Transmitted by the experts from The International Automotive Lighting and Light Signalling Expert Group (GTB)

Informal document GRE-82-40
(82nd GRE, 22-25 October 2019, agenda item 04)

DRIVER ASSISTANCE PROJECTIONS

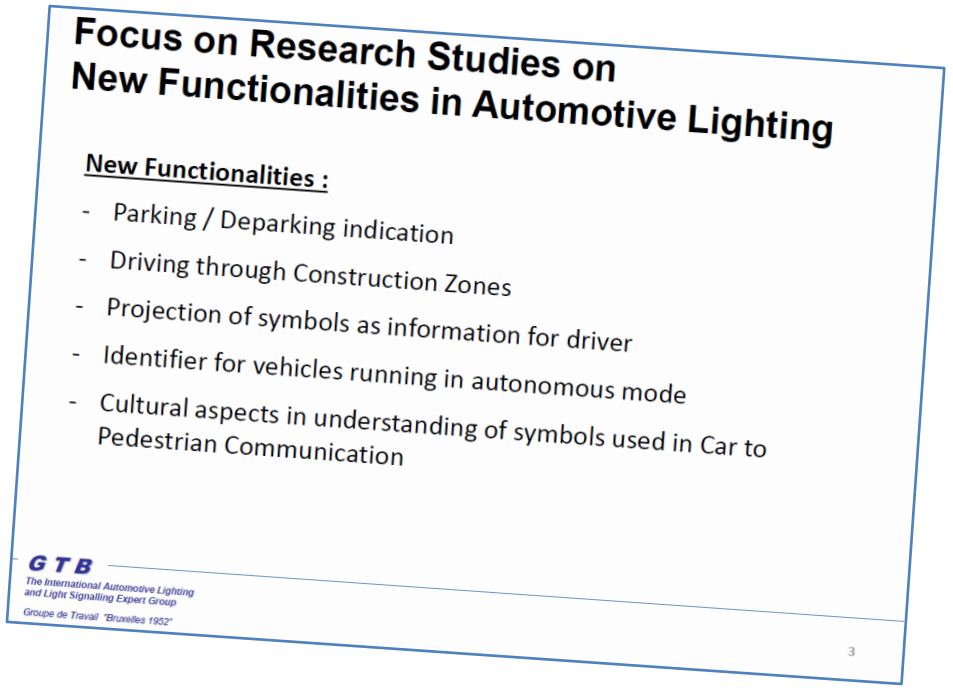
GTB Presentation to support
informal document GRE-82-04

GTB Ref. CE-5655

Introduction

Review: Following on from GRE-81-23 – GTB Activity Report

- One of the main GTB working areas is: **New Lighting Functions**
- GTB has initiated and supported **independent research studies** by universities and institutes to investigate if a new function provides safety benefits, is a comfort feature and provides important information to the driver and to other road users.
- The studies also investigate whether a new function is disturbing or confusing other road users.
- Two topics from the research studies are **communication** and **driver assistance**.



Agenda

1. High resolution adaptive front lighting systems

Driver Assistance Road Projections

a) Concepts

b) Results of scientific studies

2. Demonstration

Assistance Road Projections under real driving conditions,

from 7:00 pm (3 test cars available)

