Problems of night time traffic and new steps of solutions ...

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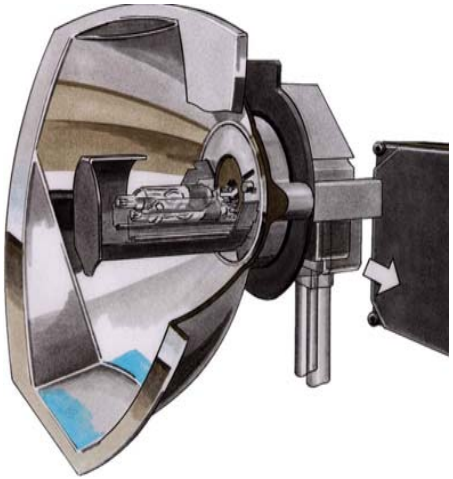
Agenda

- Introduction
- Aims
- State of the art
- Measuring of recognition distance
- Planned examinations
- Summary

Development has been affected by …

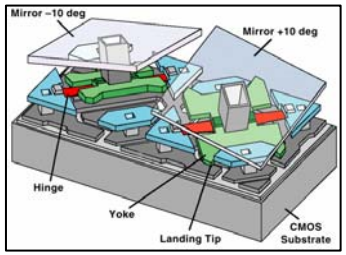
During the last 10 years:

- Gas Discharge Lamps
- New strategies of reflectors
- Dynamic bending Light (2003)



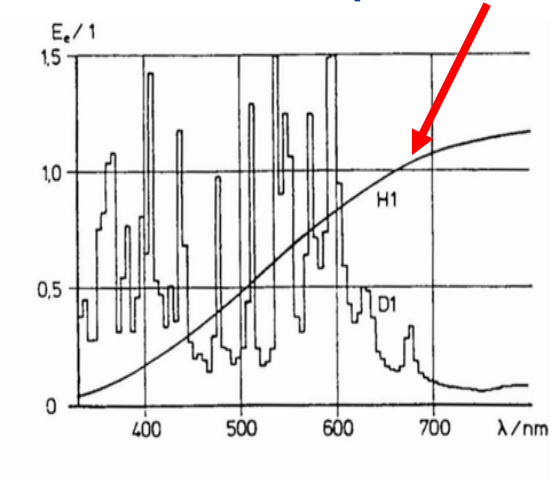
In the future:

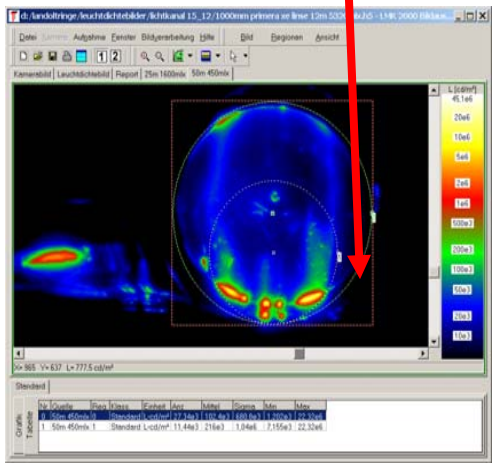
- Adaptive front lighting system (2006)
- LED headlamps (2008)
- DMD headlamps

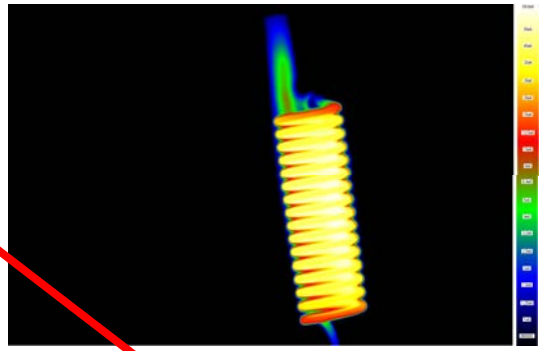


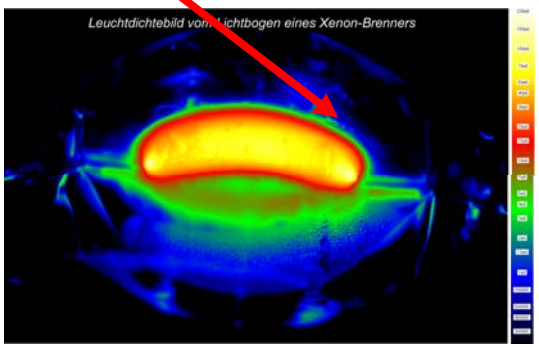
Consequences of this Development …

- Higher Luminance
- Very inhomogeneous luminance distribution or extreme peaks
- Different spectral distributions









More safety?

