NEW FUNCTIONALITIES IN AUTOMOTIVE LIGHTING – RESULTS OF RECENT RESEARCH STUDIES

汽车照明的新功能 -近期研究成果

DVN, 25TH OF APRIL 2019

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AGENDA 议程

- *INTRODUCTION* 介绍
- *RESEARCH STUDIES ON NEW FUNCTIONALITIES* 新功能研究

  - *PARKING / DEPARKING* 驻车灯 /启动灯

  - *GUIDELINES IN CONSTRUCTION ZONE* 施工区指示灯

  - *SNOWFLAKE* 雪灯

  - *IDENTIFICATION SIGNAL FOR VEHICLES RUNNING IN AUTONOMOUS MODE*

    自主行驶车辆的识别信

  - *CULTURAL ASPECTS IN USING SYMBOLS FOR CAR TO PEDESTRIAN COMMUNICATION*

    使用汽车符号与行人通信交流的文化习惯

- *SUMMARY & OUTLOOK* 概括 &总结

PROJECTIONS SYSTEMS 投影系统

LIGHTING TECHNOLOGY IS GOING TO INTRODUCE HIGH RESOLUTION PROJECTION SYSTEMS IN SERIES PRODUCTION.

照明技术将在系列生产中引入高分辨率投影系统。

TECHNOLOGIES ARE : MICRO-AFS, DMD, MEMS AND OTHER SYSTEMS USING CHIPS FROM 1000 TO MORE THAN A MILLION PIXEL

技术包括： *MICRO-AFS* ，*DMD*，*MEMS* 和 使用芯片从*1000*到*100*多万像素等系统

PROJECTIONS SYSTEMS 投影系统

- *ADDITIONALLY, TO CREATE LIGHT PATTERN FOR AUTOMOTIVE LIGHTING THESE SYSTEMS ALLOW TO PROJECT SYMBOLS, SIGNS ETC. AS INFORMATION TO THE DRIVER ON THE ROAD.*

此外，为了创造汽车照明的照明模式，这些系统允许投射符号、标志等。作为在路上的司机的信息。

- *IN THE LEGISLATION APPROVAL SYSTEM OF ECE WE NEED TO DEFINE SUCH NEW FUNCTIONS TO ALLOW THEM TO APPLY IN SERIES PRODUCTION.*

在欧洲经委会的立法审批制度中，需要明确这类新的功能，以使其适用于系列化生产。

TECHNOLOGY IS READY ， LEGISLATION IS MISSING !!!!!!

科技已成熟，但车灯法规缺失***!!!!!!***

BENEFITS 好处;

- *TO CONVINCE THE AUTHORITIES TO ALLOW NEW FUNCTIONALITES IN THE FUTURE ONE HAS TO HAVE GOOD ARGUMENTS AND DATA SHOWING:* 说服权威机构在未来允许新的功能，就必须有完整的数据来证明:

a) *A SAFETY BENEFIT*有益于安全

b) *A COMFORT FOR THE DRIVER AS A BENEFICIAL INFORMATION*
提供对司机提供有益的信息

c) *A PROOF, THAT THE HELPFUL INFORMATION AND HINT FOR THE DRIVER DOES NOT DISTURB OTHER ROAD USERS*
证明- 对司机有益的资料和提示不会干扰其他道路使用者

- *FOR THIS, ONE HAS TO EXECUTE RESEARCH STUDIES FROM OBJECTIVE AND ACCEPTED INSTITUTES AND UNIVERSITIES.*
要做到这一点，必须从客观的,有权威的研究所和大学进行研究。

RESEARCH 研究

THE FOLLOWING RESEARCH STUDIES HAVE BEEN WORKED OUT FROM VARIOUS INSTITUTES AND UNIVERSITIES :

以下是研究机构和相应的研究项目

- *PARKING / DEPARKING*

  (ELS (EMBEDDED LIGHTING SYSTEMS), PARIS, FRANCE)

- *GUIDELINES IN CONSTRUCTION ZONE*

  (KIT, UNIVERSITY KARLSRUHE, GERMANY)

