Nighttime Traffic Glare Analysis by Measurements and new Statistical Evaluations

DVN Glare Forum

2025-02-18, Munich

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Introduction
Influence Factors on overall Glare Ratings ?

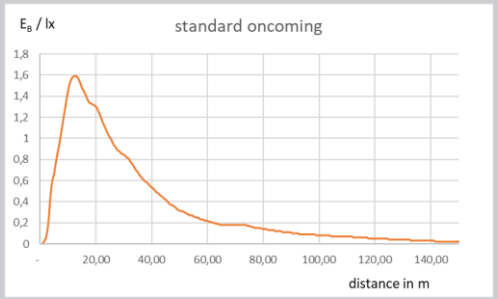
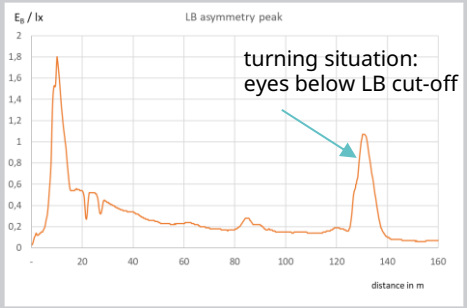
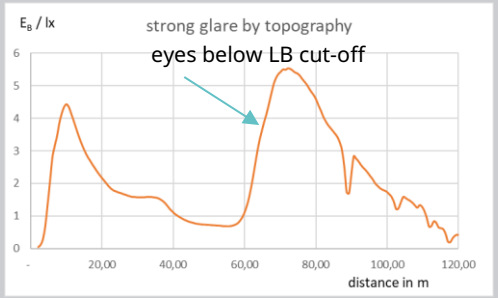
1. Increased traffic density ?
2. Increasing percentage of LED Headlamps ?
3. Light source color temperature ?
4. Incorrect LB aiming ?
5. Dirt on outer lens ?
6. Dynamic vertical inclination of the vehicle ?
7. Percentage of projection systems increasing ?
8. Average installation hight ?
9. Average driver‘s eye hight position ?
10. Sharpness of LB cut-off gradients ?
11. Higher average performance level of LB & HB ?
12. Road topography ?
13. Camera controlled automatic High Beam & ADB ?
14. Size of the LB light output area ?
15. .....

Glare Reduction:

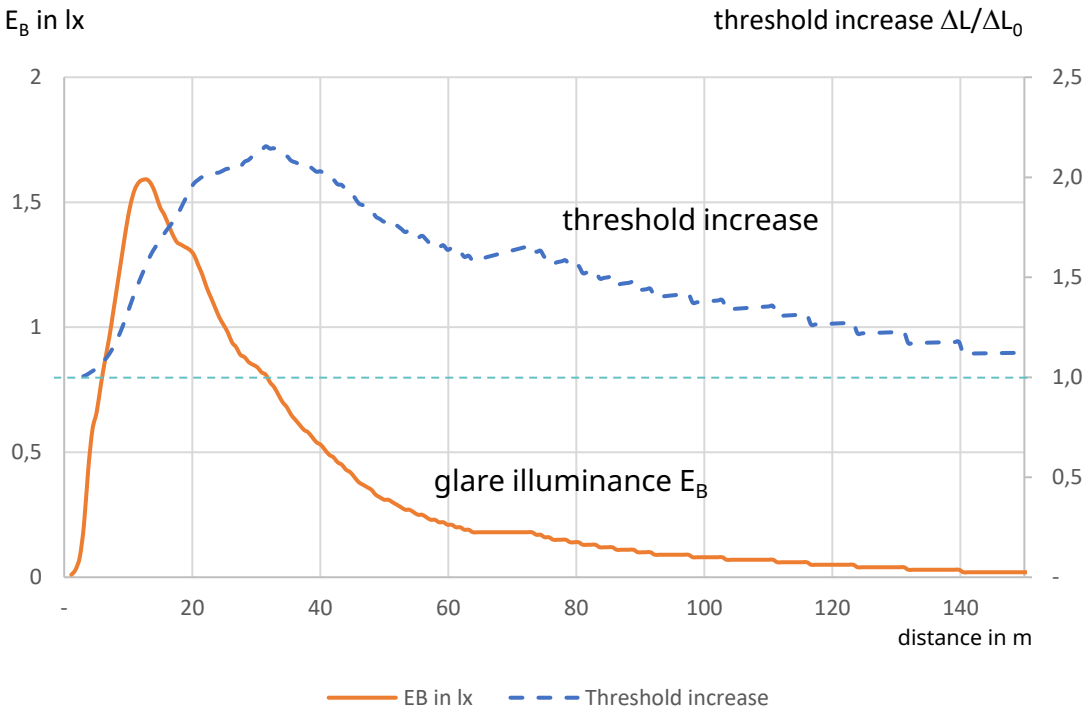
1. **Step:**
   Which effects are the most relevant ?

