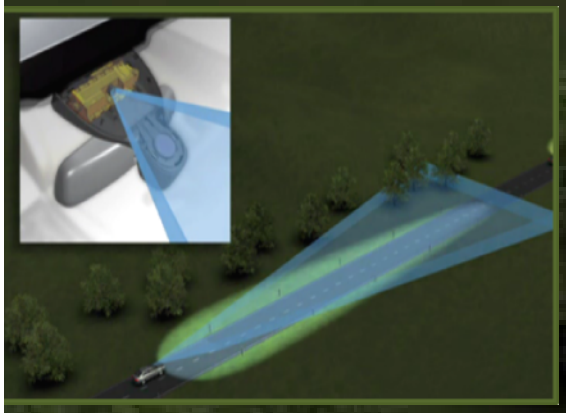
Informal Document No. **GRE-63-21**
(63rd GRE, 29-31 March 2010,
agenda item 5(d))

GTB

Automotive Lighting and Light Signalling Expert Group
(Groupe de Travail "Bruxelles 1952" (GTB))

Transmitted by the expert from GTB



Automatic Adaptation of the Main Beam

Introduction of Provisions into Regulations 48 and 123

Status Report

Presented to the 63rd Session of GRE
30 March 2010

GTB

Automotive Lighting and Light Signalling Expert Group
(Groupe de Travail "Bruxelles 1952" (GTB))

GTB Presentation relating to item 5 (d) of the agenda for the 63rd GRE session

Extract of ECE/TRANS/WP.29/GRE/2010/1 + Add. 1

5 (d) Regulations Nos. 48 and 123

ECE/TRANS/WP.29/GRE/62, paras. 14 and 22
(ECE/TRANS/WP.29/GRE/2009/56)
(ECE/TRANS/WP.29/GRE/2009/57)
(ECE/TRANS/WP.29/GRE/2009/59)
(GRE-62-05) (GRE-62-13) (GRE-62-14) (GRE-62-16) (GRE-62-17) (GRE-62-18) (GRE-62-19) (GRE-62-20)
(GRE-62-21)

GRE may wish to resume discussion on this agenda item, including also automatic activation/deactivation of main beam, awaiting consolidated and revised proposals, if available.

GRE may wish to consider on **Tuesday, 30 March 2010 at 4.30 p.m**. a presentation of the status of discussions of GTB with support of GRE experts and an overview of the approach to introduce provisions into the Regulations. In the meantime, it is also expected an overview of the experience of vehicle manufacturers (who have the responsibility for the complete system performance). On **Wednesday, 31 March 2010 at 9.30 a.m**., GRE is expecting to hold an open discussion and exchange of views with GRE experts to understand the concerns and requirements of the contracting parties concerning necessary provisions to be introduced into the Regulations. Finally, GRE may wish to consider the next steps based upon the GTB objective to submit official proposals for the October 2010 session of GRE.

Introduction

GRE 60th session (Oct. 2008)

Concept and demonstration of prototypes

Informal document "Presentation by GTB - AFS main beam (driving beam) improvements".

GRE 62nd session

Formal proposals to amend Regulations 48 and 123 with accompanying presentation

(ECE/TRANS/WP.29/GRE/2009/56) / (ECE/TRANS/WP.29/GRE/2009/57)
(ECE/TRANS/WP.29/GRE/2009/59)
(GRE-62-05) (GRE-62-13) (GRE-62-14) (GRE-62-16) (GRE-62-17) (GRE-62-18)
(GRE-62-19) (GRE-62-20) (GRE-62-21)

GTB taskforce continued to work to develop proposals taking into account the comments received. It was agreed that it would be helpful for GRE experts to be informally invited to participate in the GTB taskforce meeting.

GTB Taskforce meetings with participation of GRE Experts

Paris 25 November 2009 / Frankfurt 26 January 2010 / Karlsruhe 25 February 2010

Agenda

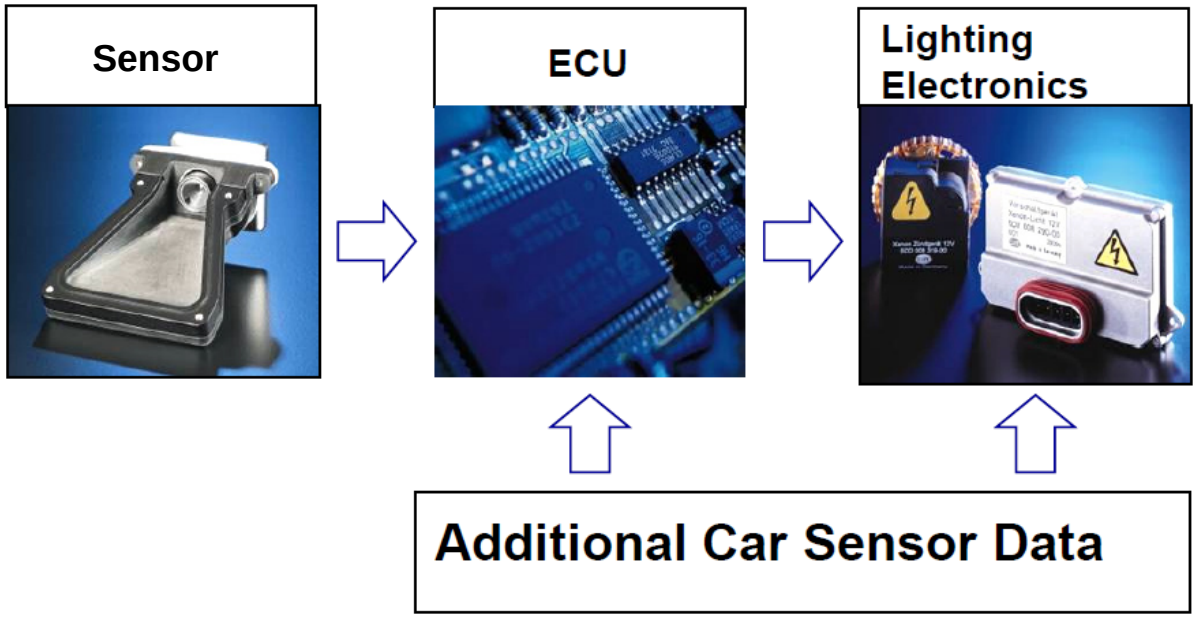
- Technology Update
- Safety Issues
- The Regulatory Challenge
- Status report
- Discussion related to open issues (09:30 on 31 March)
- Formal Proposals for GRE 64th session (Oct 2010)

Technology Status

Automatic activation / deactivation of the main beam	Type Approvals already granted based upon interpretations of the existing provisions of R48 No complaints from users or other road users
Adaptive dipped beam cut- off Line	Some vehicles type approved with these systems based upon interpretations of the existing AFS regulations. Sold as optional equipment world-wide. High level of confidence of vehicle manufacturers
Adaptive Main Beam	Systems fully developed and ready for launch based upon high level of confidence of vehicle manufacturers. Cannot be type approved according to existing AFS regulations