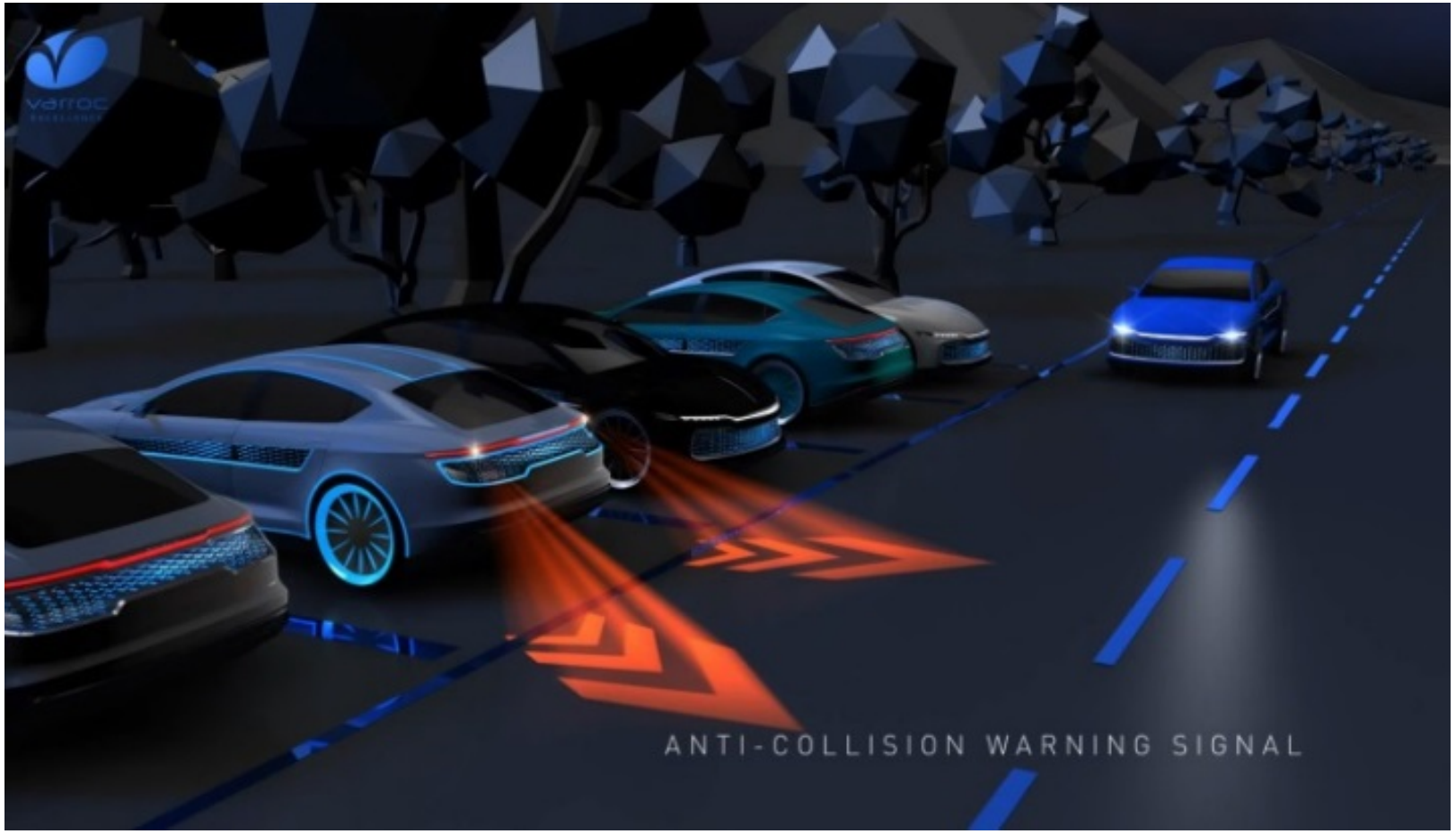
- *SNOWFLAKE (TU DARMSTADT, GERMANY)*

- *IDENTIFICATION SIGNAL FOR VEHICLES RUNNING IN AUTONOMOUS MODE*

- *CULTURAL ASPECTS IN CAR TO PEDESTRIAN COMMUNICATION USING SYMBOLS*

  (TU DARMSTADT, GERMANY)