2. **Step:**
   According to step 1 the most effective countermeasures should be defined

Classification of Glare Conditions & Glare Indicators
Based on Research Results and Statistics

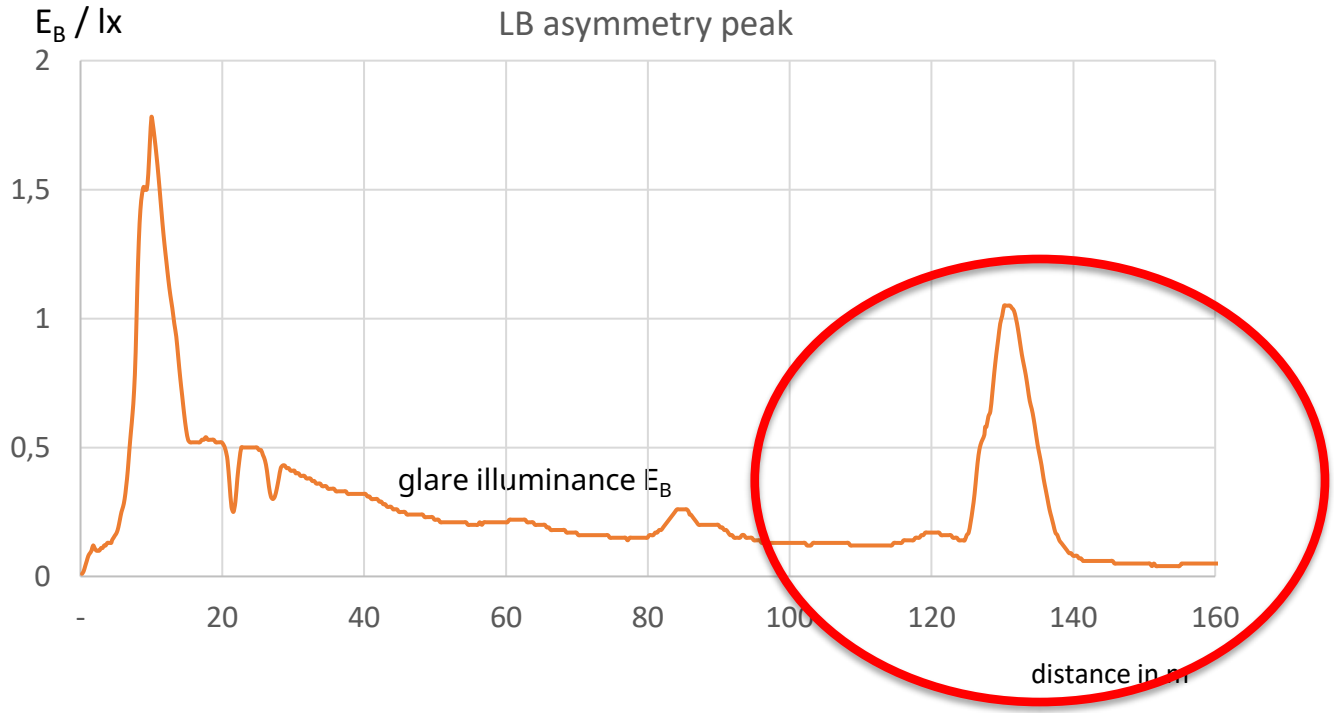
moderate glare level		strong glare level
Standard oncoming: physiolocical & psychological glare Rating > 5 (de Boer scale) $\Delta L / \Delta L_0 \approx 2$ (typical level) H < 2,5 lx*s (exposure)	**Observer's eyes below LB cut-off** **=> additional peak:** dynamic effects, mis-aim, asymmetry, etc. Rating >5 (de Boer scale) Pulse exposure $H_{pulse\ offset} \approx 1$ lx*s	**Observer's eyes below LB cut-off:** $\Delta L / \Delta L_0 >> 2$ significantly increased Readaptation time: 1...4 sec
		