Automatic activation / deactivation of the main beam

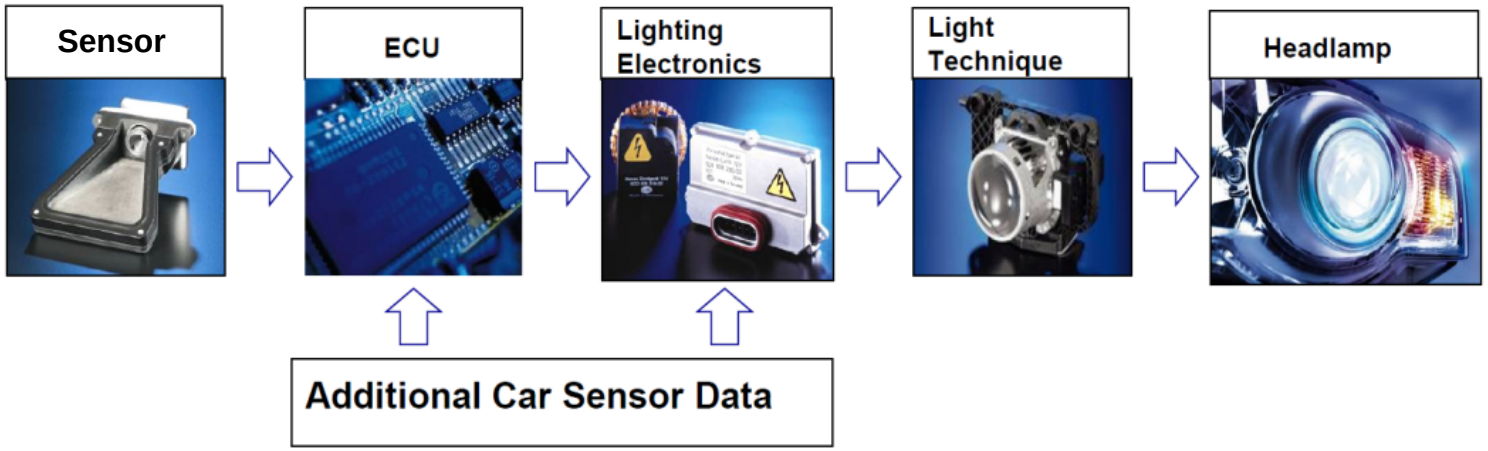
Senses the presence of oncoming and preceding vehicles and automatically activates / deactivates the main beam



(Taken from ISAL 2009 Paper A35)

Adaptive Dipped Beam Cut- off Line

Based upon a sensor system identifying the positions of other vehicles and connected to an image processor and electronic control unit (ECU) to automatically adapt the dipped beam cut-off to provide optimised glare controlled illumination of the road scene ahead

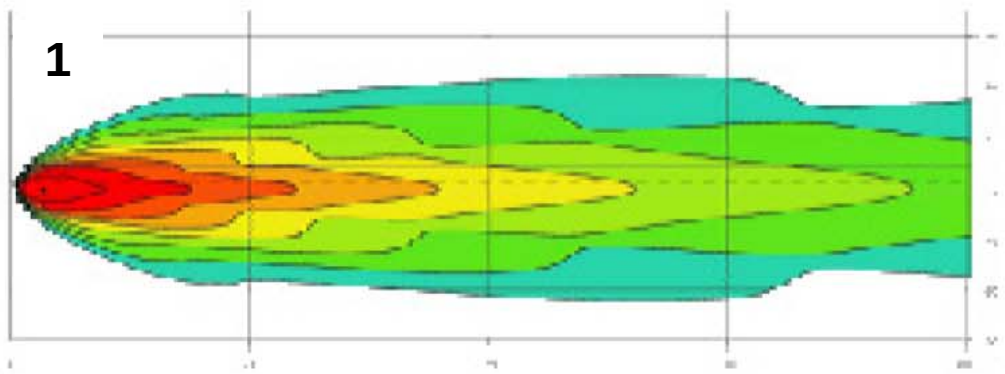


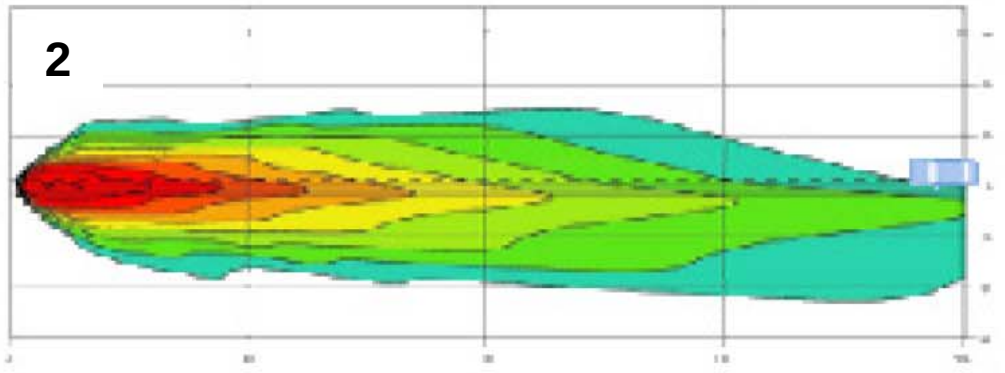
(Taken from ISAL 2009 Paper A35)