High Resolution Technology
Assistance Road Projections

high resolution matrix (additional): 20.000 … 1,3 Mio pixels

assistance road projection area

base light

standard matrix light

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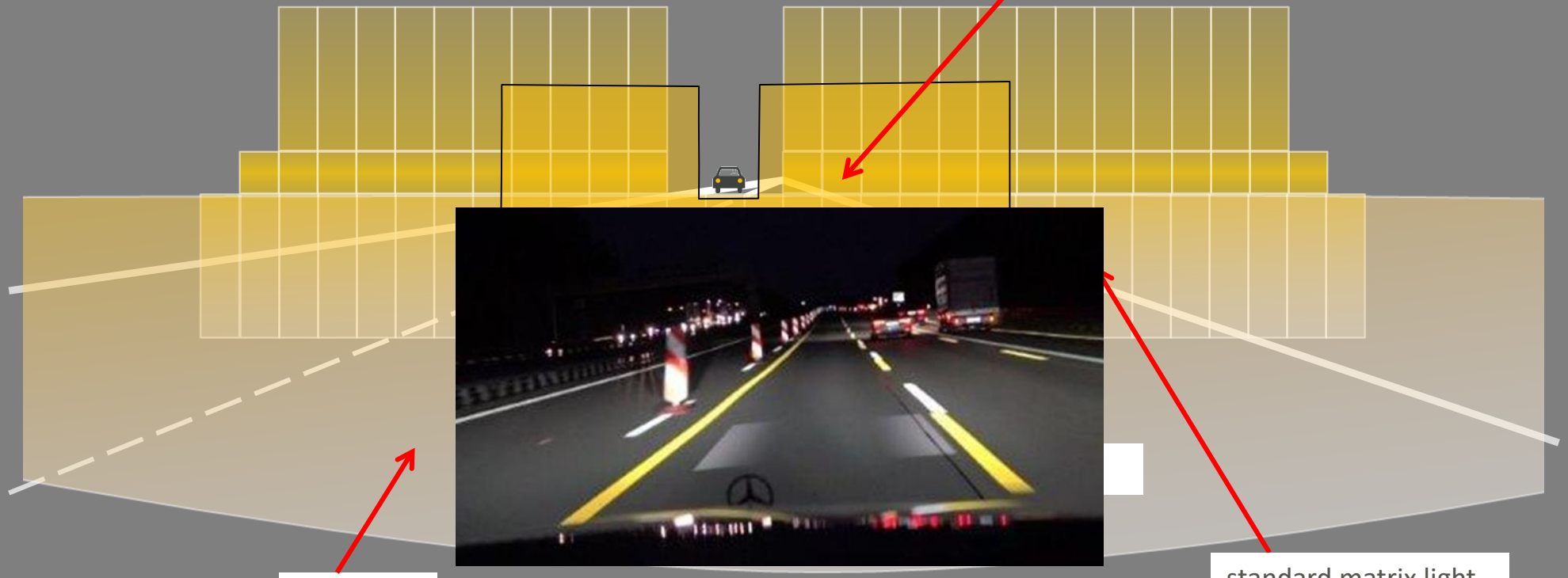
High Resolution Technology
Assistance Road Projections

high resolution matrix (additional): 20.000 … 1,3 Mio pixels



base light

standard matrix light

Assistance Road Projections
History: 1st Patent Application

Nr. 169206 Klasse 126 b

SCHWEIZERISCHE EIDGENOSSENSCHAFT

EIDGEN. AMT FÜR GEISTIGES EIGENTUM

PATENTSCHRIFT

Veröffentlicht am 1. August 1934

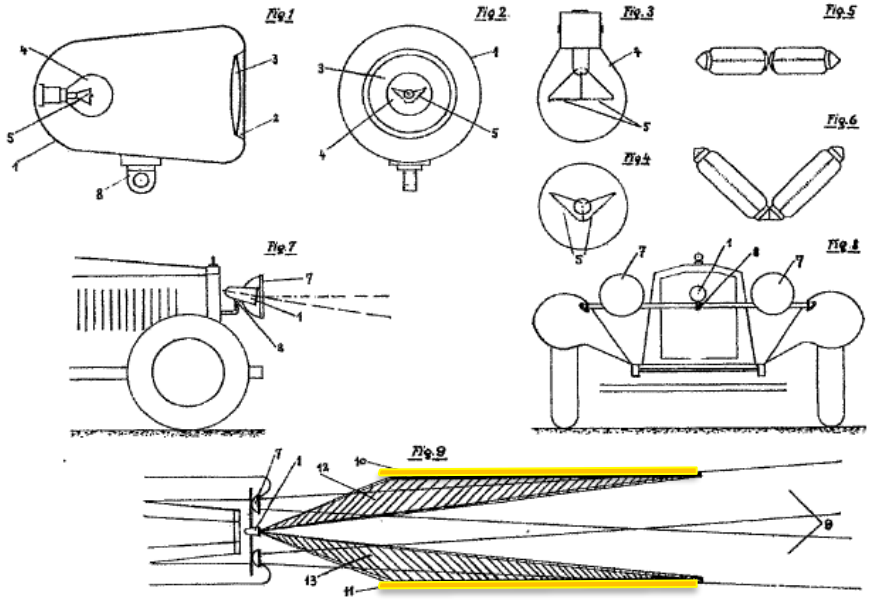
Gesuch eingereicht: 19. November 1932, 13 Uhr. — Patent eingetragen: 15. Mai 1934.

HAUPTPATENT

Ottmar RALL, Zürich (Schweiz).

Spurlichtprojektor an Kraftfahrzeugen.

1932



The idea of road projections is not new !

