

# interactive



Accident avoidance by active intervention for Intelligent Vehicles

[www.interactIve-ip.eu](http://www.interactIve-ip.eu)

**Images in mind – Design metaphor and method to classify driver distraction in critical situations**

**Stefan Griesche**

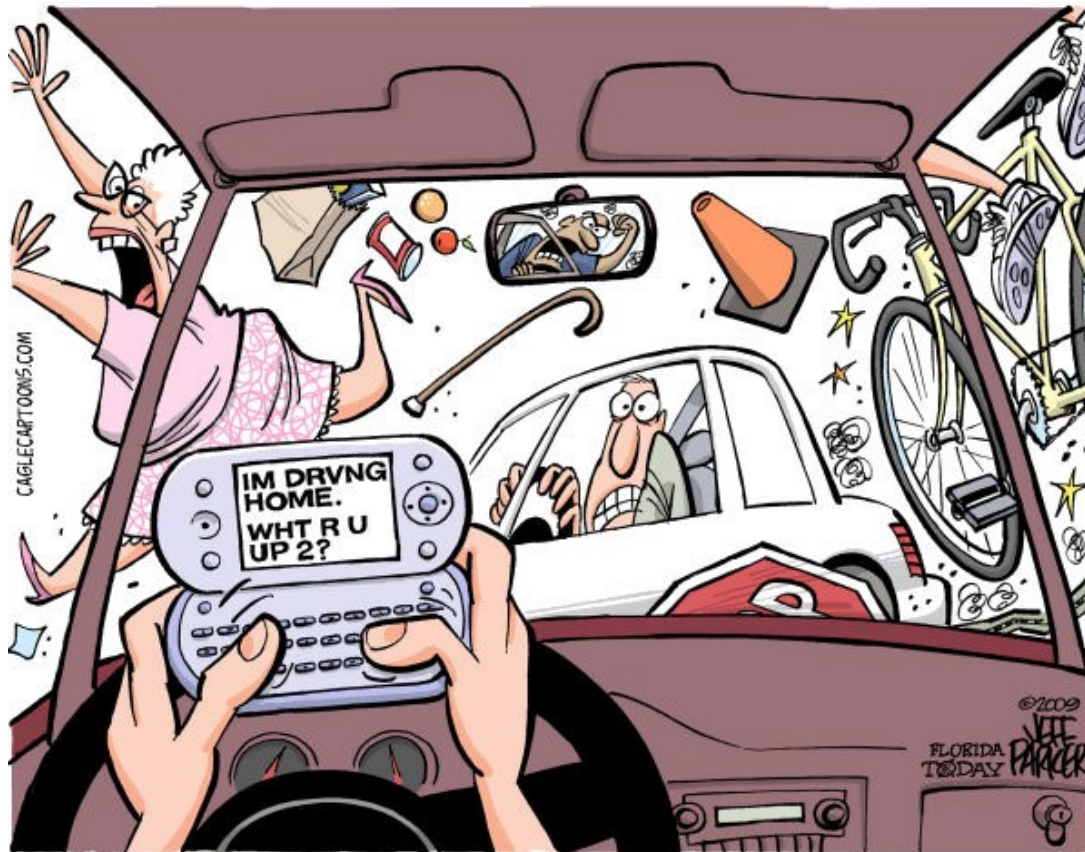
**German Aerospace Center (DLR)**

# Motivation: Emergency situations



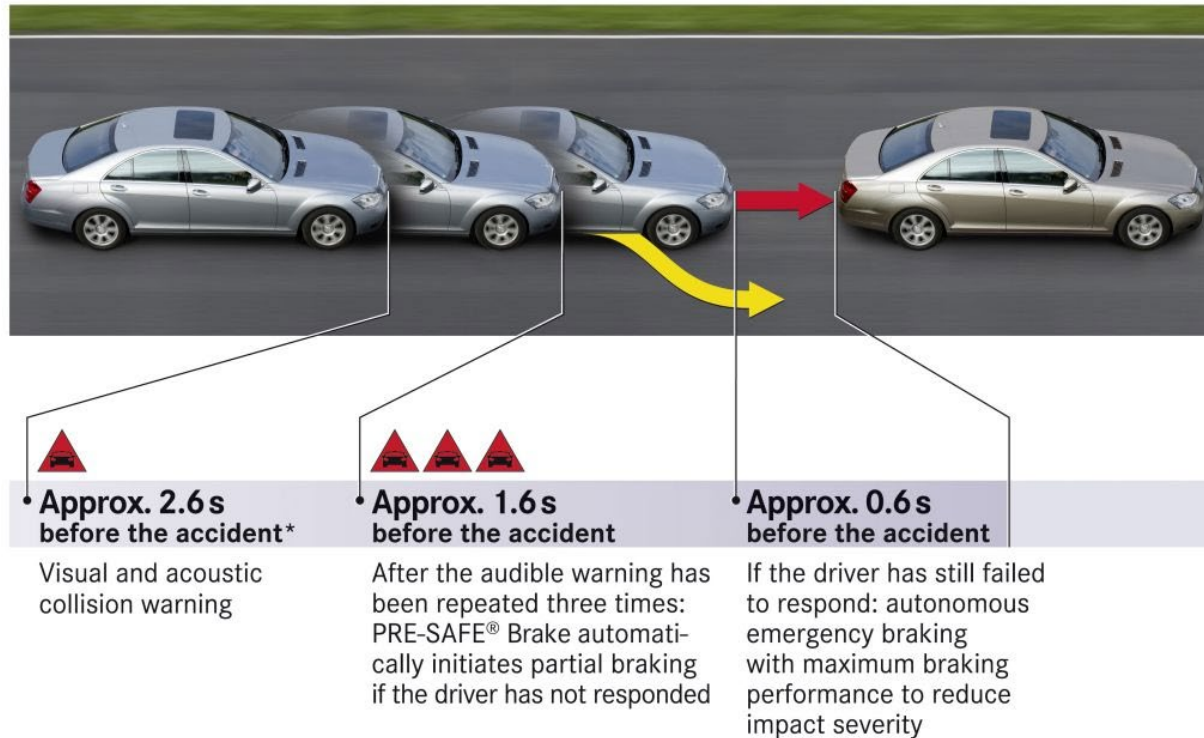