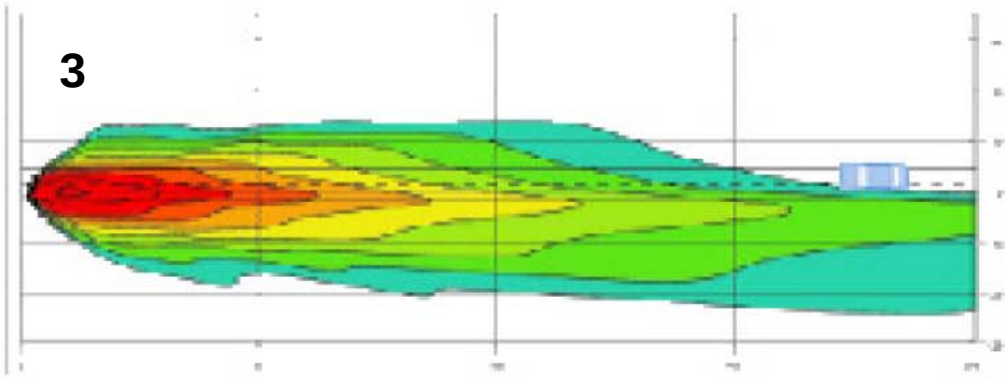
Technology Status

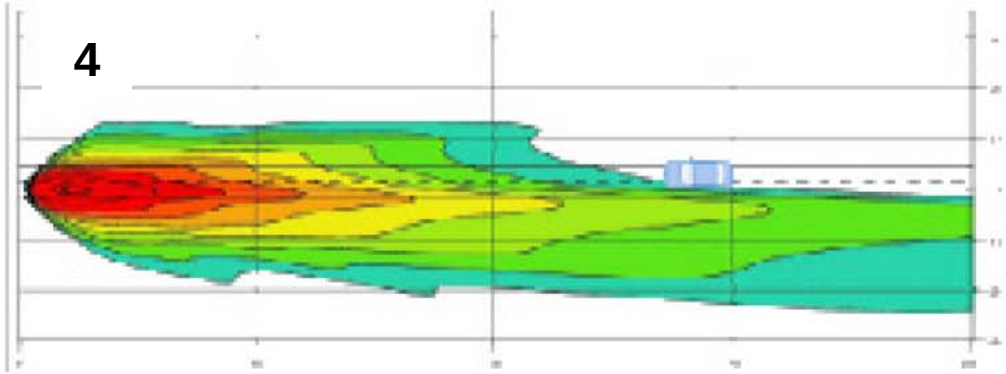
Adaptive Dipped Beam Cut- off Line

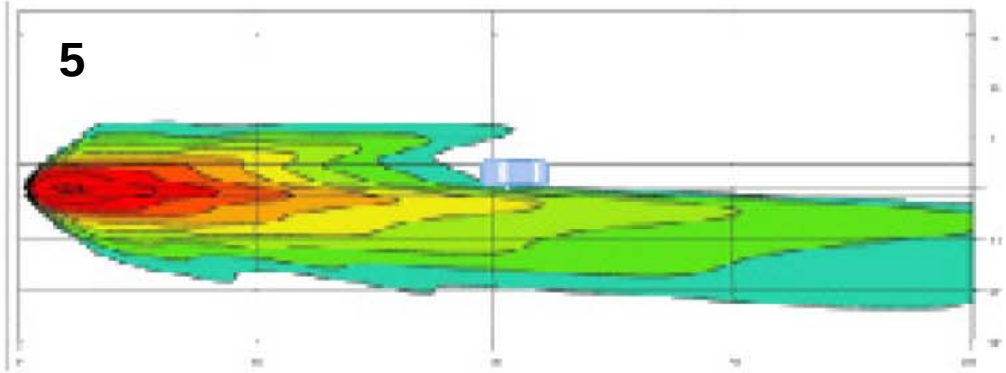
Adaption sequence 1 ➡ 6

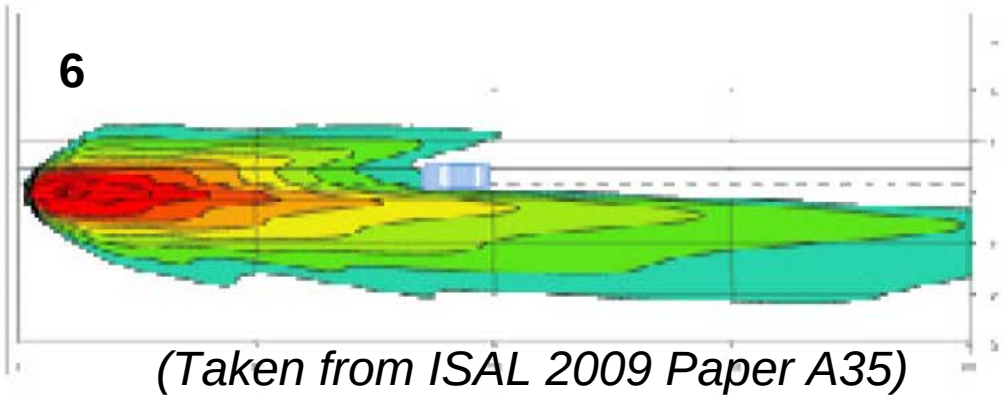








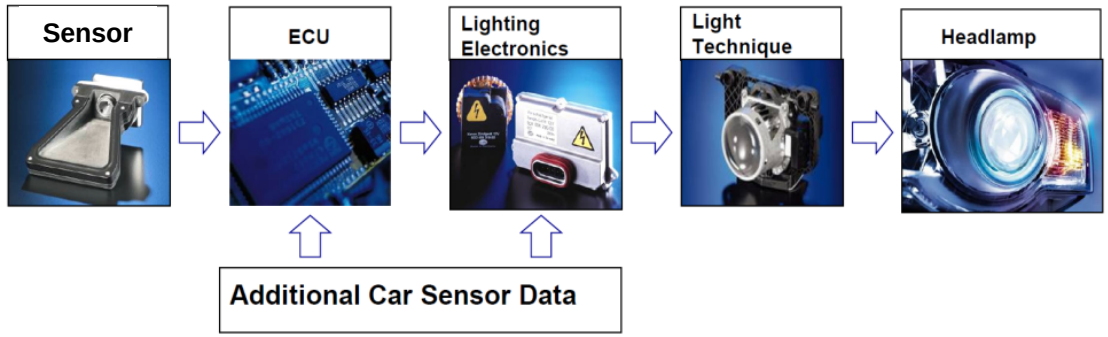


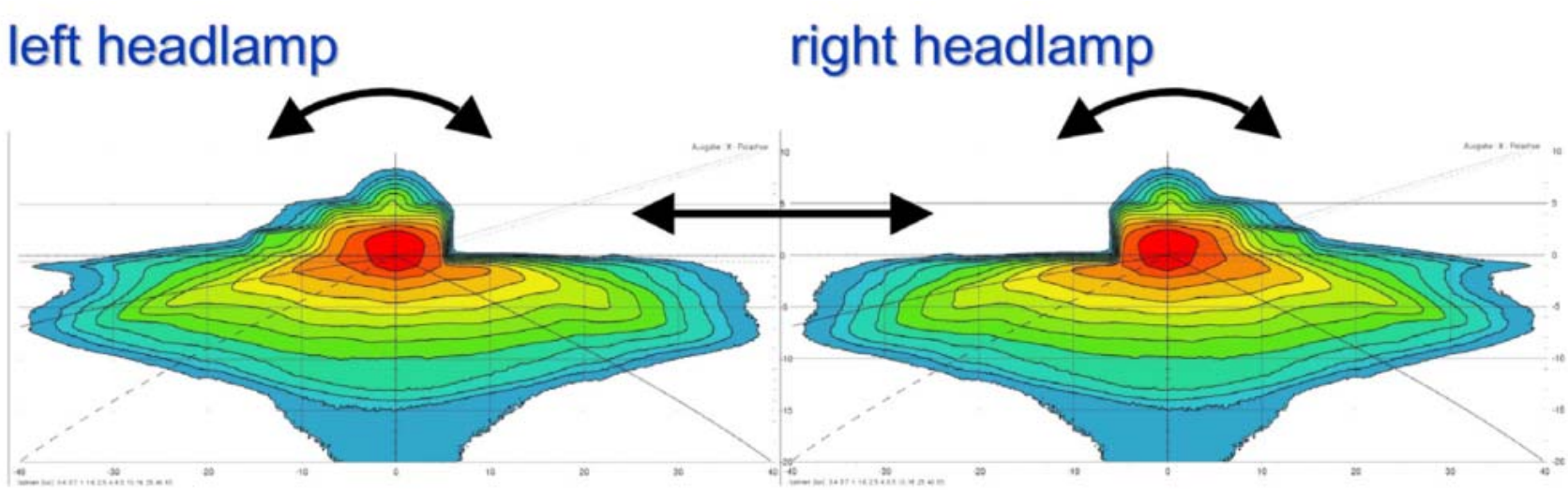


(Taken from ISAL 2009 Paper A35)