PARKING/DEPARKING 驻车灯 /启动灯



*PARKING/DEPARKING*驻车灯 /启动灯

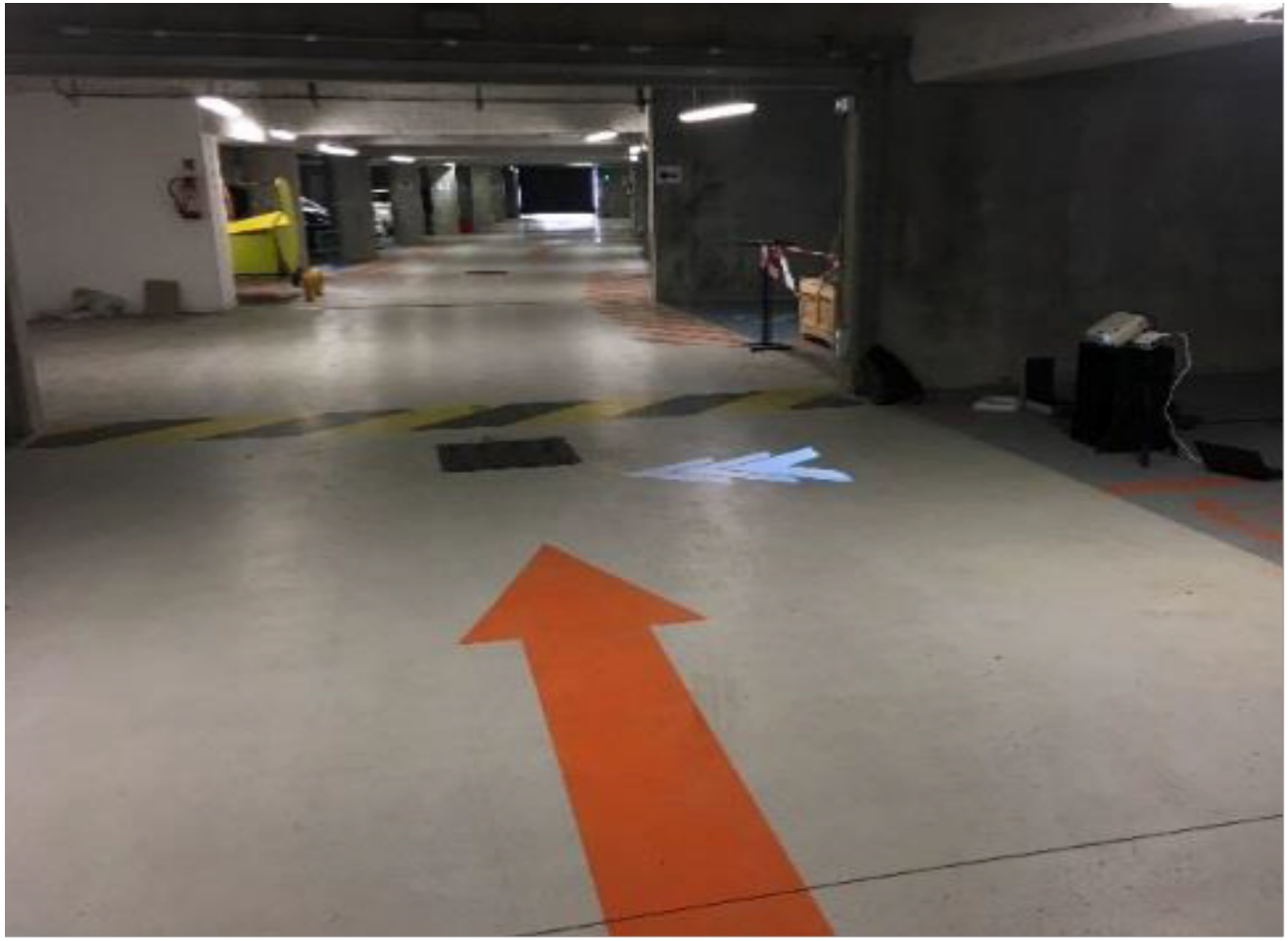
- *STUDY WITH DIFFERENT PROJECTION DEVICES*

  - ***BETWEEN-SUBJECTS PROTOCOL***
  - *NUMBER OF SUBJECTS:* ***31***
  - *AGE:* ***6 SUBJECTS < 40 YO*** *AND* ***25 SUBJECTS > 40 YO***
  - *GENDER:* ***10 WOMEN*** *AND* ***21 MEN***
  - *VISUAL IMPAIRMENT:* ***21 SUBJECTS*** *(66%)*

- *31 SUBJECTS ALL AGES*

- *RESULTS:*
  - *SIGNAL IS VERY MUCH APPRECIATED DURING NIGHT TIME OUTDOOR*
  - *SIGNAL IN HOUSE (GARAGE) ALL DAY AND NIGHT APPRECIATED*
  - *EASY UNDERSTANDING OF THE MEANING OF THE SIGNAL*