„….guidelines indicating the width of the car……“

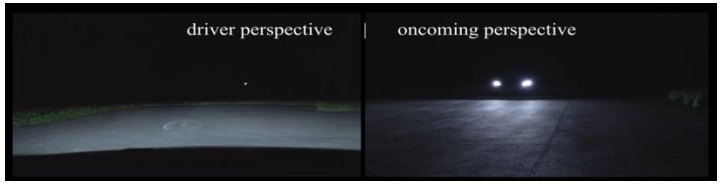
Examples for Assistance Road Projections

1 guiding elements

2 collision warning

3 speed limit warning

4 view of oncoming driver



Driver Assistance Projections

- Driver assistance road projections: To **assist the driver** of the system vehicle in preventing or solving specific traffic situations or conditions, **without negatively affecting any other road user**.

- Already a batch of **studies has been carried out from 2016 - 2019**

Research on Road Projection Applications

Status: September 2019

Budanov, M., Prof. Dr. Cornelius Neumann, Karlsruhe Institute of Technology:
Front Lighting System – Future Communication with the Driver, Vision Conference Proceedings, Paris, 2016.

Budanov, M., Prof. Dr. Cornelius Neumann, Karlsruhe Institute of Technology:
Success of Driver Assistance throught Light Projections on the Road, ISAL Symposium, Darmstadt, 2019.

Budanov, M., Prof. Dr. Cornelius Neumann, Karlsruhe Institute of Technology:
Road Projections as a new and intuitively understandable Human Maschine Interface, Advanced Optical Technologies (pp77 – 84), 2019.

Hamm, M.: **Glare Investigations and Safety Research on Digital Light Technologies**, SAE Congress, Detroit, 2019.

Hamm, M.: **Real Driving Benefits and Research Findings with Digital Light Functions**, ISAL Symposium, Darmstadt, 2019.

Krieft, E., et al.: **Symbole projection: Gain or Gadget?** Research Institute of Automotive Lighting and Mechatronics, Germany, 2019.

Polin, D.; Prof. T. Q. Khanh**: Research on Headlamps with High Resolution Projection Modules,**
Technical University Darmstadt, ATZ, 2018.

Polin, D.; Prof. T. Q. Khanh**: Investigation on Road Projection of Traffic Sign, Technical University Darmstadt,**
internal study, 2018.

Rosenhahn, E.-O.: **New Systems for Safety and Comfort Improvement by High Resolution Flexibility**, Vision Congress, Paris, 2018.

Rosenhahn, E.-O.; Link, F.: **Traffic Safety Benefits provided by High Resolution Headlamp System,** ISAL Symposium, Darmstadt, 2019.

Research on Road Projection Applications

Status: September 2019

Aspects investigated in the field tests:

- **Distraction potential for other road users** by assistance road projections

- **Effect of guideline projections on the driving behaviour**

- **Glare investigation on wet roads** by assistance road projections

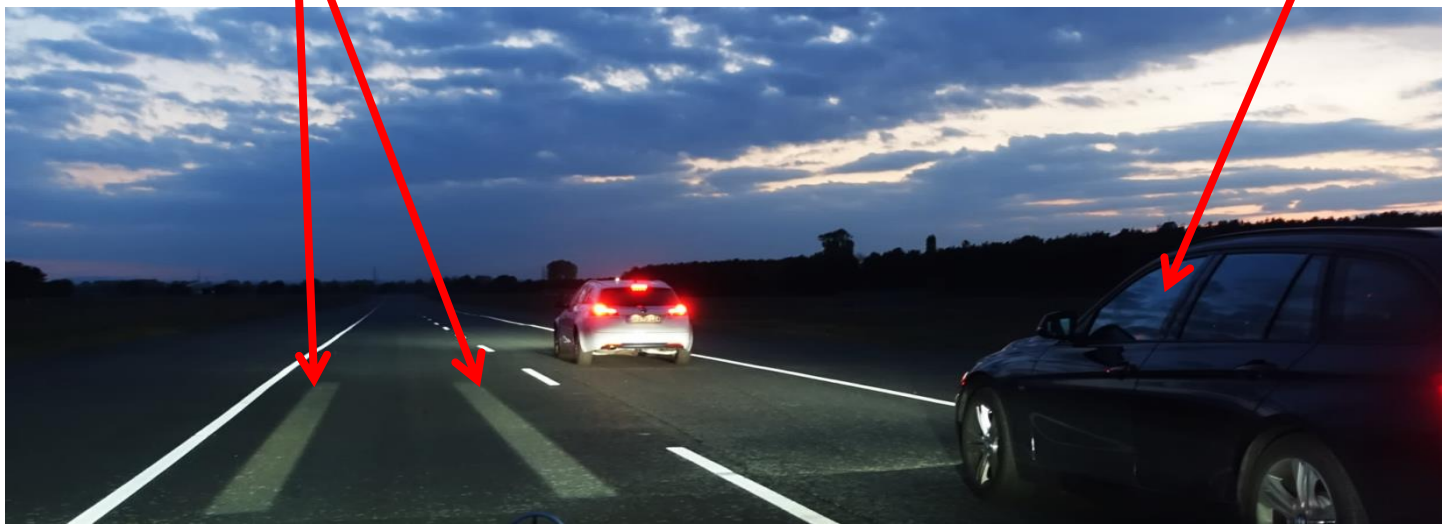
- **Warning effectiveness (collision warning, ice warning, …)** by assistance road projections