Adaptive Main Beam

Main beam adapting to the presence of other vehicles to provide optimised glare controlled illumination of the road scene ahead

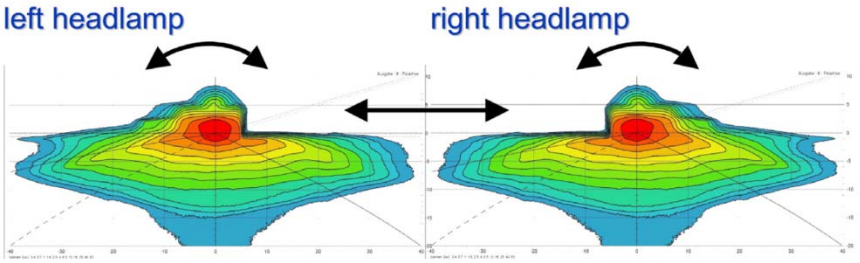




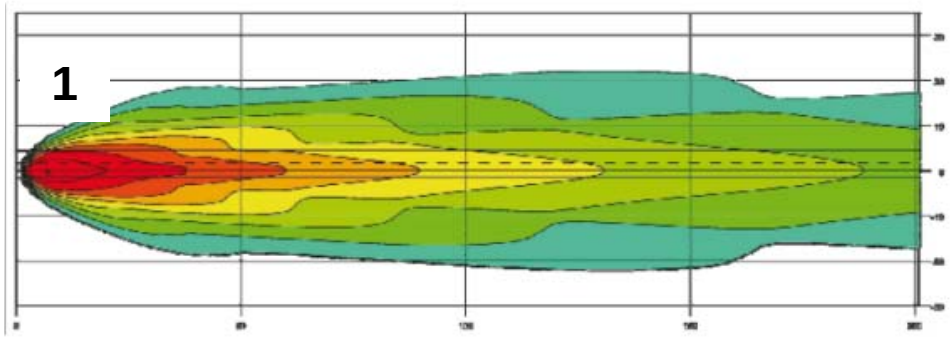
(Taken from ISAL 2009 Paper A35)