Source: [http://www.ur.ch/dl.php/de/508e4e41b1320/foto\\_mb\\_27\\_03\\_10\\_a2\\_auffahrunfall\\_03%5B1%5D.jpg](http://www.ur.ch/dl.php/de/508e4e41b1320/foto_mb_27_03_10_a2_auffahrunfall_03%5B1%5D.jpg)

# One reason - distraction



Source: <http://www.cagle.com/category/cartoonist/page/155/>

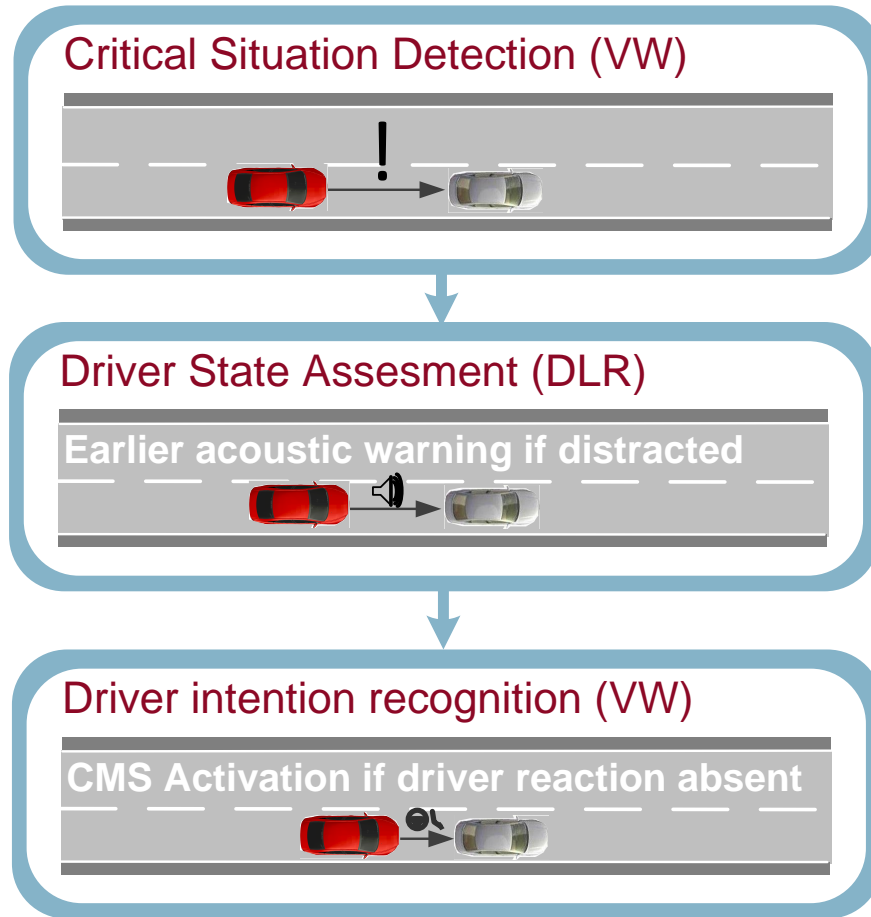
# Technical solution: Collision Mitigation Systems