Headlamps on the Roads in 2025
Typical Oncoming Situation



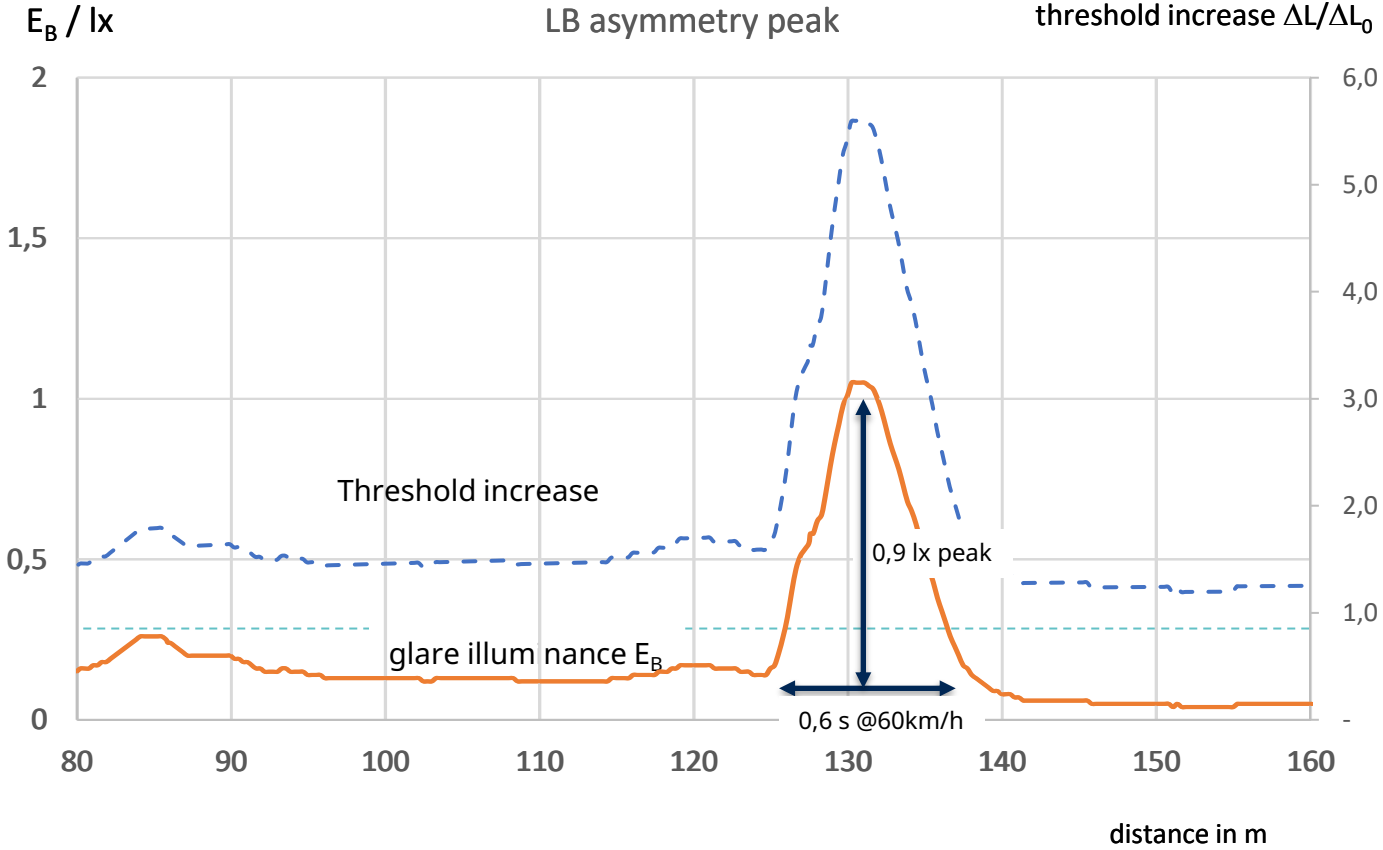
Headlamps on the Roads in 2025