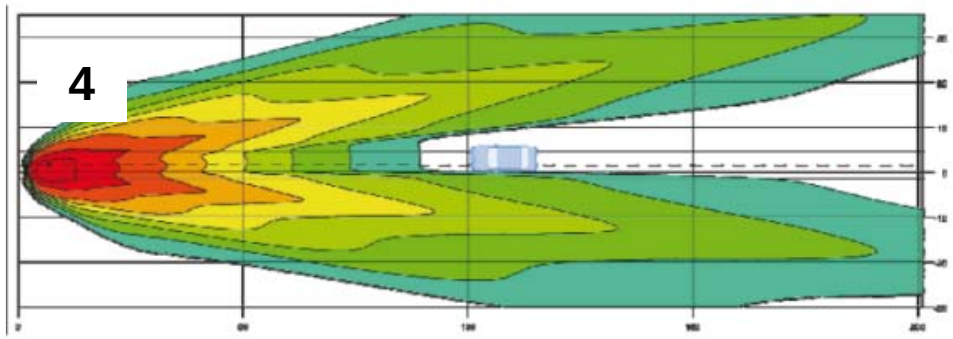
Technology Status

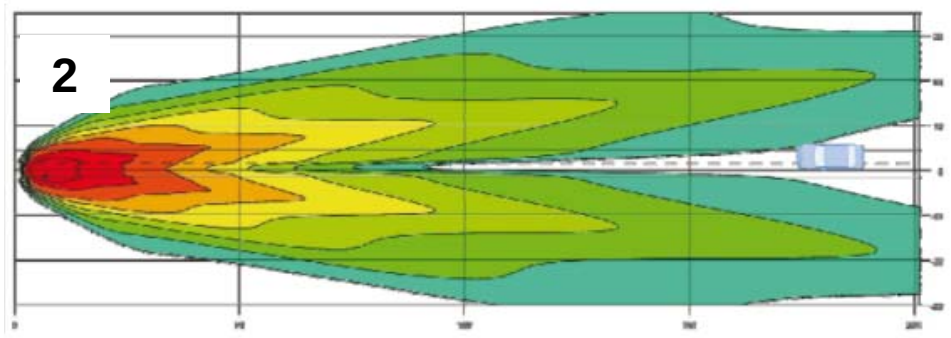
Adaptive Main Beam

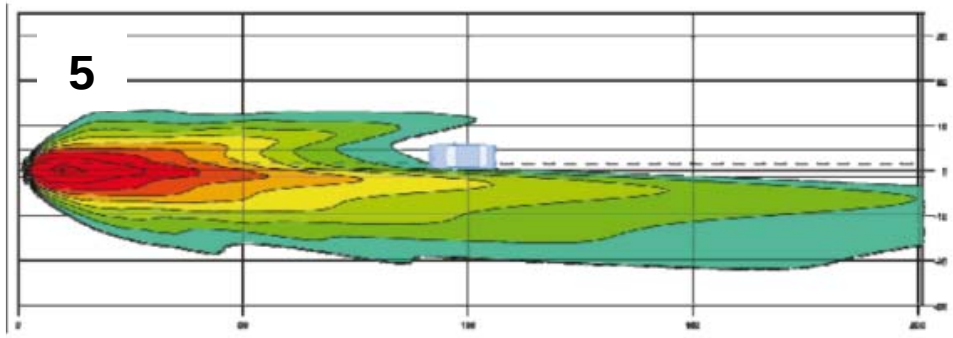


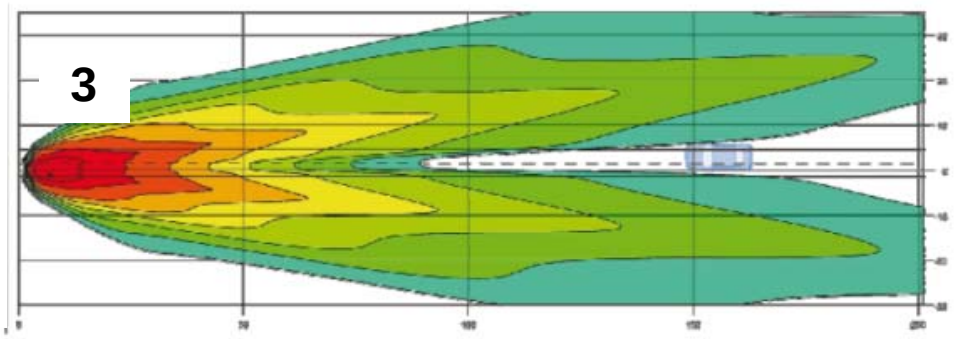
Adaption sequence 1 ➡ 6

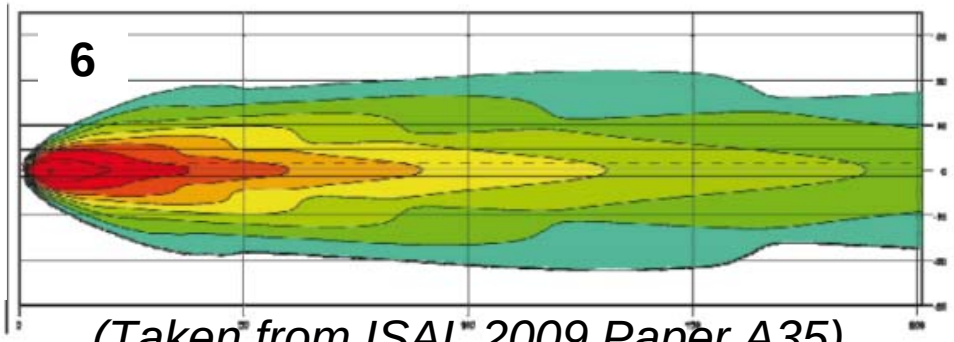










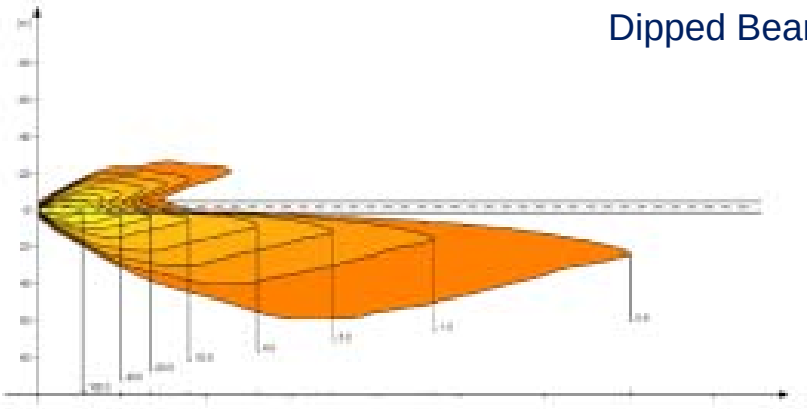


(Taken from ISAL 2009 Paper A35)

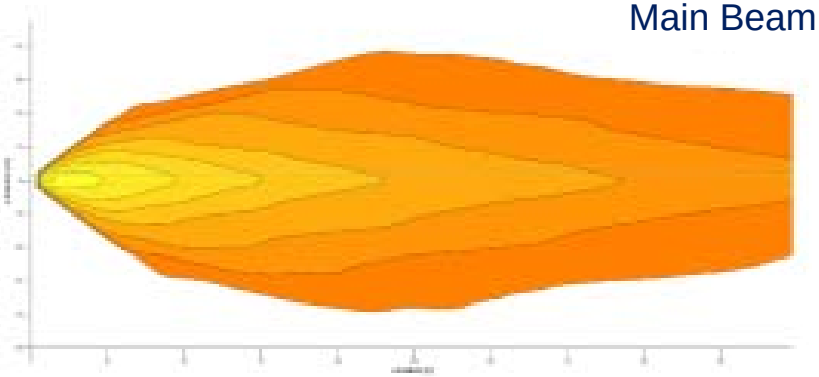
Technology Status

Adaptive Main Beam

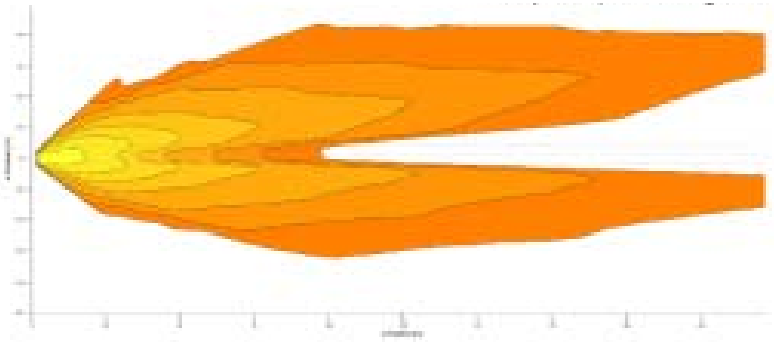
Dipped Beam



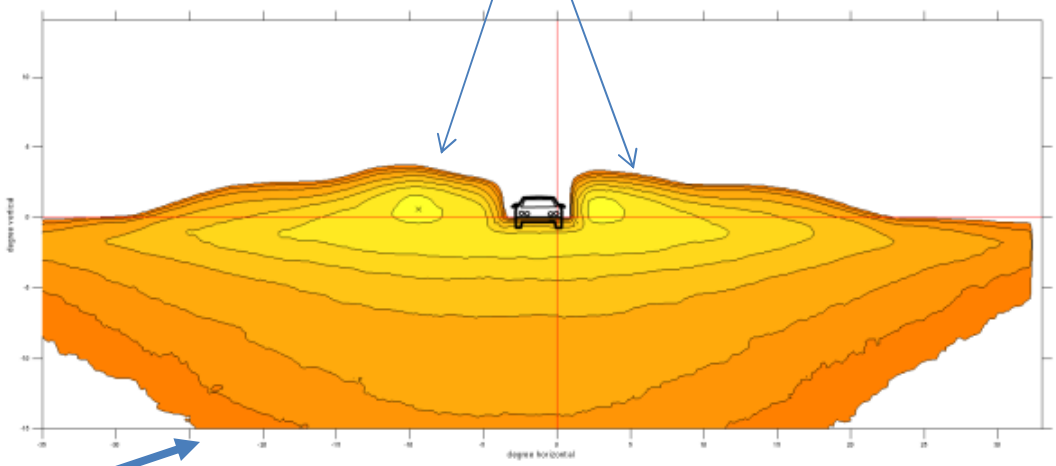
Main Beam



Adaptive Partial Main Beam



Improved visibility for detection of pedestrians, cyclists, lane guidance etc.



(Taken from ISAL 2009 Paper A36)

First application of this technology on high range vehicles sold globally

- Safety of prime concern
- Introduced as part of an AFS lighting System
- Manufacturer liability
- Manufacturer‘s vehicle brand image and reputation at stake
- Vehicle manufacturers investment in extensive development and proving
- Technological support from equipment suppliers

Vehicle manufacturers will only launch this technology after gaining a high level of confidence

Technology Status

Extensive experience with senor systems on vehicles.