What are the criteria for the evaluation of such new headlamps ?

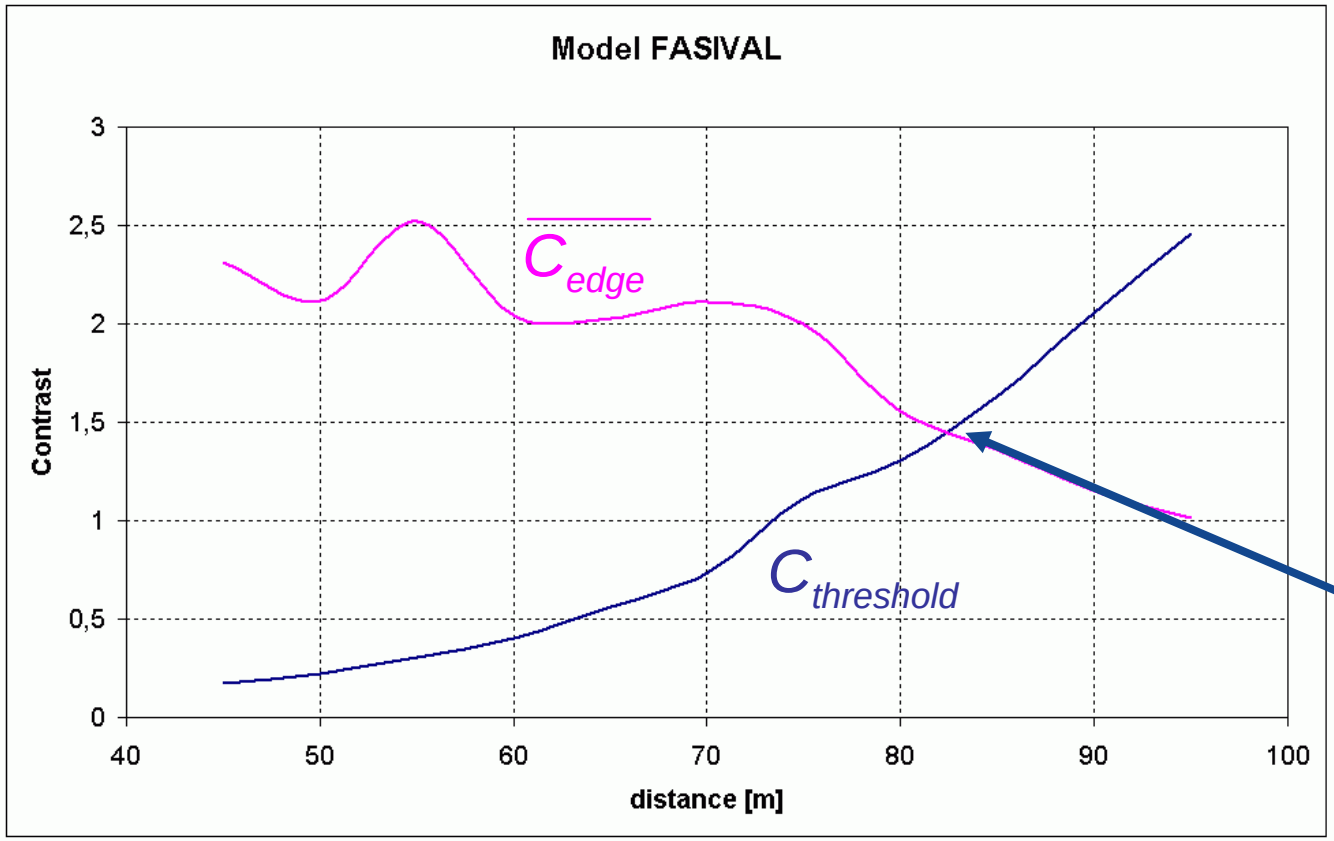
Why don’t we find a label for the recognition distance of our headlamp?