DEPARKING: TEST WITH SUBJECTS IN PUBLIC GARAGE

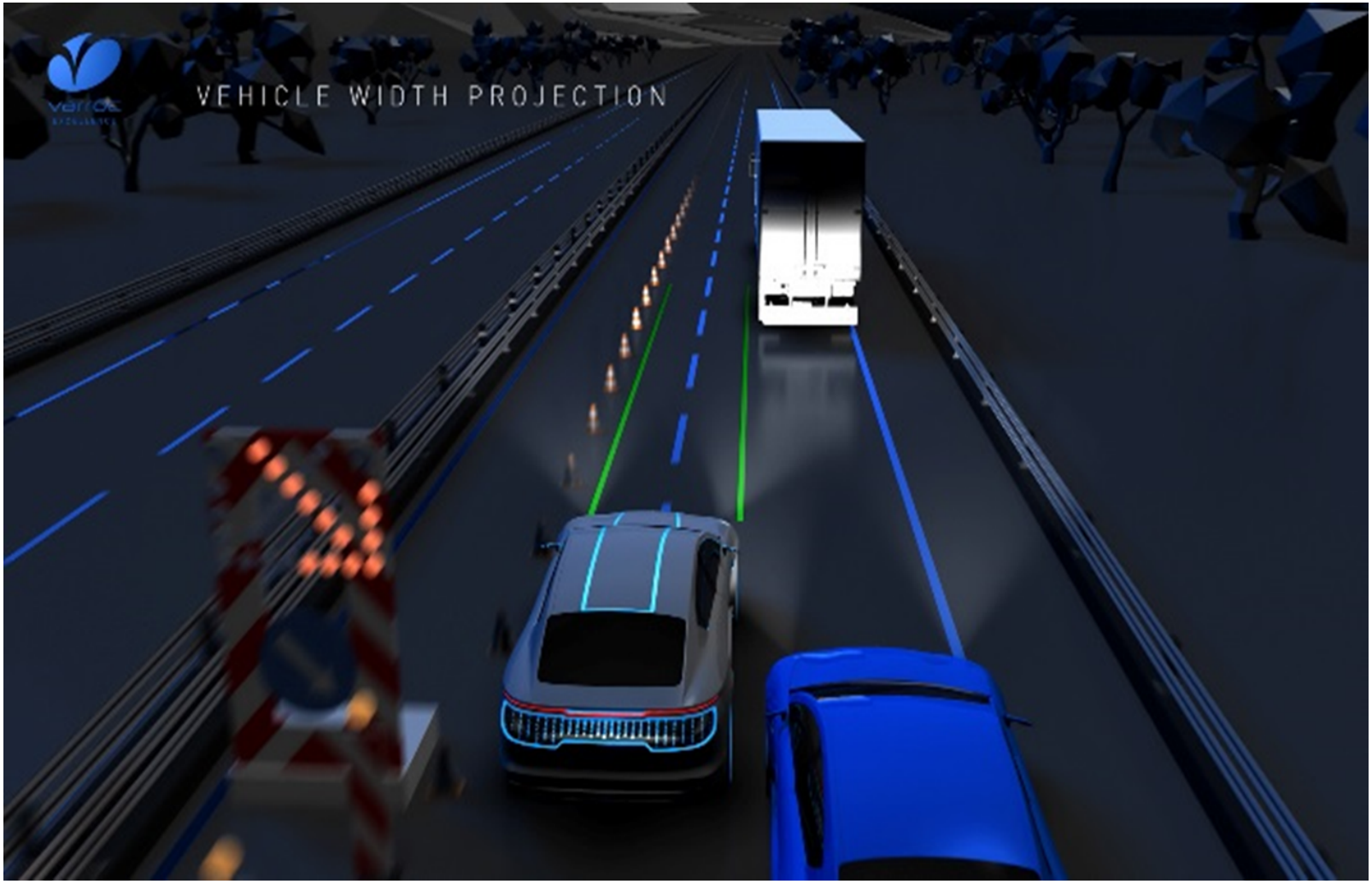


SIGNAL DEPARKING: REAR EXIT

Blinking (2s period – 1s on – 1s off)
White
2500 lux

Ambient Light Level (garage) : app 250 Lx.