Objective performance specifications well established

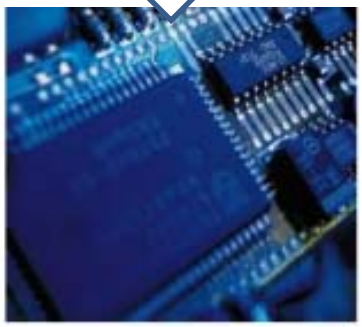


Image processing and generation of appropriate control systems is based upon algorithms developed by the vehicle manufacturer in conjunction with suppliers. These algorithms are the result of extensive testing in real-world conditions.

Objective performance specifications difficult to prescribe.

Lighting electronics, optical techniques and headlamp construction technology are all well developed based upon AFS experience.

Objective performance specifications well established

Technology Status

Systems tested:

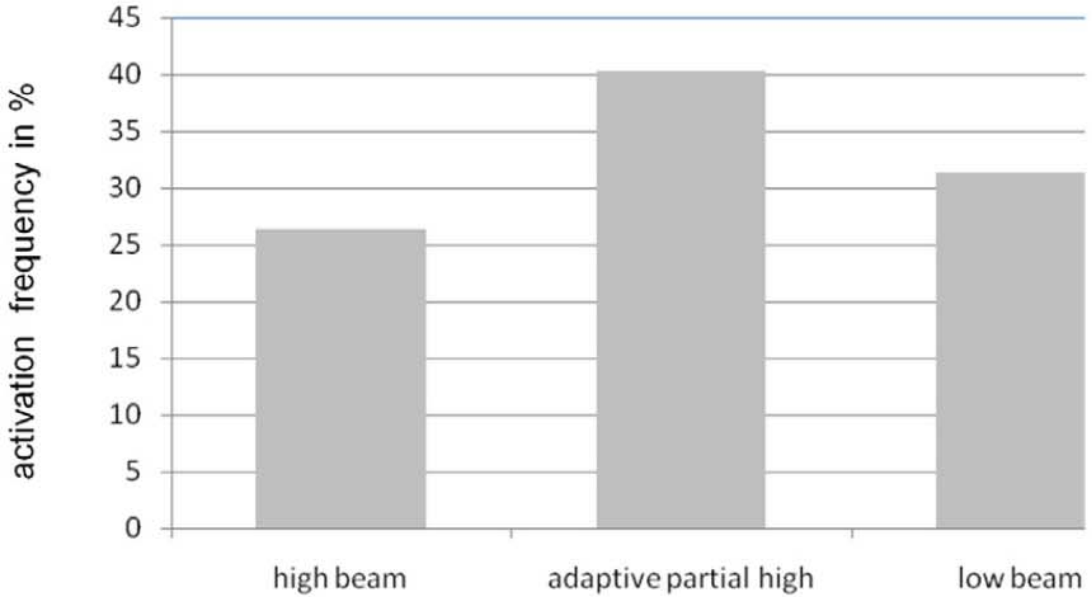
oover a period of 2 years

ounder all real road conditions in Europe and USA

oover more than 1 million Km

Optimised use of main beam

Reduces driver fatigue through improved visibility and by reducing the work load BUT the driver remains responsible for deciding when it is appropriate to use the main beam and when to switch to dipped beam



: *Distribution between low beam, adaptive partial high beam and high beam on country roads and motorways over all test runs*

	distance / km	share
town	54	7,8 %
country	422	61,2 %
motorway	213	31,0 %

(Taken from ISAL 2009 Paper A36)

Enhanced detection of pedestrians

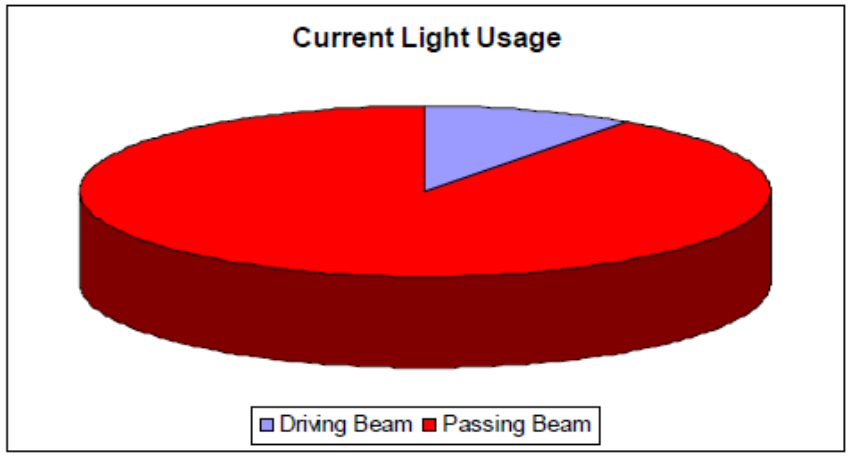
SAE Information Report J2829 produced in conjunction with GTB and CIE identifies minimum requirements for the detection of pedestrians and shows that in many cases the dipped beam is incapable of providing sufficient visibility.

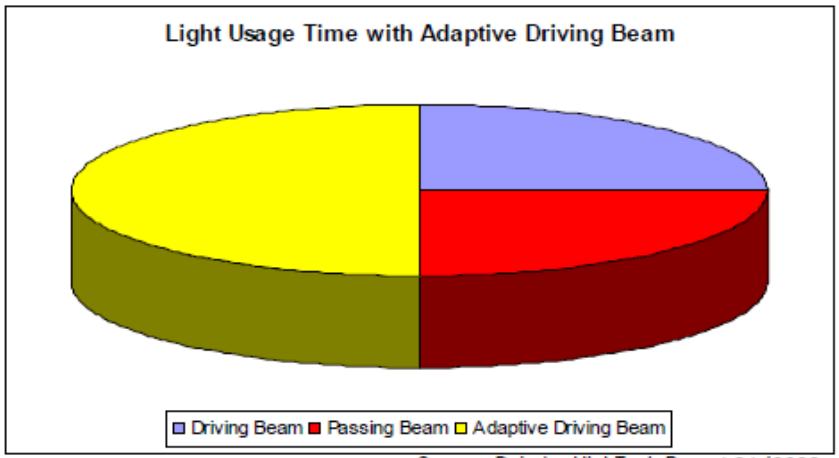
ISAL 2009 Paper A36 concludes

- ADB systems result in higher usage of driving beam
- ADB systems result in more than doubling the average illumination distance (150m vs. 65m)
- Pedestrians can be detected by the driver at more than twice the distance compared to passing beam (260m vs. 110m)

→ **ADB system may result in up to 68% less accidents with pedestrians involved on country roads**(*)

(Taken from ISAL 2009 Paper A36)





Source: Daimler HighTech Report 01/2009

Enhanced detection of bicycles

Cycles equipped with good lighting will be detected by the system which will react and adapt the main beam to avoid causing discomfort.