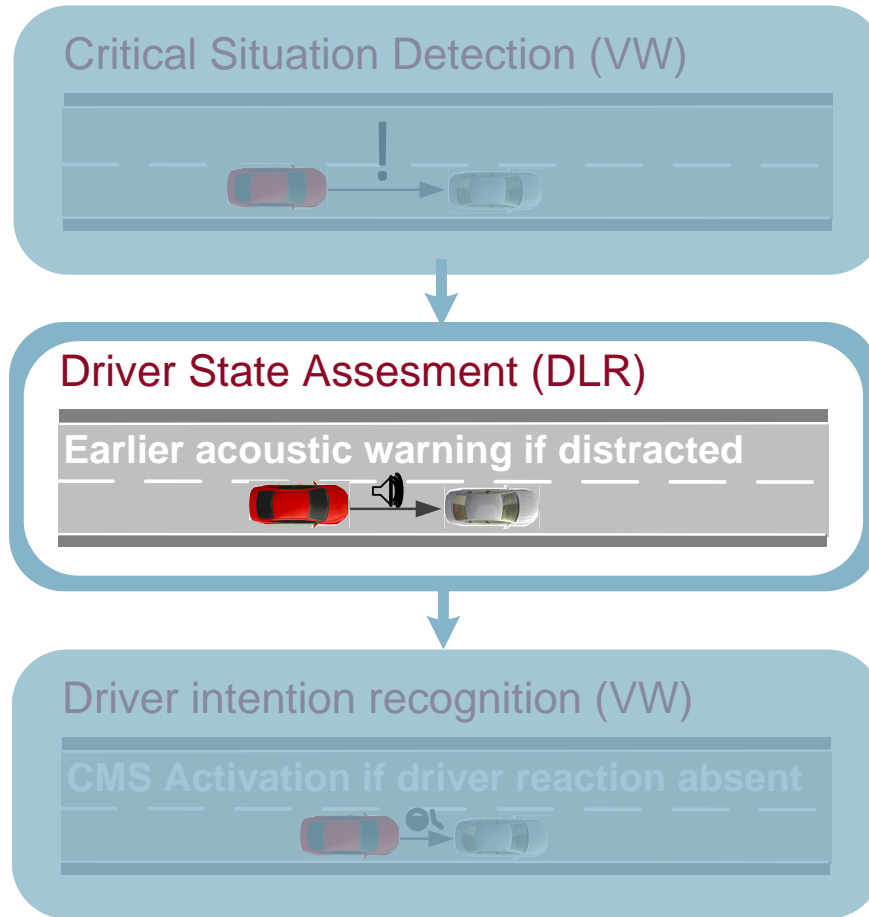
\*Time calculated by the system until the impact where the relative speed remains unchanged

Source: <http://www.mercedesclass.net/wp-content/uploads/2011/08/713966.jpg>

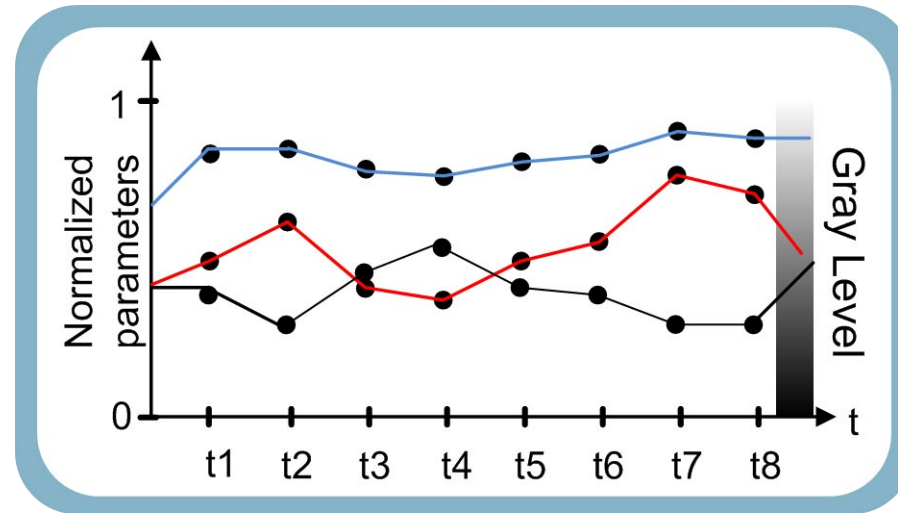
# interactiVe approach: Driver-adaptive CMS