Glare Effect in Turning Situation (Asymmetry)



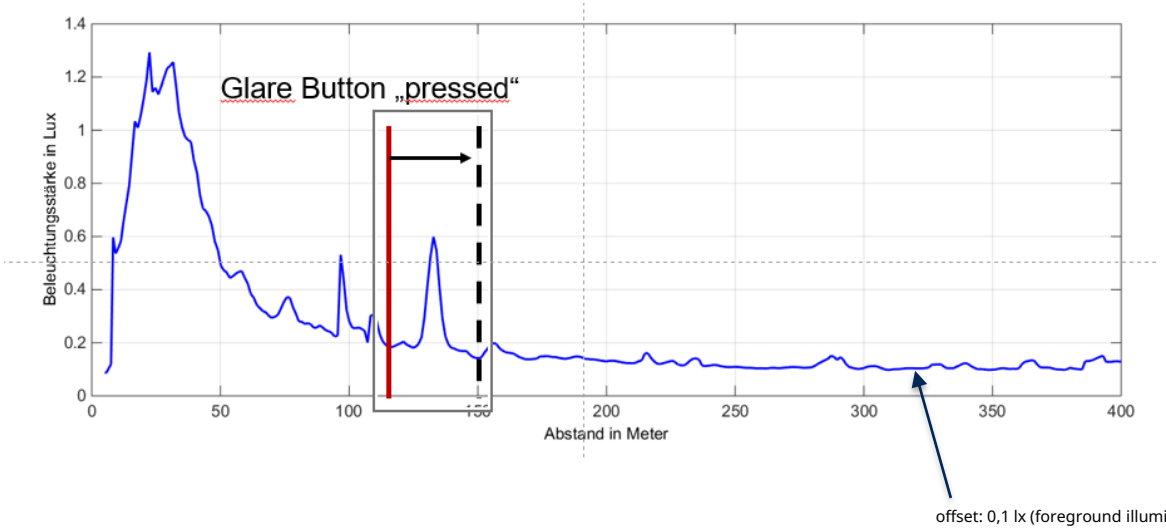
Headlamps on the Road in 2025

Glare Effect in Turning Situation (Asymmetry)



