ADVANCED FRONT LIGHTING SYSTEM - SAFETY IMPROVEMENTS AT NIGHT

R. Neumann
Visteon Deutschland GmbH, Germany
Rneuman8@visteon.com

ABSTRACT

Automotive Lighting has become an important safety device. Due to the increased traffic density the demands on exterior lighting equipment have become higher in order to avoid accidents during night time.
Today twice as much severe accidents occur than in daytime, although the traffic during night time is only half that much as during daytime.
A new headlamp system will come out soon, which contributes to an improved safety at night. Its called advanced front Lighting system (AFS). It shows for the first time a movable, adaptive light, which directs the light automatically in the direction the vehicle is going to drive. Bends, type of roads (rural, highway, cities) will lead to specific light output. In the future also weather conditions and a coupling to navigation system will be taken into account. The system concept of the first generation will operate based on the information of the steering wheel angle and the speed of the vehicle. According to an algorithm included in the electronic control unit, the headlamps will swivel horizontally and vertically along with the curvature and type of the road. Aside the description of the new lighting device it will be demonstrated, that this feature contributes to better visibility and safety in night driving. An empirical study was made to measure the degree of safety improvement when driving with AFS. The findings show clearly the positive result of AFS systems compared to conventional headlamps of today. Subjects, which have been selected to represent the average driver (not lighting experts) have driven the AFS vehicle on a selected public rural road. In comparison they also used the same car without the AFS effect. Although we are not able to simulate the daytime illumination with automotive lighting, the increase in seeing distance and the time to react when detecting an obstacle demonstrates that AFS will be an appropriate mean to increase safety on the road.

INTRODUCTION

In Europe we can see since March of 2003 first production parts of the so called Advanced Front Lighting Systems (AFS) in Automotive vehicles like Mercedes E-class, BMW 3er Coupe and Cabrio, and Opel Signum.
It took nearly a decade to get this system released in the ECE-regulation (1). For the first time, the low beam function of headlamps can swivel horizontally in order to optimise visibility in bends when driving at night without increasing glare light for the oncoming vehicles. Questions are, how fast this new technology will be adapted in the market and what kind of safety benefit can we expect.

SYSTEM DESCRIPTION

According to the so called Fast Track solution, the AFS system consists of a projector Module, which is designed for low beam. Separately we use a reflection system for high

beam. Just the projector module is swiveling horizontally (totally 20 degrees). The parameters we use are the speed and the steering wheel angle (see Fig.1).

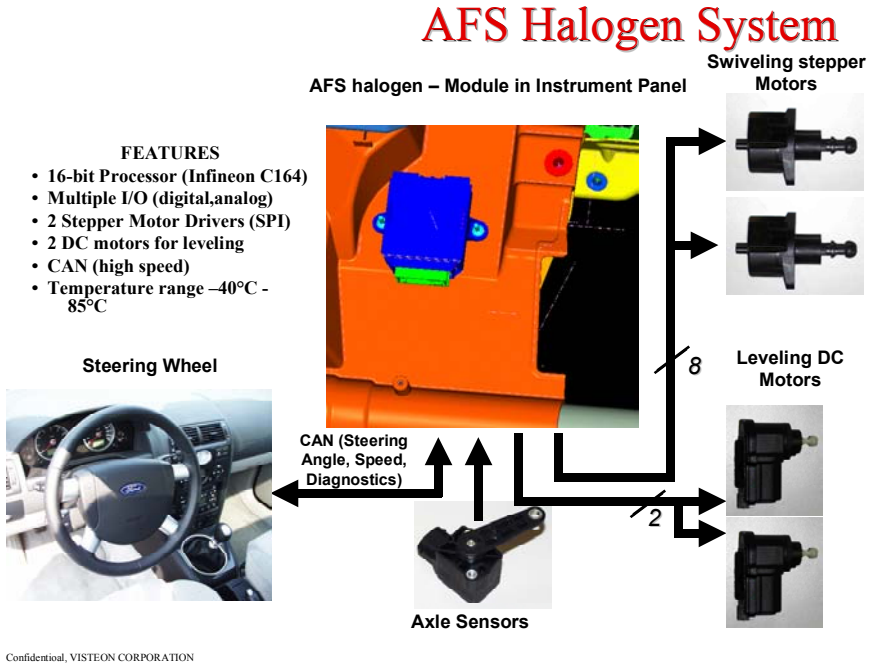

Fig.1

The mechanical movement is realized by a separate frame, which carries the projector module and a separate leveling motor which realizes the movement. The electronic control unit is programmed to act more sensitive when the speed is increasing. The movement of the headlamps are asymmetric, i.e. the swiveling mode is not parallel.
With a Xenon light source (not shown here) , a headlamp cleaning and a dynamic leveling device is additionally mandatory.