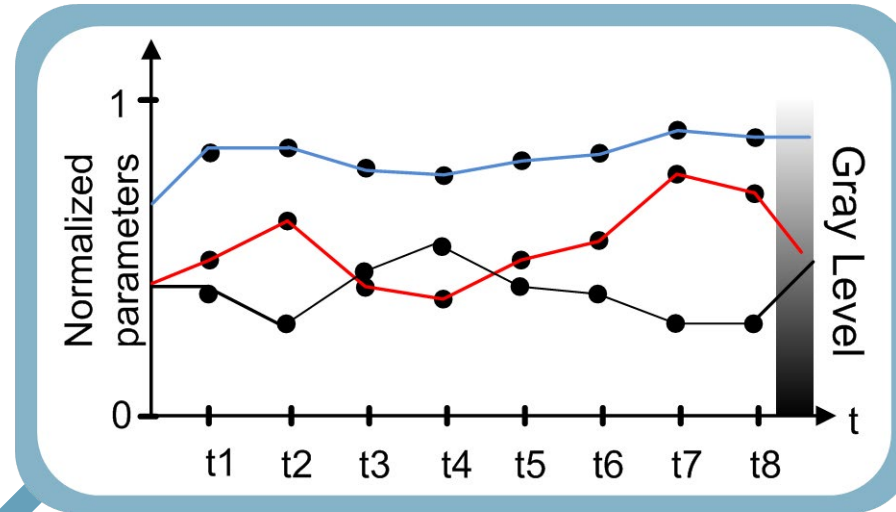
# Focus: Driver State Assessment



# Starting point: Driving behavior as multivariate time series



# Driving behavior as data matrix

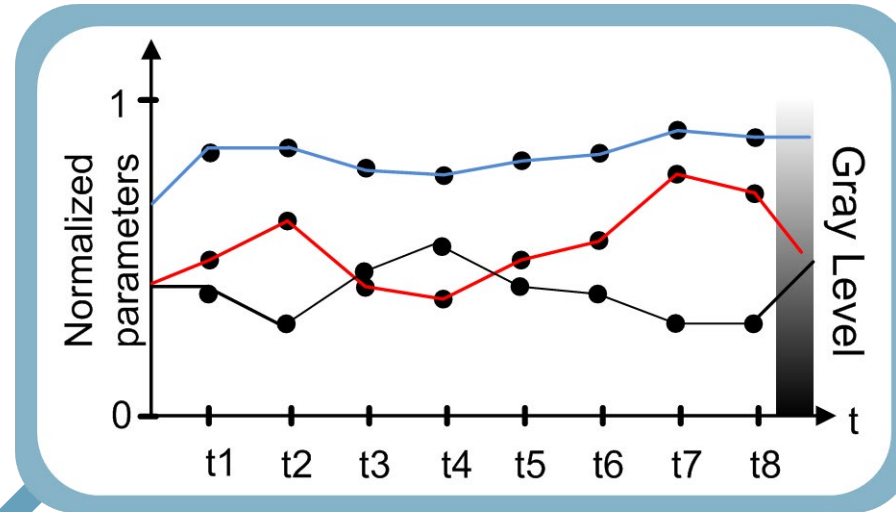


Data Matrix

$$\begin{pmatrix} A(t_1) & A(t_2) & A(t_3) & A(t_4) & A(t_5) & A(t_6) & A(t_7) & A(t_8) \\ B(t_1) & B(t_2) & B(t_3) & B(t_4) & B(t_5) & B(t_6) & B(t_7) & B(t_8) \\ C(t_1) & C(t_2) & C(t_3) & C(t_4) & C(t_5) & C(t_6) & C(t_7) & C(t_8) \end{pmatrix}$$



