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Requirements for an Ambient Interior Lighting System for Motor Vehicles

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3 Introduction

Interior ambient lighting was very uniform in most motor vehicles over a long period of time, relatively independent of the vehicle class. An essential feature of this interior lighting is its design, typically with a central main lamp positioned near the inner rearview mirror. The function is activated by contacts at the doors or by remote control, and provides sufficient light for a stationary vehicle. Due to the design and light distribution of this lamp, its use while driving usually entails a reduction in visual acuity or visual comfort for the driver. In certain situations the vehicle needs to be illuminated inside during night journeys - if passengers or co-drivers need to read or work during the journey, or if the vehicle needs to be permanently discreetly illuminated to aid the driver's orientation. Making an estimate of the size of the interior is generally not possible since the distance to the limiting areas cannot be perceived. These deficiencies can be compensated for, and an orientation within the vehicle can be provided, as well as an estimate of the size of the vehicle, by directed lighting. This therefore creates a comfortable feeling which contributes to a less tiring and safer journey during night driving.

A further aspect which plays a key role in the orientation within the vehicle is the possibility of recognizing switches and instruments on the instrument panel. Switches used to operate specific functions (for example, rear window heating) are usually illuminated using backlighting. The switch itself is not recognizable during night driving. But the design of an adapted ambient lighting system allows the driver to perceive the contour of the switch. By this means it is possible to have a clear correlation between the function and the physical switch. In terms of traffic safety this saves valuable time: the driver can find the switch easily without having to manually feel for it. In addition to the described safety aspects, vehicle designers now also require permanent illumination inside the vehicle. The use of superior materials for interior design is very common, especially in top of the range vehicles, and this design must also be clearly visible by night.

The above observations demonstrate that there are several aspects which now favour permanent interior lighting while driving at night. These additional luminances could, however, potentially distract the driver. Extra luminances could influence the driver's adaptation level in such a way that

his or her visual performance decreases. Furthermore, inside luminances can potentially be mirrored on the windscreen, giving the driver a double vision effect. This is comparable to the impact of fog, where the contrast of the view is reduced due to veiling luminances. A further negative effect caused by poorly-adapted luminances in the vehicle is that the driver can be optically distracted. These saccades are unwanted and distract the driver.

On top of the luminances provided by ambient interior lighting, modern vehicles are increasingly equipped with more displays, offering navigation information or other vehicle-relevant data. These displays are positioned close to the vision's axis to ensure optimal readability, and can be read with only small angular eye movements. At the same time, however, the driver is in danger of distraction from the actual driving task on hand due to the additional luminances.

The influence of the different parameters of vehicular interior lighting on the visual performance of the driver shall be evaluated in this thesis. Based on this systematic investigation, the optimised and maximum values of such interior lighting shall be determined.

4 Task definition

The technical design of the vehicle's interior lighting is based on different parameters, so that examining various situations separately is highly beneficial. The requirements for a parked vehicle are different from the requirements when driving. There are also differences between users, who have different lighting design requirements; the needs of the driver, front and rear seat passengers have to be differentiated.

The parameters describing the assessment of the interior lighting are displayed schematically in Illustration 1.

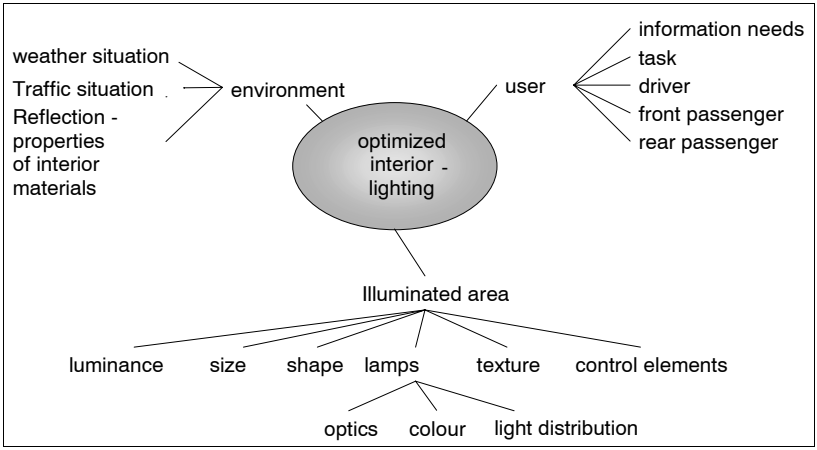

Illustration 1: Representation of the influencing parameters on an inside ambient light for motor vehicles

The demands that the driver makes on ambient interior lighting play a special role, since any negative influence on the perception of the driver must be prevented at all costs. A permanent interior lighting system must satisfy both comfort and safety issues.

The ambient lighting must support the driver in his or her perception of the interior without impairing perception of traffic. In this context, aspects like the perceptibility of control elements have to be taken into account. By choosing optimised luminances inside the vehicle, the adaptation level can be influenced positively.

The process of readaptation from inside the vehicle to the traffic is influenced positively, thus offering a gain in reaction time which can help to prevent night-time accidents.

The parameters influencing the assessment of an ambient interior lighting shall be determined based on physiological experiments. In so doing, both objectively measurable criteria and psychometric assessments shall be employed as a scale. From the results of the physiological trials, design rules shall be worked out for the description of the interior ambient light.

The possible consequences of a technical realization shall be shown and taken into account in a concept for the design of the ambient interior lighting system. If the findings are not within the existing legal guidelines, then trials seeking a solution should be made.