What can we say to the brightness evaluation of light distributions under mesopic conditions?

… for all these questions – we are looking for answers …

1. Recognition distance under mesopic conditions

Model of Kokoschka - FASIVAL

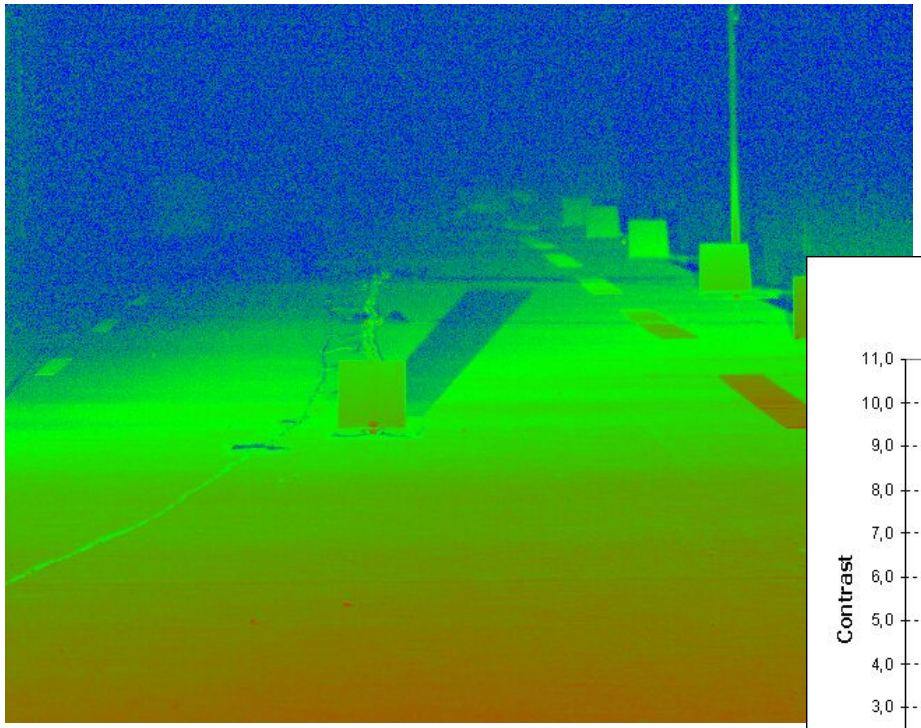


$$VL = \frac{\overline{C_{edge}}}{C_{threshold}}$$

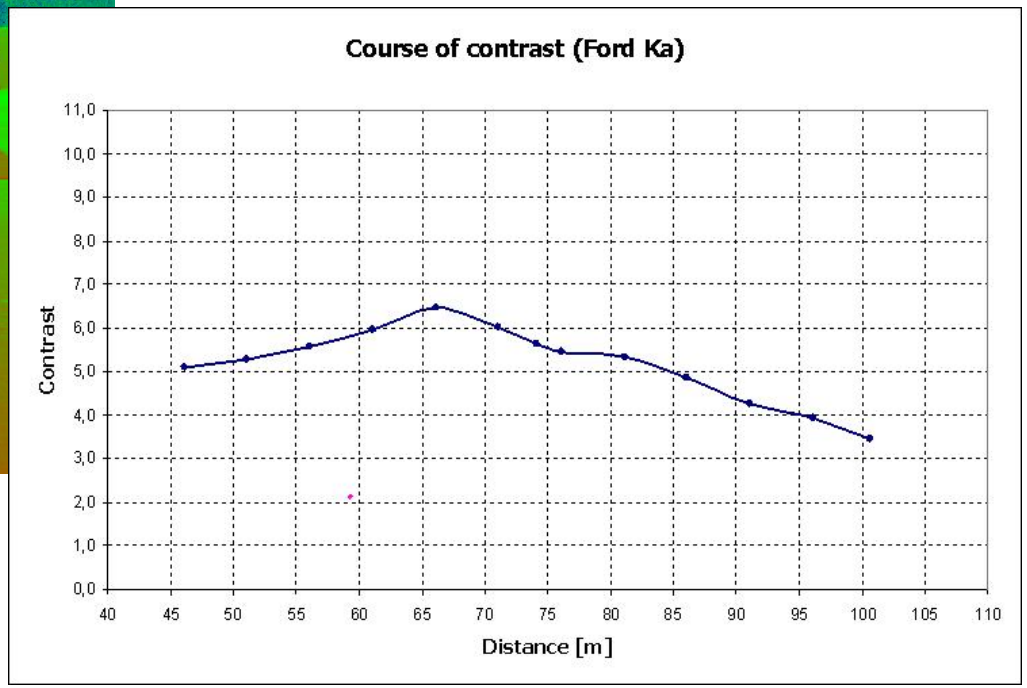