In the case of cycles not having good lighting it is preferable for a driver to be able to recognise them through the use of the main beam even at the risk of causing some glare discomfort.

Many concerns relating to cyclist safety due to

- poor or no lighting on the cycle,
- No standard cycle lighting performance
- high proportion of crashes not involving other vehicles

Conclusion: There is no strong case to compromise the potential benefits of improved detection of cyclists through the use of ADB systems. Most cyclist accidents and fatalities occur in urban areas where the ADB system is deactivated.

How to introduce objective requirements into the regulations?

- Assure safety and avoidance of compliants from other road users
- Technology Independent
- Provisions that can be verified during type approval
- Validatation of the effectiveness of the software

Definition of Adaptive Main Beam

“Adaptive main-beam" means a main-beam of the AFS that adapts its beam pattern to the presence of oncoming and preceding vehicles in order to improve long-range visibility for the driver without causing discomfort, distraction or glare to other road users.

Sensor Requirements

…….the control signals being produced by a sensor system which is capable of detecting and reacting to all the following:

oambient lighting conditions;
othe light emitted by the front lighting, front light-signalling devices or retro-reflected light of oncoming vehicles;
othe light emitted by the rear light-signalling devices or retro-reflected light of preceding vehicles.

Additional sensor functions to improve performance are allowed.

Vehicles" means vehicles of categories L, M, N, O, T, and additionally includes bicycles] equipped with retro-reflectors and front lighting which is switched ON.

Are different sensor characteristics required for the automatic activation / deactivation and for the adaptive systems?

Sensor Requirements

Minimum Detection Angles

The sensor used to control the adaptation of the main-beam shall comply with the following requirements:

The boundaries of the minimum fields in which the sensor is able to detect (light emitted or retro-reflected) from other vehicles are defined by the angles indicated below. These angles are measured from the centre of the sensor aperture relative to a horizontal straight line through its centre and parallel to the longitudinal median plane of the vehicle.

oHorizontal angles: 15° to the left and 15° to the right.
oVertical angles: 5° upwards and 2° downwards ;
o[depending upon the mounting height of the sensor]

Sensor Requirements

Minimum Detection Distance

The sensor shall be able to detect on a straight level [flat] road:

- an oncoming power driven vehicle at a distance extending to at least 300 [450] m
- a preceding power driven vehicle or a vehicle/ trailers combination at a distance extending to at least [100] 200 m;

Open Issue

- an oncoming bicycle at a distance extending to at least 50 m with the illumination corresponding to a white lamp with a luminous intensity of 150 cd with a light emitting surface of at least 10 cm^2 and at a height above the ground of 0.8m.

Sensor Requirements

Minimum Detection Distance

UMTRI Research

1. Report No. UMTRI-2006-11	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Real-World Use of High-Beam Headlamps		5. Report Date April 2006 6. Performing Organization Code 302753
7. Author(s) Mefford, M.L., Flannagan, M.J., and Bogard, S.E.		8. Performing Organization Report No. UMTRI-2006-11
9. Performing Organization Name and Address The University of Michigan Transportation Research Institute 2901 Baxter Road Ann Arbor, Michigan 48109-2150 U.S.A.		10. Work Unit no. (TRAIS) 11. Contract or Grant No.
12. Sponsoring Agency Name and Address The University of Michigan Industry Affiliation Program for Human Factors in Transportation Safety		13. Type of Report and Period Covered 14. Sponsoring Agency Code

"While regional differences in high-beam use were observed, substantial underuse of high-beam headlamps was present in all areas of the country.

In car-meeting scenarios, on average, drivers dimmed their high beams at an inter-car distance of 522 m.

From an obstacle detection standpoint, Helmers and Rumar **(1974) reported a distance of 250 m to 400 m as an optimal distance for switching from high to low beams.

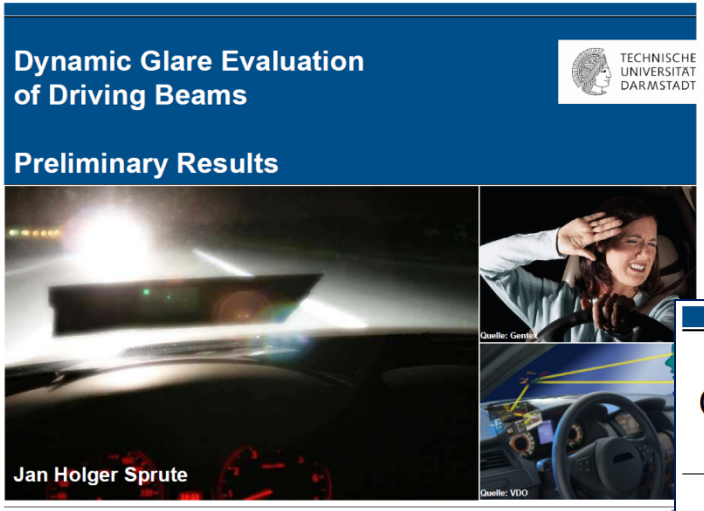
The dimming distances observed by Hare and Hemion were clearly substantially longer than is advisable for object detection and occurred at distances at which disability glare is not a factor."