GUIDELINES IN CONSTRUCTION ZONES 施工区指引灯



Guidelines in Construction Zone Areas

Daynamic test drive with 80 subjects

Construction zone: guiding lines

M. Budanow, HDT 2018

Dynamic Test Drive Study: Results

Results of first round	Low Beam	Low Beam + Guiding Light	Δ	Δ (%)
Average speed	45.11 km/h	59.78 km/h	+ 15 km/h	+ 33
Total amount of steering wheel angle change	6.37 °	2.02 °	- 4°	- 62
Average speed of steering wheel movement	0.39 °/s	0.30 °/s	- 0.1 °/s	- 26

Average Results (4 rounds)	Low Beam	Low Beam + Guiding Light	Δ	Δ (%)
Average speed	55.43 km/h	63.71 km/h	+ 8.28 km/h	+ 15
Total amount of steering wheel angle change	3.86 °	2.55 °	- 1.31°	- 35
Average speed of steering wheel movement	0.35 °/s	0.29 °/s	- 0.05 °/s	- 16

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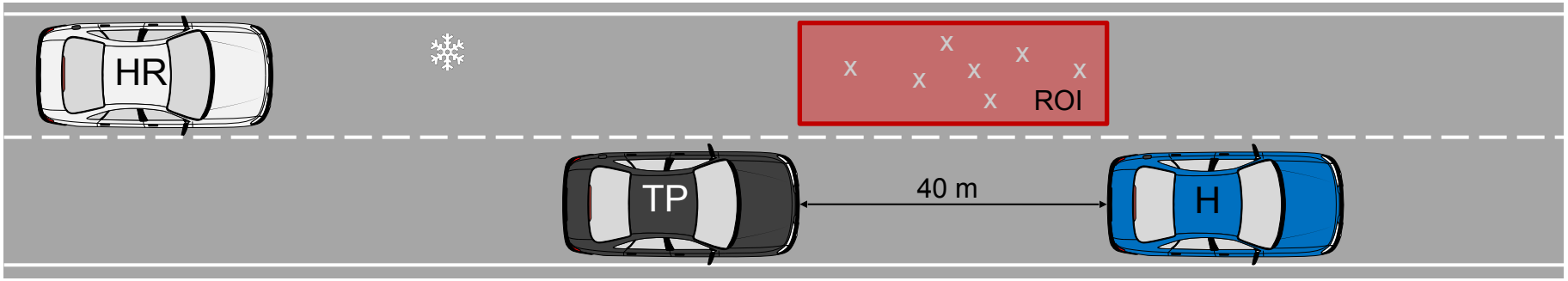
Average Results (10 rounds)	Low Beam	Low Beam + Guiding Light	Δ	Δ (%)
Average speed	55.43 km/h	63.71 km/h	+ 8.28 km/h	+ 15
Total amount of steering wheel angle change	3.86 °	2.55 °	- 1.31°	- 35
Average speed of steering wheel movement	0.35 °/s	0.29 °/s	- 0.05 °/s	- 16