TU Darmstadt (Khanh, Kobbert, Kosmas 2016) Levelling & Glare

Dynamic Glare Effect

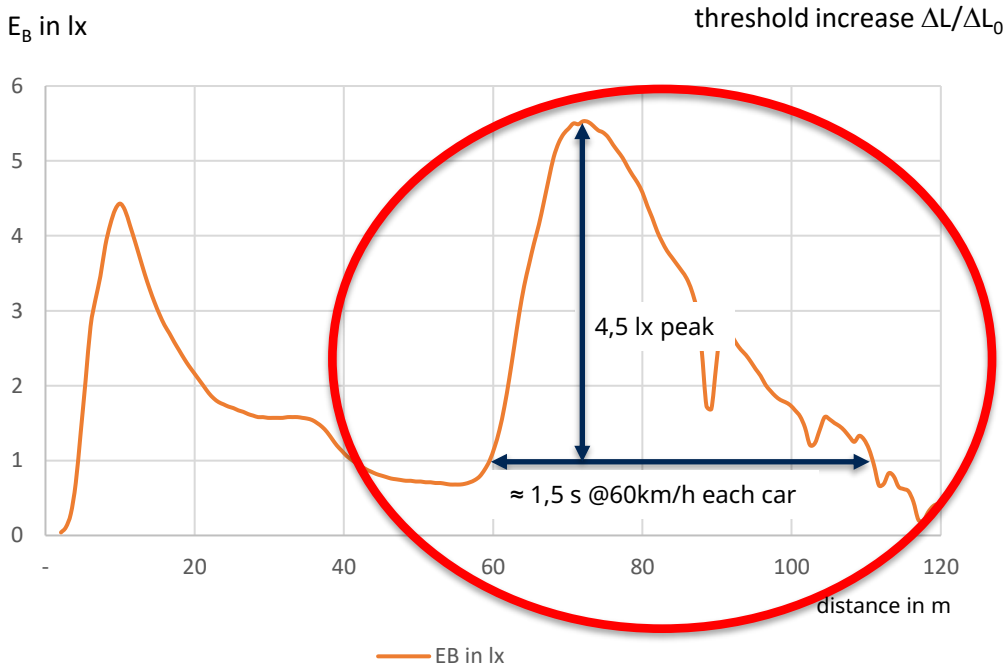


Analysis:

ΔE = 0,4 lx in 125 m distance

(@ 25m: 10 lx (5 lx each headlamp: not above, but close to cut-off) => glare feeling, but moderate glare level

Headlamps on the Roads in 2025
Glare caused by Road Topography



exposure H_{Peak} = 3,4 lx*s
exposure H_{total} ≈ 7 lx*s

=> strong glare

Analysis:

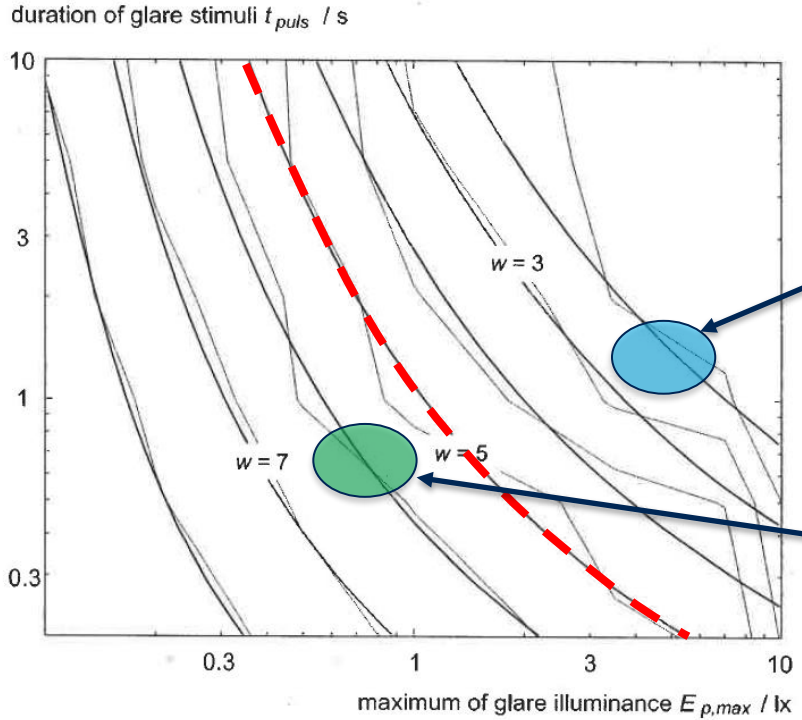
ΔE = 5,5 lx in a distance of d = 70 m

(@ 25m: 43 lx (=> 21,5 lx @ 25 m from each headlamp)

