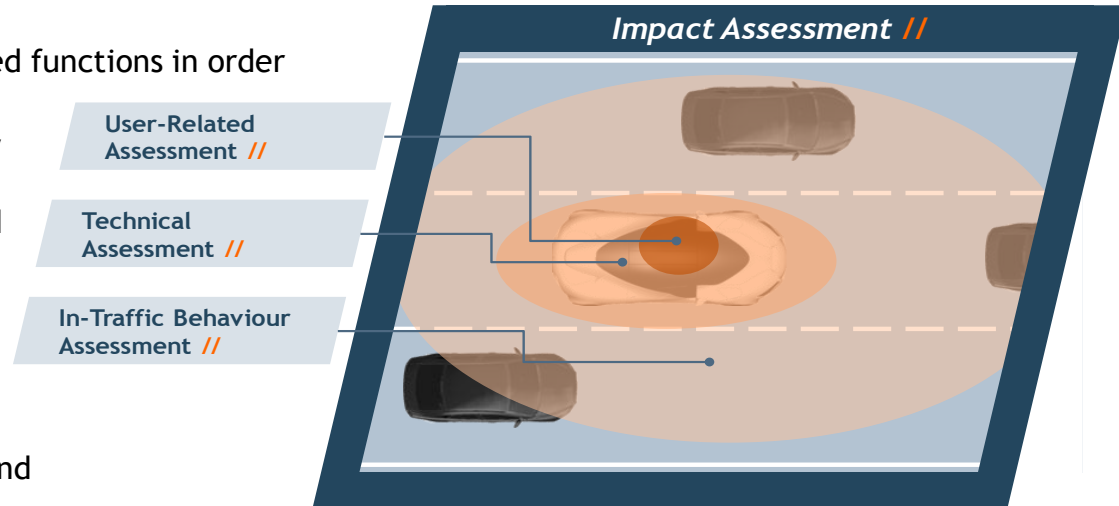


Automated driving on highway

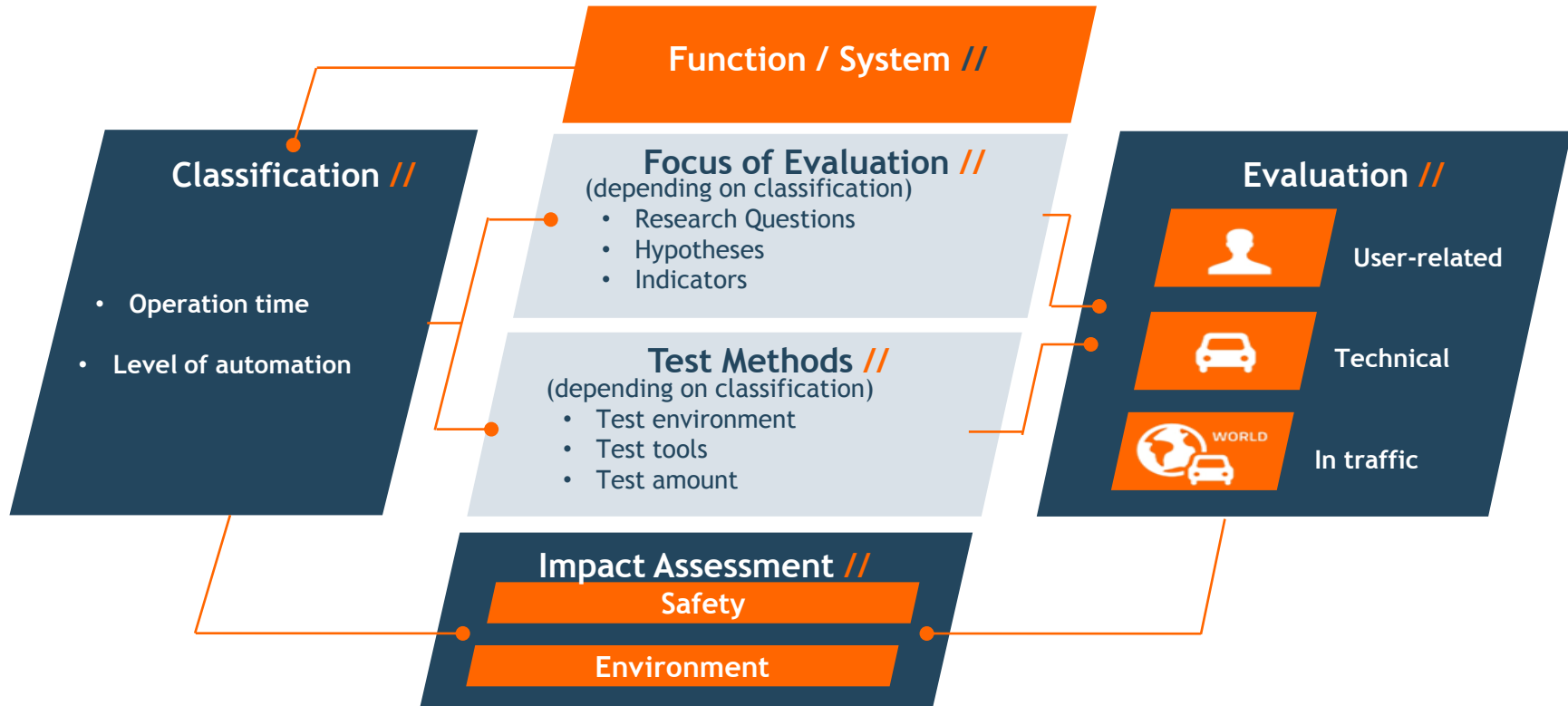


// Adaptive - SP „Evaluation“

- Main objectives:
 - Development of an evaluation framework for automated driving systems
 - Methodology for impact analysis of automated driving systems
- Detailed objectives:
 - Apply developed methods on selected functions in order to verify the evaluation methods
 - Benefit analysis with focus on safety and environmental impact
 - > Derive first recommendations and results on the impact of automated driving applications
- Partners:
 - ika, BMW, CRF, BASt, TNO, CTAG, Lund



// Adaptive - Evaluation Approach



// Technical Assessment Evaluation Approach


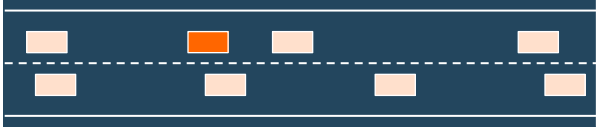
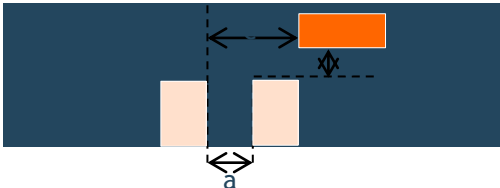
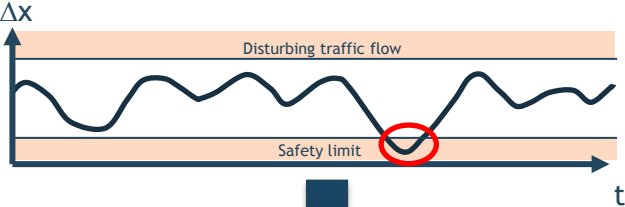
Classification of automated driving functions:

- **Event based operating**
 - Function that is only active for a short period in time (typically vehicle stands still at the end or the automated driving ends)
 - Examples: Parking, Minimum Risk Manoeuvres
- **Continuously operating**
 - Function that is active for a longer period in time (typically vehicle is still moving at the end of an manoeuvre respectively automated driving is continued)
 - Example: Highway Pilot



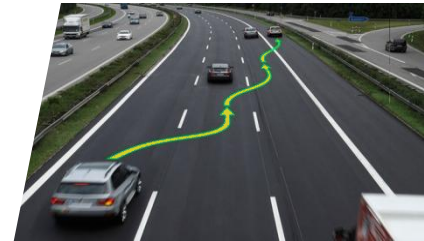
<http://www.kurfuerstenbad-amberg.de>, www.welt.de/

// Technical Assessment Evaluation Approach

	Event Based Operating	Continuously Operating
Example		
Main focus of the evaluation	 <p>Use Case</p>	
Definition of hypotheses	 <p>Test Case</p>	
Definition of test scenarios		
Evaluation criteria		<ul style="list-style-type: none"> ▪ Relevant Situation detected per driven distance / driving time ▪ Decide on the severity

// Safety Impact Assessment

- Classical approach for ADAS
 - Scenario based approach
 - Accident data are analysed
 - Certain accidents are reconstructed and re-simulated accident considering function under study
 - Effect is determined by comparison of accident consequences with and without the function
- Approach for automated driving
 - Open issues
 - Today's accident data do not consider collisions of automated vehicles
 - Automated driving function operated already before a critical situation occurs
 - Consider different driving situations and not only accidents
 - Analyse how the traffic flow is affected by means of simulations
 - Identify (new) critical situations and analyse them



// Summary

- Different evaluation methods and tools are known today for the evaluation of ADAS
- Evaluation approaches for the technical and safety impact assessment in Adaptive have been described
- Classification of functions in event-based and continuously automated driving function for the evaluation



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Felix Fahrenkrog
Institut für Kraftfahrzeuge,
RWTH Aachen University
Mail: fahrenkrog@ika.rwth-aachen.de
Phone: +49 241 80 25627

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Thank you.