CASE 1: *VEHICLE WITH HIGH RESOLUTION HEADLIGHTS PROJECTS SYMBOLS WHILE OVERTAKING OTHER VEHICLES*

HR (HIGH RESOLUTION) VEHICLE PROJECTING A SNOWFLAKE



HR VEHICLE

-OVERTAKING @ 100 KM/H

-RANDOM ORDER

- *SNOWFLAKE*
- *GUIDING LINES*
- *CONSTRUCTION SITE*
- *LOW BEAM*

TP(TEST PERSON) VEHICLE

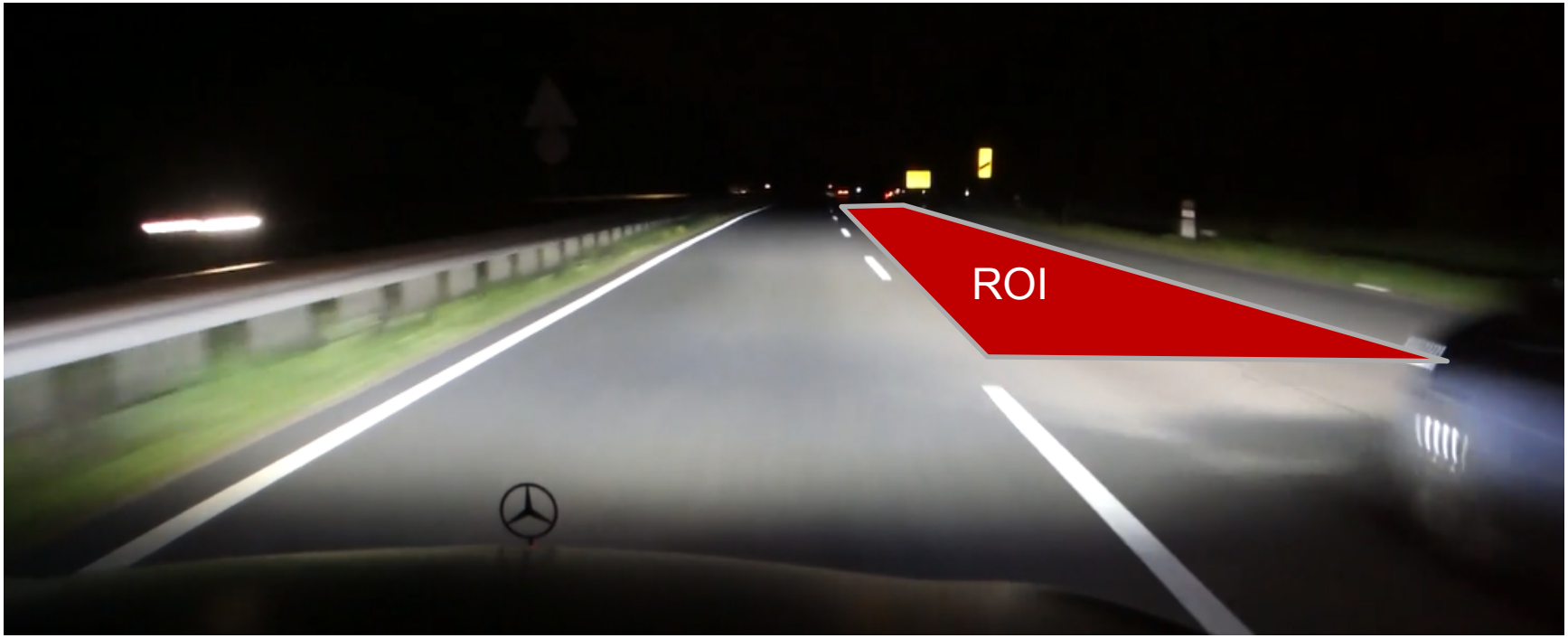
- *SUBJECT DRIVING*
- *FOLLOWING H*
- *GAZE BEHAVIOR*
- *FIXATIONS IN ROI*
- *TEST INSTRUCTOR*

H (HARE) VEHICLE

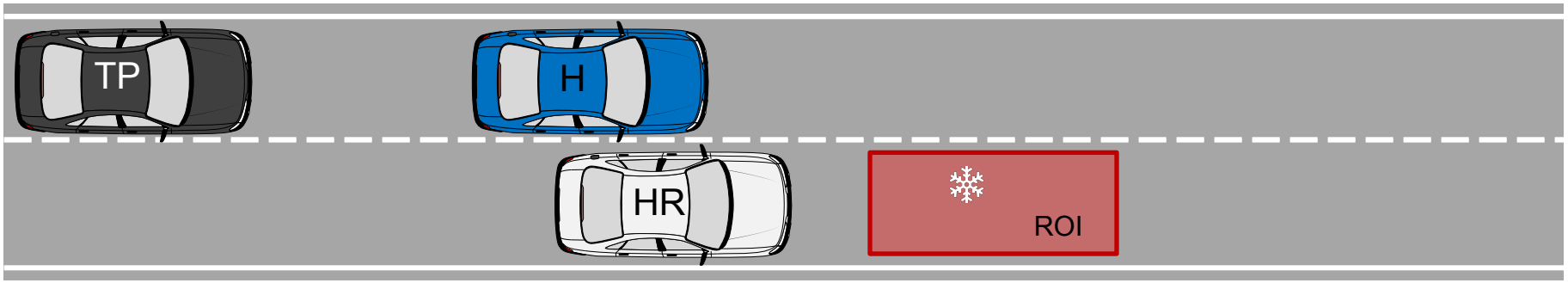
- *PRECEDING*
- ***CONSTANT SPEED 80 KM/H***