Subjective Glare Rating

P. Lehnert, TU Darmstadt, 2001

$w = 1$	3	5	7	9
unbearable	disturbing	just acceptable	satisfactory	just noticeable



strong glare

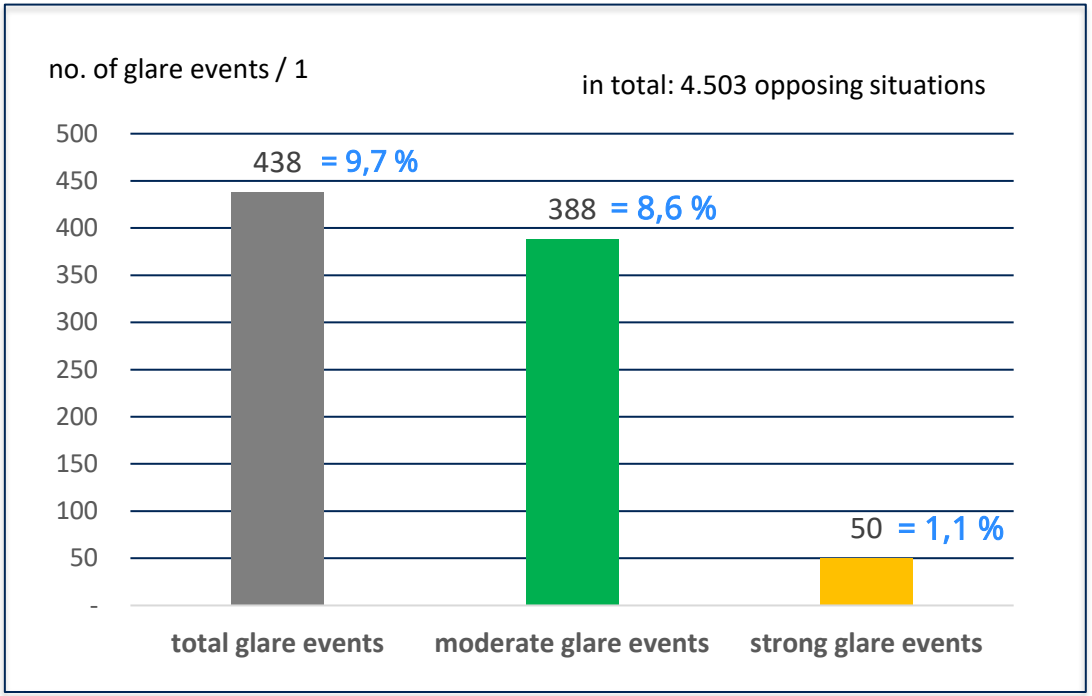
moderate glare

Statistics about Glare Events

Nighttime Driving on Country Roads and in Town Situations

Definition:

Glare Event = Situation with vehicle driver's eyes below low beam cut-off of oncoming headlamp(s)