EXPERIMENTAL TEST

In order to determine the safety effect of the AFS system described above,
A survey was conducted. Subjects have been asked to drive with a vehicle along a
Test track without being informed what kind of headlights have been installed.
The AFS system could be switched off and on correspondingly.
Subjects passed the test track several times using both, standard Halogen and AFS mode.

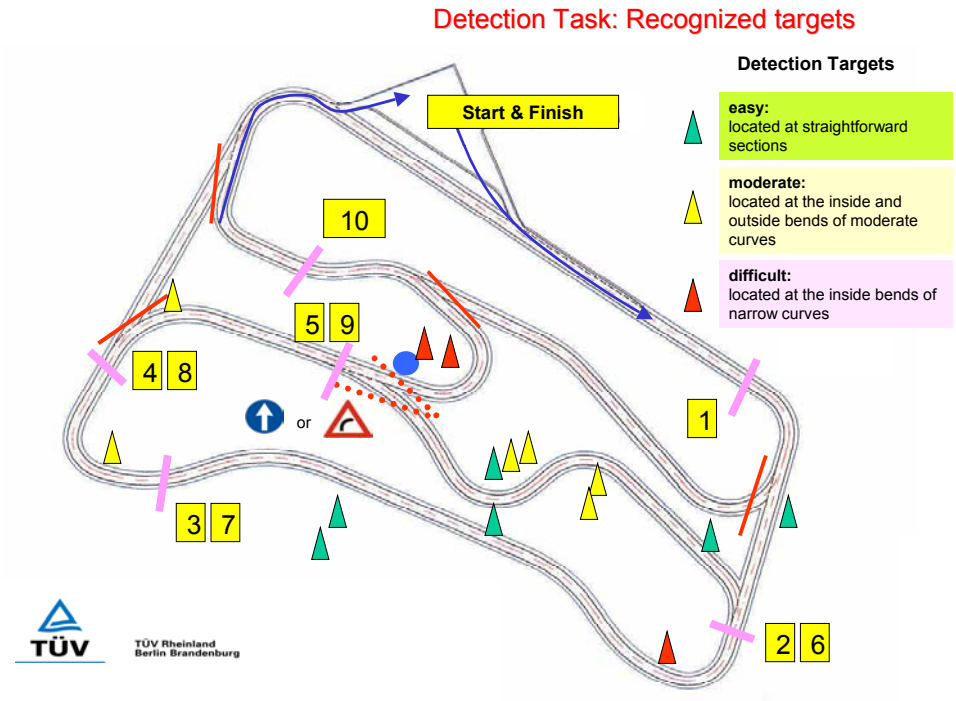

Fig.2

Along the test track there were place different obstacles (see Fig.2). The subjects had the task to detect the obstacles and to indicate the recognition by pressing a button, which was placed at the steering wheel. We divided the obstacles into three categories: easy, moderate and difficult, depending on the curvature of road, where they were placed.
The results are shown in Fig.3.