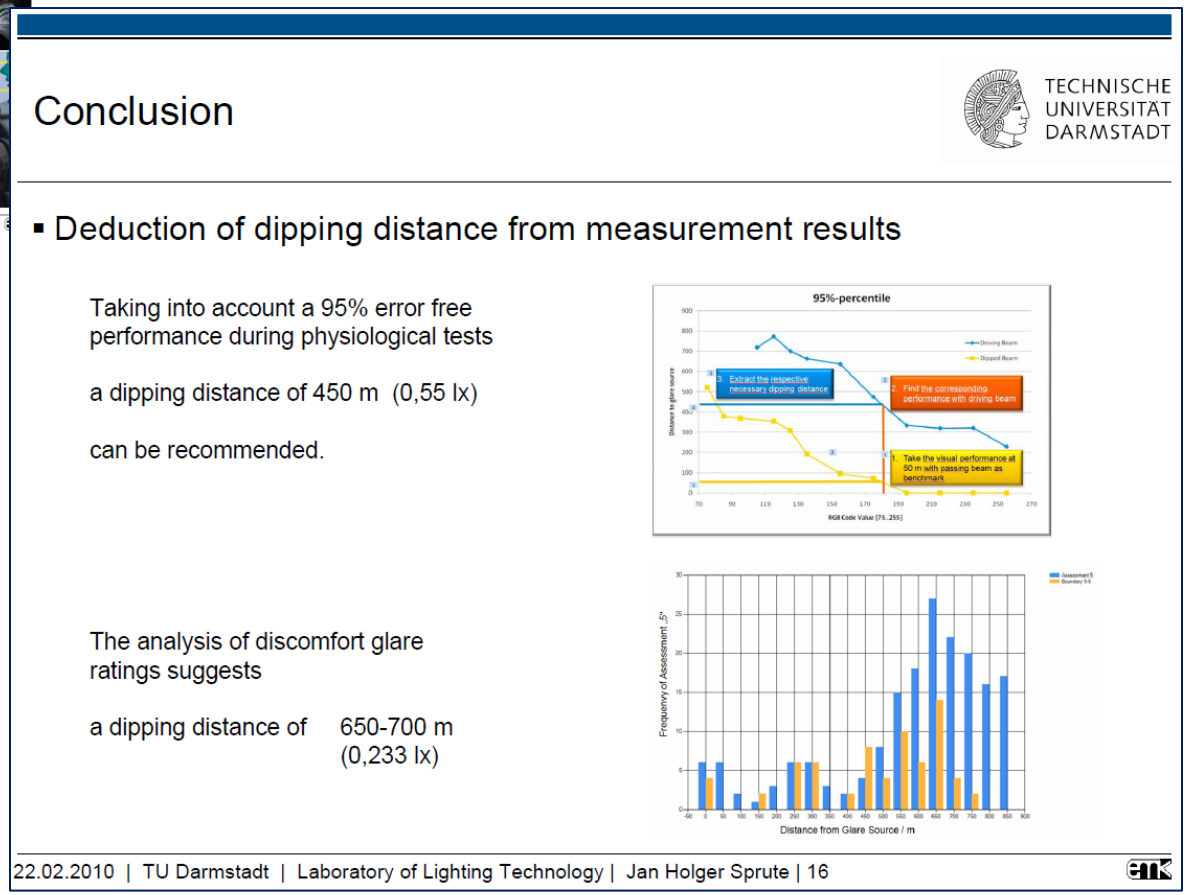
** Professor *Kare Rumar* of the Swedish Road and Traffic. Research Institute

Sensor Requirements

Minimum Detection Distance

Technical University - Darmstadt Research





This is new research and further analysis is required.

Sensor Requirements

Minimum Sensitivity

The challenge is to differentiate between oncoming vehicles and the road infrastructure, especially red and white retro reflecting devices

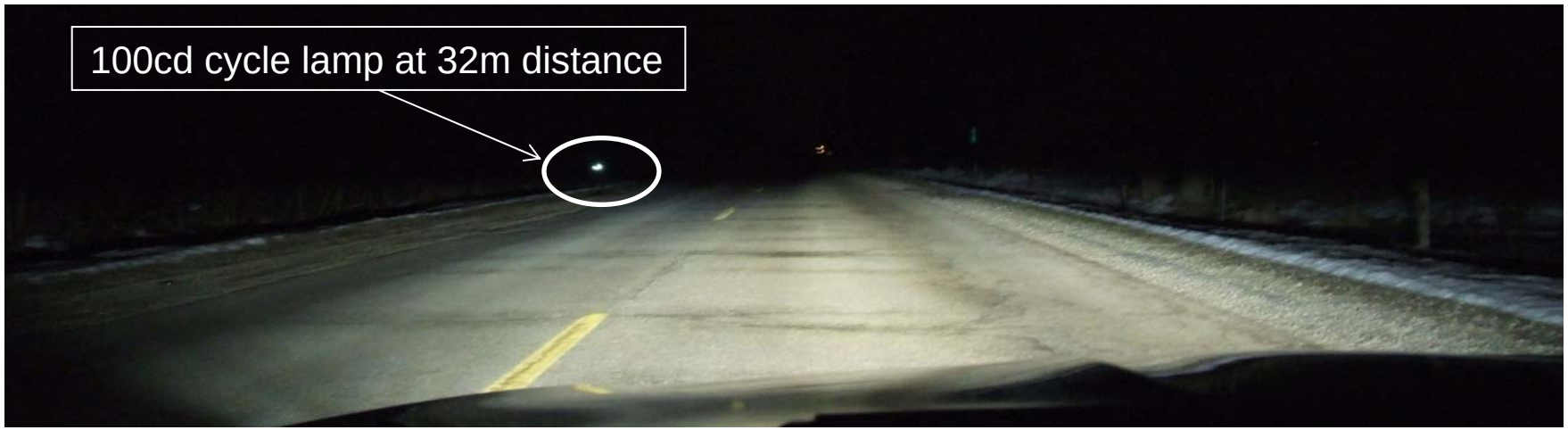
Setting a low detection range for bicycles may result disproportionately in an increased number of false main beam turn-offs.

Driver acceptance of ADB systems is based on correct performance:

ominimization of false main beam turn-offs
oreacting to clearly visible, self illuminated road users

Sensor Requirements

Minimum Sensitivity



Conclusion: Do not attempt to detect bicycle lamps having an intensity of less than 200cd

Photometric Requirements (R123)

To verify correct reaction of the headlamp to control signals

- In the case of adaptation of the main-beam function the system shall meet the requirements only in the maximum position of activation.
- During adaptation, the main-beam function shall meet the requirements for all the cases of Right-Hand and Left-Hand traffic
- Requirements shall be verified during the type approval testing in conjunction with a signal generator to be provided by the applicant.
- If the requirements can be met either for the Right-Hand traffic or the Left-Hand traffic only, the relevant information shall be noticed in the communication document

Performance Verification

Verification:

that the adaptation of the main-beam does not cause any discomfort, distraction or glare, neither to the driver nor to oncoming and preceding vehicles,

Technical service shall:

perform a test drive in clear atmosphere at all relevant speed, which comprises any situation relevant to the system control on the basis of the applicants description; activation, performance and deactivation of adaptation of the main-beam shall be recorded and checked against the data submitted by the applicant. A matrix of specific aspects of the performance of the system to be evaluated during the test drive is proposed

The overall performance of the automatic control

shall be demonstrated by the applicant by documentation or by other means accepted by the authority responsible for type approval.

Next Steps

- A summary of the approach developed by the GTB Taskforce identifying the open issues to be resolved is available as a GRE63 informal document

- GTB would appreciate initial reactions and advice from GRE experts

- Open Discussion Wednesday 31 March 2010 at 09:30

- Formal proposal by GTB for GRE64 (October 2010), taking into account the input from GRE experts.

Open Discussion Wednesday 31 March

Agenda

Main open issues to be addressed:

- Does the definition of a standard performance for bicycle lamps satisfy the requirements of the contracting parties to take the effects of the system upon cyclists into account?
- Are different sensor characteristics required for the automatic activation / deactivation and for the adaptive systems?
- Should the sensing requirements be 300/100 metres or 450/250m respectively?
- What requirements should be defined for the verification of satisfactory performance during a test drive by the technical services? Should there be different requirements for automatic activation and deactivation and for adaptive systems?
- Is it permissible for the system to be designed for right hand traffic or left hand traffic only?

Thank you for your attention

GTB

Automotive Lighting and Light Signalling Expert Group
(Groupe de Travail "Bruxelles 1952" (GTB))