NEW FUNCTIONALITIES: SNOW FLAKE PROJECTION

CASE 2: *OTHER VEHICLES OVERTAKE VEHICLE WITH HIGH RESOLUTION HEADLAMPS PROJECTING SYMBOLS*



HR (HIGH RESOLUTION) VEHICLE PROJECTING A SNOWFLAKE



HR VEHICLE

- CONSTANT SPEED 80 KM/H

-RANDOM ORDER

- SNOWFLAKE
- GUIDING LINES
- CONSTRUCTION SITE
- LOW BEAM

TP(TEST PERSON) VEHICLE

- SUBJECT DRIVING
- FOLLOWING H AT 40 M
- GAZE BEHAVIOR
- FIXATIONS IN ROI
- TEST INSTRUCTOR

H (HARE) VEHICLE

- PRECEDING
- **OVERTAKING @ 100 KM/H**

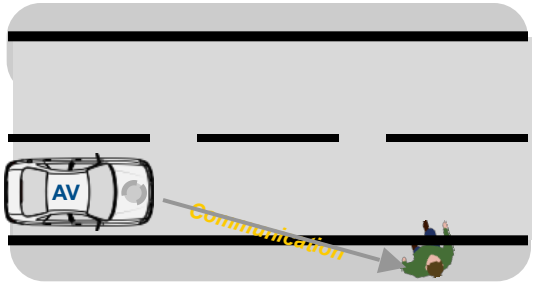
TEST RESULTS 实验结果

- *50 SUBJECTS ALL AGES* 50名不同年龄的受试者
- *INVESTIGATION OF DISTURBING EFFECT WITH SNOWFLAKE WHEN PASSING* 调查研究当开车时 雪花 的干扰
- *EYE TRACKING SYSTEM HAS BEEN USED* 应用眼睛跟踪系统
- *NO SIGNIFICANT DIFFERENCE BETWEEN TEST VEHICLE WITH OR WITHOUT SNOWFLAKE PROJECTION*
  用雪花投影灯有没有显著的区别
- *SUBJECTIVE RATING OF TEST PERSONS :* ***DO NOT FEEL DISTURBED!*** 测试人员主观评分：不要感到不安！

IDENTIFICATION SIGNAL FOR VEHICLES RUNNING IN AUTONOMOUS MODE

EXAMPLES OF LIGHTS INDICATING WHEN A VEHICLE IS IN AUTOMATED DRIVING MODE

PART 1: CONDUCTED QUESTIONNAIRE



WE ASSUME IN FOLLOWING…

- *COMMUNICATION TYPE IS SOLVED*
- *SIGNALS ARE PERCEIVED AND UNDERSTOOD*

QUESTIONNAIRES ARE ABOUT

*1.WHICH "**MESSAGES**" ARE NECESSARY IN SELECTED PHASES*
2.IN WHICH SITUATIONS IS A NEED OF COMMUNICATION

A GROUP OF 76 SUBJECTS IS EVALUATED FOR THIS STUDY, AGED BETWEEN 19 TO 59 YEARS

QUESTIONNAIRES ON MESSAGES I STRUCTURE

VISUAL CONTACT, BUT THE AUTONOMOUS VEHICLE MAINTAINS ITS SPEED.

PEDESTRIAN INDICATES TO CROSS THE ROAD. AV BEGINS TO BREAK.

a) AUTONOMOUS VEHICLE HAS STOPPED
b) STOPPING IS NOT NECESSARY ANY MORE

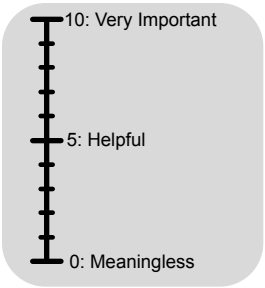
DEAD-LOCK SITUATION

DEAD-LOCK SITUATION RESOLVED AND THE AUTONOMOUS VEHICLE ACCELERATED

INVESTIGATED MESSAGES IN EACH PHASE*

"I DRIVE AUTONOMOUSLY"
„I HAVE SEEN YOU"
„I DO NOT POSE ANY DANGER"
„I WOULD LIKE TO CONTINUE MY DRIVE"
"WARNING, I'M DANGEROUS"
SPEED INDICATOR
"I CONTINUE NOW"
"I'M ACCELERATING RIGHT NOW"
"I'M SLOWING DOWN"
"THANK YOU!"

Rating with Ordinal Scale



ANSWERING TENDENCY OF FOLLOWING QUESTIONS

WHICH MESSAGE IS IMPORTANT IN DIFFERENT SITUATIONS?
"RANKING" OF TOP MESSAGES?

IS THERE AN INCREASING OF IMPORTANCE BETWEEN THE SITUATIONS?

QUESTIONNAIRES ON MESSAGES II STEPS OF EVALUATION

Phase 1
Visual contact, but the autonomous vehicle maintains its speed.