Scientific Investigations (TU Darmstadt, 2017)
Potential for Driver Distraction by Road Projections

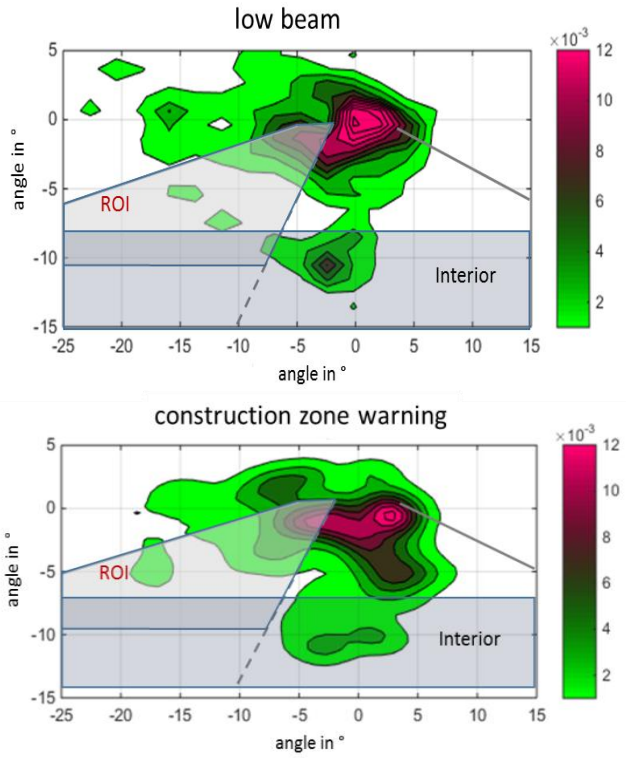
TECHNISCHE UNIVERSITÄT DARMSTADT

road projections:
- snow flake (ice warning)
- construction zone warning
- **guidelines for construction zones**

test subject:
Fixation-behaviour, -time (eye mark camera)



driver‘s fixation behaviour



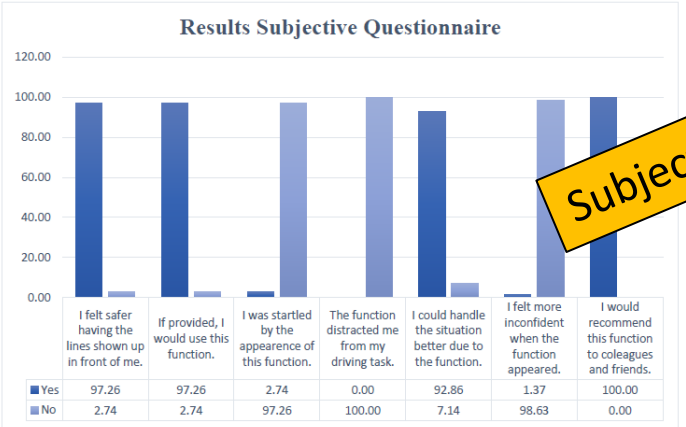
Result: „The investigated assistance road projections have no significant influence on the fixation behavior of other drivers and do not lead to distraction of other road users.“

Driver Assistance Road Projections
Studies and Benefits (Karlsruhe Institute of Technology)

	Low Beam	Guiding Light	Δ	
Mean velocity	55.43 km/h	63.71 km/h	+ *8.28*	*.92*
Summed up steering motion	3.86 °	2.55 °		*- 34.28*
Mean steering velocity	0.35 °/s	0.29 °/s		*- 15.72*

	Low Beam → Low Beam	Lo	ding Light → Low Beam	Guiding Light → Guiding Light
Increased velocity (Δ)	+ 2.54 km	km /h	+ 0.65 km /h	+ 7.04 km /h
Decreased summed up steering motion (Δ)		+ 1.53 °	-0.20 °	+ 0.09 °
Decreased steering velocity (Δ)	.05 °/s	+ 0.06 °/s	-0.04 °/s	+ 0.01 °/s
ocity (Δ)	+ 6.98 %	+ 30.37 %	+ 1.06 %	+ 10.61 %
eased summed up steering motion (Δ)	+ 15.00 %	+ 22.61 %	-24.35 %	+ 5.35 %
Decreased steering velocity (Δ)	+ 10.11 %	+ 6.77 %	-25.70 %	+ 2.80 %

Driving behaviour: Analysis of steering wheel amplitude, -speed, etc.