# Driving behavior as data matrix

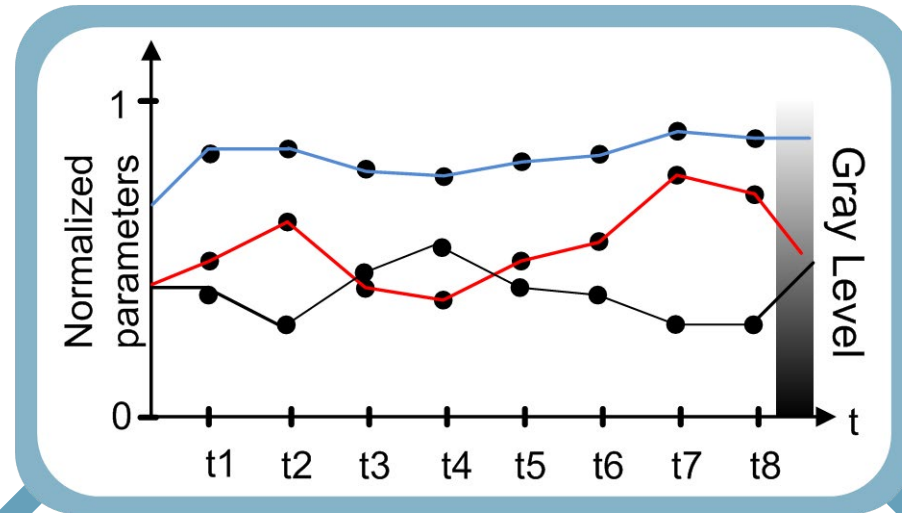


Data Matrix

~~$$\begin{pmatrix} A(t_1) & A(t_2) & A(t_3) & A(t_4) & A(t_5) & A(t_6) & A(t_7) & A(t_8) \\ B(t_1) & B(t_2) & B(t_3) & B(t_4) & B(t_5) & B(t_6) & B(t_7) & B(t_8) \\ C(t_1) & C(t_2) & C(t_3) & C(t_4) & C(t_5) & C(t_6) & C(t_7) & C(t_8) \end{pmatrix}$$~~

Too complex 😊

# Better: Multivariate time series as an image by gray level mapping

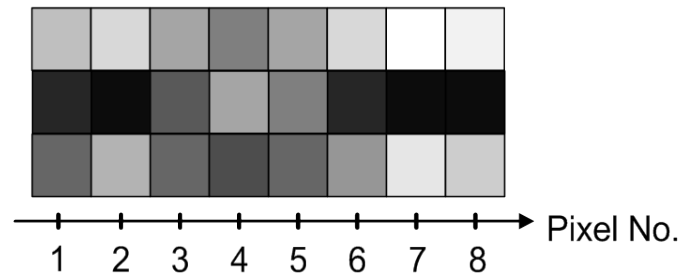


Data Matrix

~~$$\begin{pmatrix} A(t_1) & A(t_2) & A(t_3) & A(t_4) & A(t_5) & A(t_6) & A(t_7) & A(t_8) \\ B(t_1) & B(t_2) & B(t_3) & B(t_4) & B(t_5) & B(t_6) & B(t_7) & B(t_8) \\ C(t_1) & C(t_2) & C(t_3) & C(t_4) & C(t_5) & C(t_6) & C(t_7) & C(t_8) \end{pmatrix}$$~~

Too complex 😊

Data Image



## What's the advantage of a transformation into an image?

1. Possibility to introduce a design metaphor which helps to understand easily the driver model
2. Connection to pattern recognition in image processing

What's the advantage of a transformation into an image?

1. **What I mean in detail and how good it is works...**  
Possibility to produce a design metaphor which helps to understand easily the driver model
2. **“Images in mind – Design metaphor and method to classify driver distraction in critical situations”**  
Connection to pattern recognition in image processing

# Images in mind – Design metaphor and method to classify driver distraction in critical situations

## Bilder im Kopf – Designmetapher und Methode zur Klassifikation von Fahrerablenkung in kritischen Situationen

We are presenting a driver model developed within the EU-project interactIVe which classifies visual distraction based on the detection of abnormal driving behavior. The model forwards the information to a Collision Mitigation System and activates an acoustic warning in case of distraction up to 300 ms earlier.

Since the model requires information regarding normal driving behavior to do this, we introduced a design metaphor, focused on using human memory and its ability to construct mental representations. Based on the idea of interpreting multivariate

time series as gray-level images, we adapted the concept of mental images for learning situation-based normal behavior.

The model transformed the property of long-term memory to store, interfere and forget prototypes of mental images. During driving, we compared the prototypical images stored with the current image to obtain a distraction index. If this index exceeded a certain threshold, the warning was actuated. The driver model was evaluated in a simulator study where the system improvement could be shown.