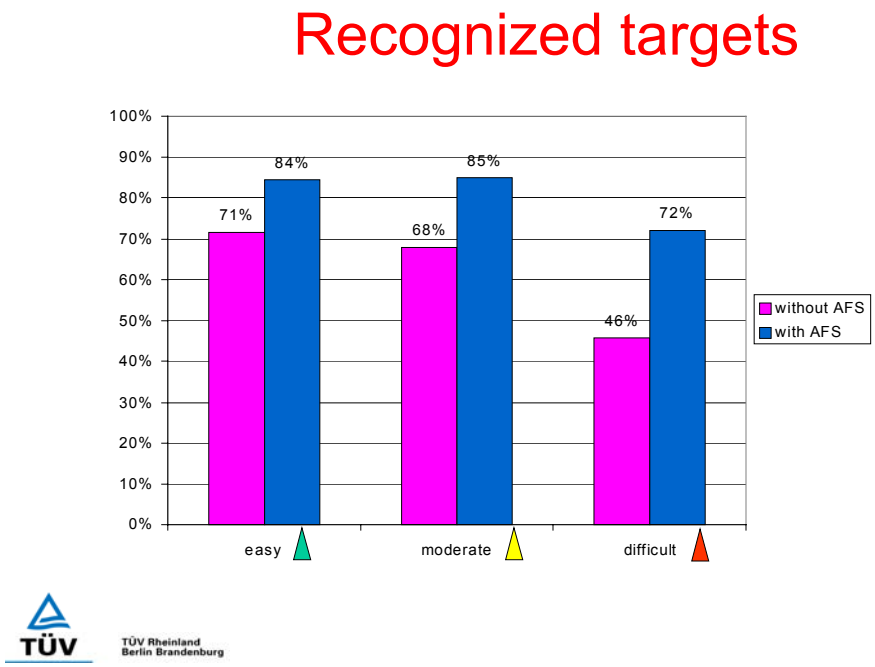

Fig.3

The more difficult the obstacles have been to be recognized , the more effective is the AFS system.
The gain is up to 56% with AFS compared to the standard Halogen system.
Within this test procedure subjects where also asked to stop their vehicled, when a Pedestrian dummy will be visible on the road.
Within a right hand curve we positioned a dummy. A photo cell initiated the dummy to move onto
The road. The photo cell was activated by the car, when he it passes a certain point with a Speed of 50 km/h.
Results are to be seen in Fig.4.

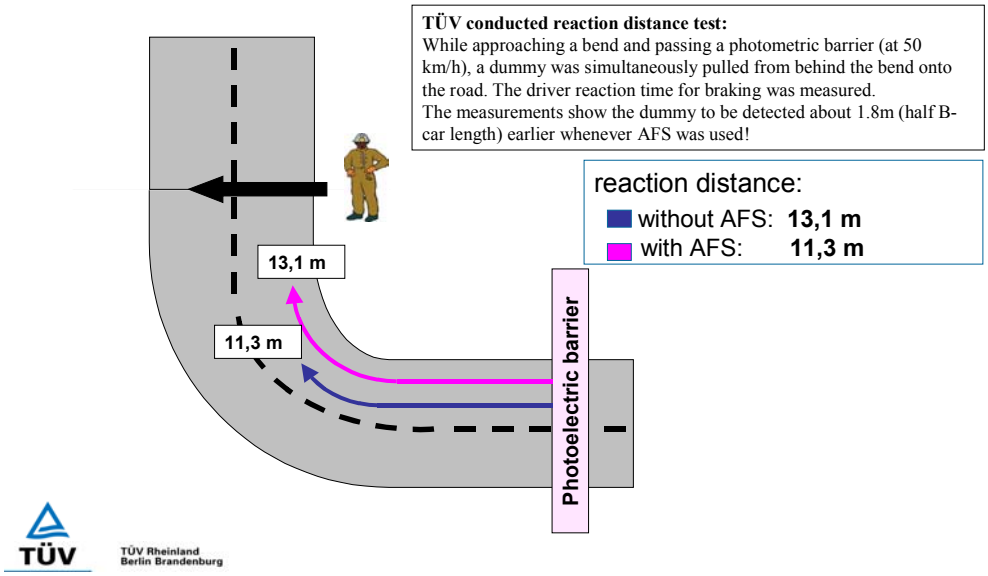

Fig.4

The safety benefit with AFS is app. 1.8m, which is a result of the earlier detection of The pedestrian with the swiveling low beam light distribution.
With AFS the driver recognizes the pedestrian much better and earlier than with the standard system, thus leading to a benefit of app. half a length of a passenger car (B-car).

SUMMARY

The experimental study has clearly demonstrated, that the AFS system increases Safety at night significantly, especially in curved roads.
If the efficiency of the different available systems of today: Standard Halogen, Standard Xenon, AFS Halogen and AFS Xenon are compared regarding visibility in curved roads, the following results can be reported

Visibility improvement with AFS in curved roads (see Ref. 2).:

Halogen Standard 100%

Xenon Standard 123%

AFS Xenon 168%

AFS Halogen 155%

Concentrating on both AFS solutions one can see that the principal AFS philosophy enhances the visibility drastically compared to the standard solutions, independent of the light source.
By means of the new headlights, safety at night time can be improved significantly.

REFERENCES

1. AFS – Advanced Front Lighting System , Eureka Project 1403

2. Michael Hamm: System Strategies for Adaptive Lighting systems, Proceedings PAL 2001, p. 368

3. Rainer Neumann: System Integration in Automotive Lighting
   - Improvements in visibility at night, FISITA Congress Paris, Proceedings, 2002