Subjective rating of test subjects

Result: Driver are supported by the road projection to a more confident way of driving.

Assistance Road Projections
Field of Assistance Road Projections

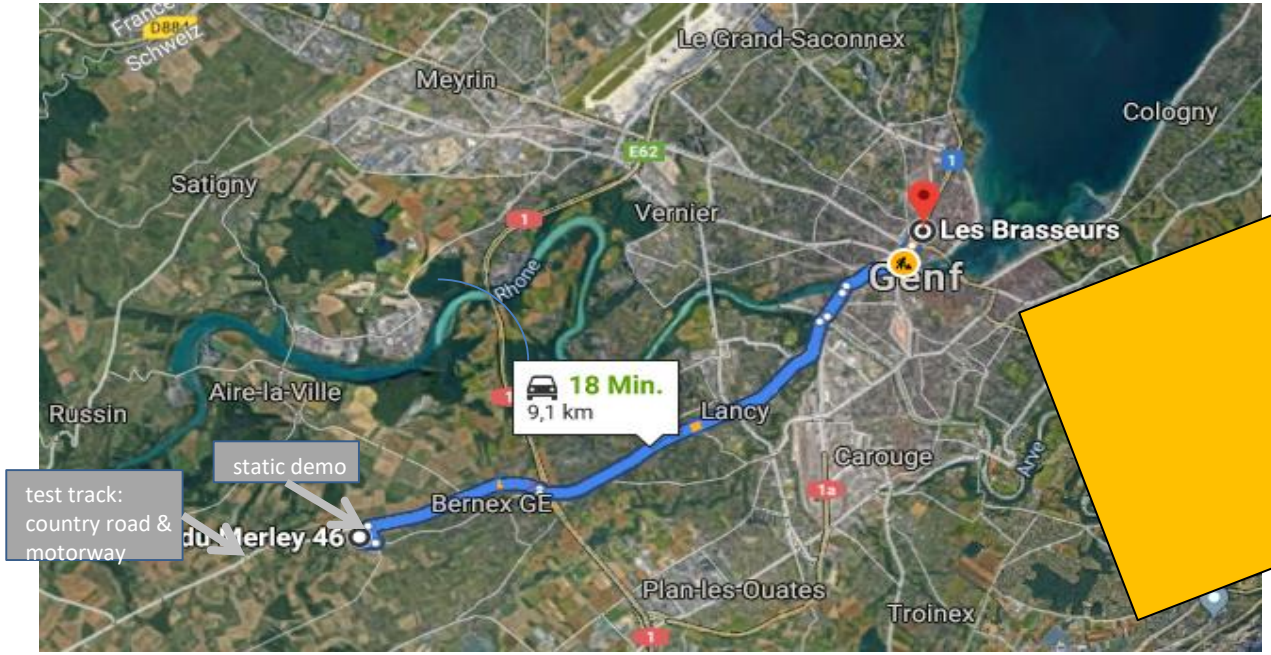
2. Demonstration

Invitation to system demonstration

Demonstration: Road projections under real driving conditions

October 22, 2019, **7:00 pm (3 test cars available):**

Audi, Mercedes, Automotive Lighting



shuttle service:
- start at 7 pm
- every 45 min

2. Meeting Point

Les Brasseurs

Bière artisanale & Restaurant brasserie

Place de Cornavin 20, 1201 Genève

2. Demonstration

Invitation to system demonstration

Demonstration: Road projections under real driving conditions

Geneva: October 22, 2019 7:00 pm (3 test cars available)

Demonstration: Assistance Road Projections
Meeting point: “Les Brasseurs”
each group with 6 people
Total time: about 1 h 15 min

democar with DMD projector system for road projections

Meeting point @ Les Brasseur	#1	#2	#3	#4	#5	#6
7 pm	Name: CP/NGO:					
7:45 pm						
8:30 pm						

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Thank you for your kind attention.