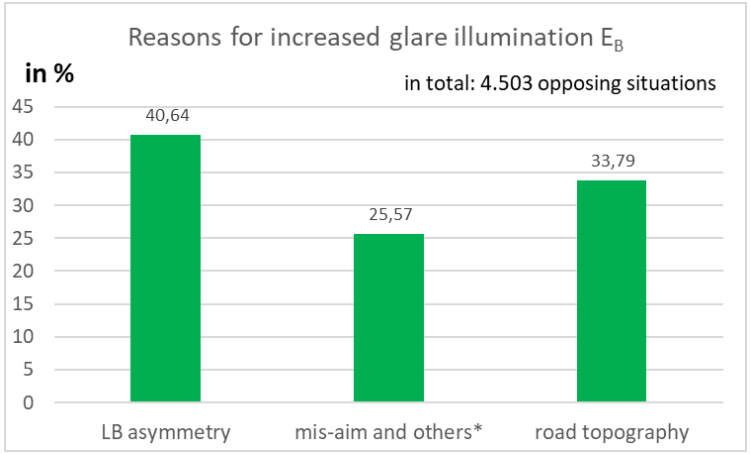


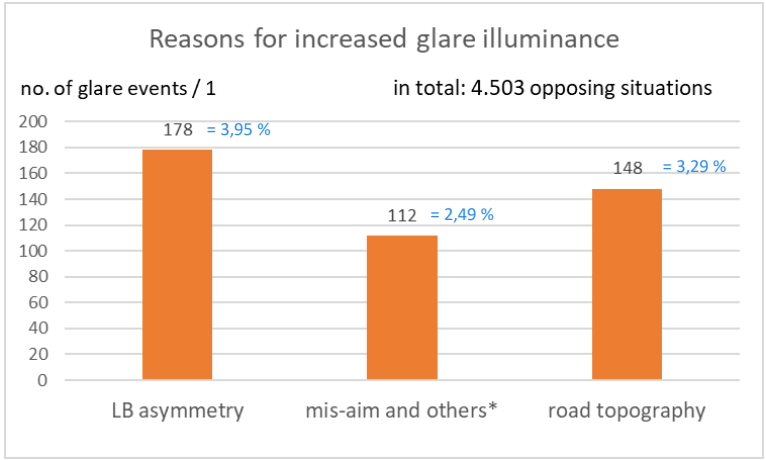
Split in 3 categories:

Glare caused by:

1. Asymmetry
2. cut-off mis-aim
3. Road topography

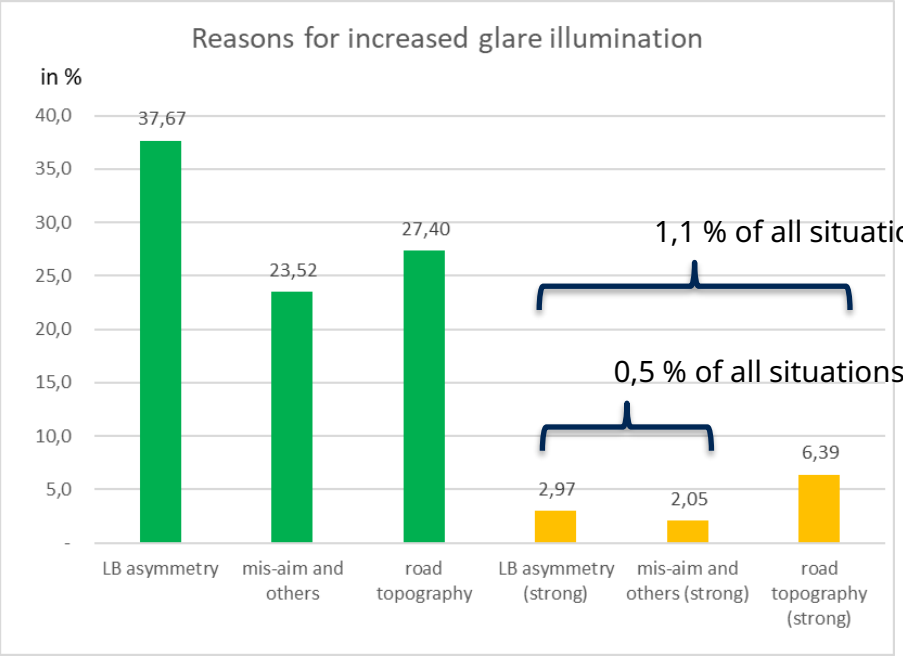
Statistics about Glare Events
Nighttime Driving on Country Roads and Town Situations





Statistics about Glare Events

Nighttime Driving on Country Roads and Town Situations



* mis-aim and others: car inclination caused by load, mis-adjustment, high beam on, ...

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Thanks!