Phase 2
Pedestrian indicates to cross the road. AV begins to break.

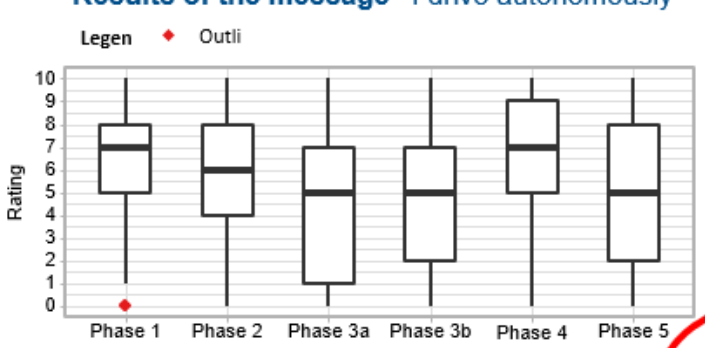
Phase 3 a
a) Autonomous vehicle has stopped

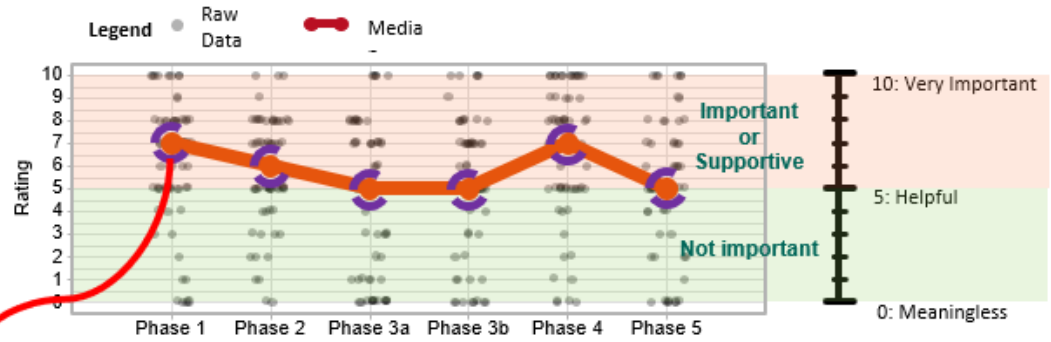
Phase 3 b
b) Stopping is not necessary any more

Phase 4
Dead-lock situation

Phase 5
Dead-lock situation resolved and the autonomous vehicle accelerated

Results of the message "I drive autonomously"





Summary of the results – Median values

	Phase 1	Phase 2	Phase 3a	Phase 3b	Phase 4	Phase 5
„I drive autonomously"	7	6	5	5	7	5
„I have seen you"						
„I do not pose any danger"						
„I would like to continue my drive"						
„Warning, I'm dangerous"						
Speed indicator						
„I'm accelerating right now"						
„I'm slowing down"						
„Thank you!"						

Color coding

If Rating ≥ 5

If Rating < 5

Which message is important in different situations?

"Ranking" of top messages?

Cultural Aspects in Communication
Car to Pedestrian using Symbols

Research Tests in Europe, Japan, China, South Korea, USA

*SUMMARY & OUTLOOK*概括 &总结

- *STUDIES DEMONSTRATING GOOD JUSTIFICATION FOR BEEING ACCEPTED* 研究证明了应用是有充分理由的

- *IN FUTURE ECE REGULATION* 法规的未来

- *IMPORTANT POINTS LIKE THE BENEFITS AND THE EXCLUSION OF DISTURBANCE OF OTHER ROAD USERS HAVE BEEN SHOWN*
  要点如其他道路使用者的利益和排除干扰，已经显示出来了

- *THE NEW FUNCTIONALITIES TESTED ARE HELPFUL AND BENEFICIAL FOR FUTURE APPLICATION*
  新功能的测试对以后的应用是有帮助和有益的

*SUMMARY & OUTLOOK*概括 &总结

- *THE AUTONOMOUS MODE DRIVING IDENTIFIER SEEMS TO BE APPRECIATED* 自动模式驱动标识符 - 受到赞赏。
- *TARGET TO ALIGN WITH ECE AND SAE (TF J3134)*
  目标 - 保持*ECE*和*SAE*一致性
- *RESULTS OF THE CULTURAL ASPECT TO ACCEPT AND UNDERSDTAND SYMBOLS*

  WILL BE REPORTED SOON。
  关于文化对自动模式符号的影响将在下次演讲


Varroc
EXCELLENCE