VL_{Grenz}

object becomes visible

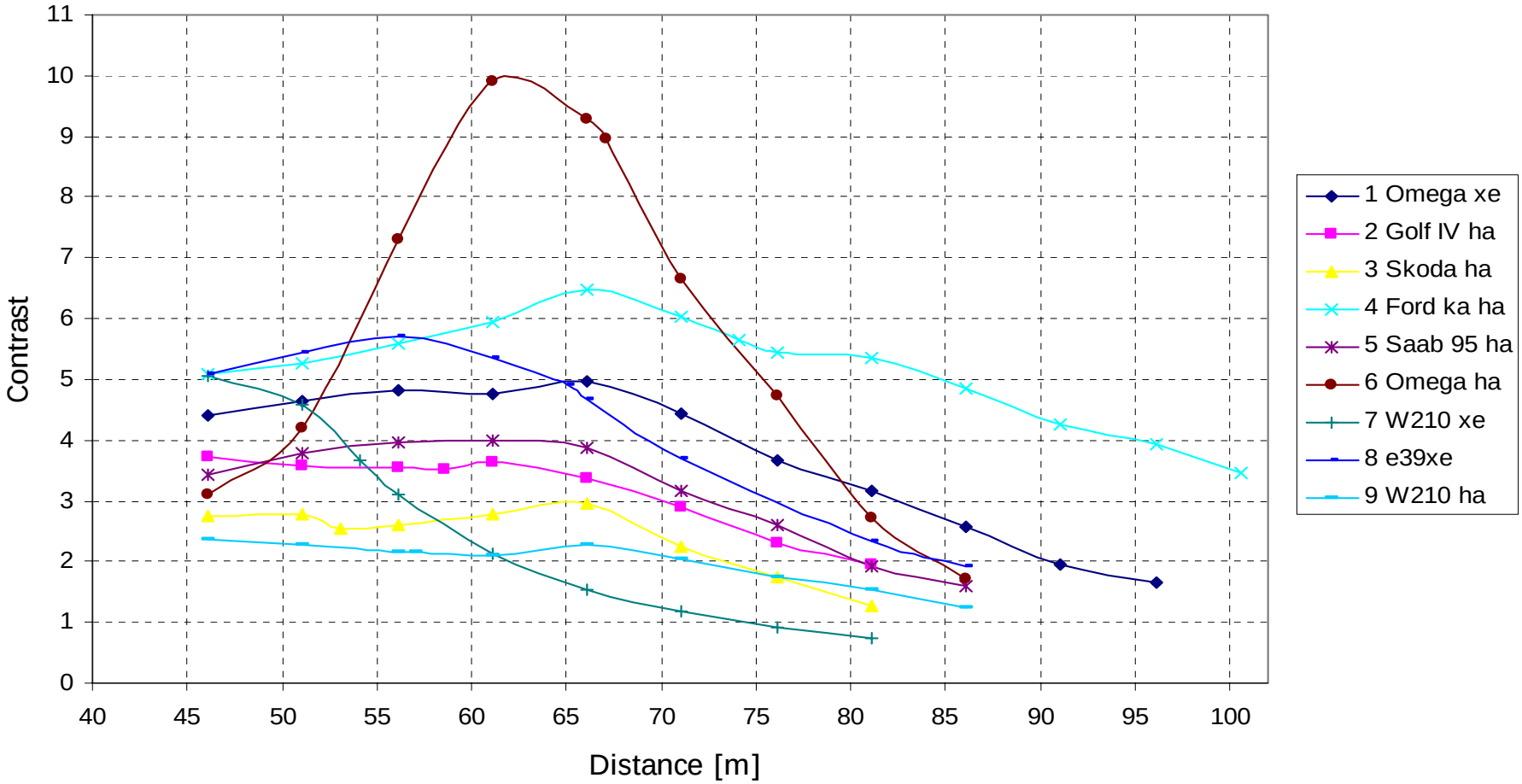
Courses of contrast



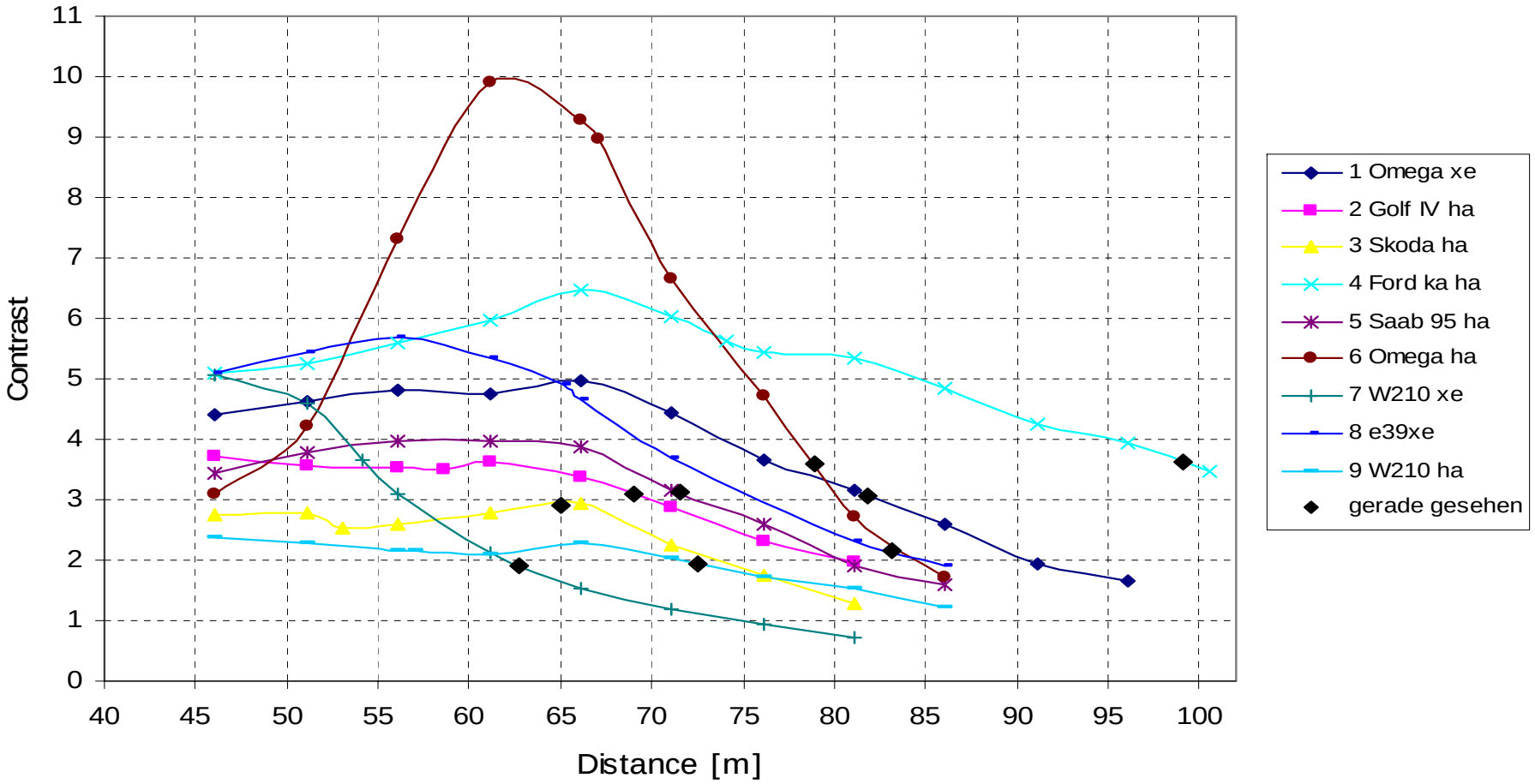
$$C = \frac{L_O - L_U}{L_U}$$



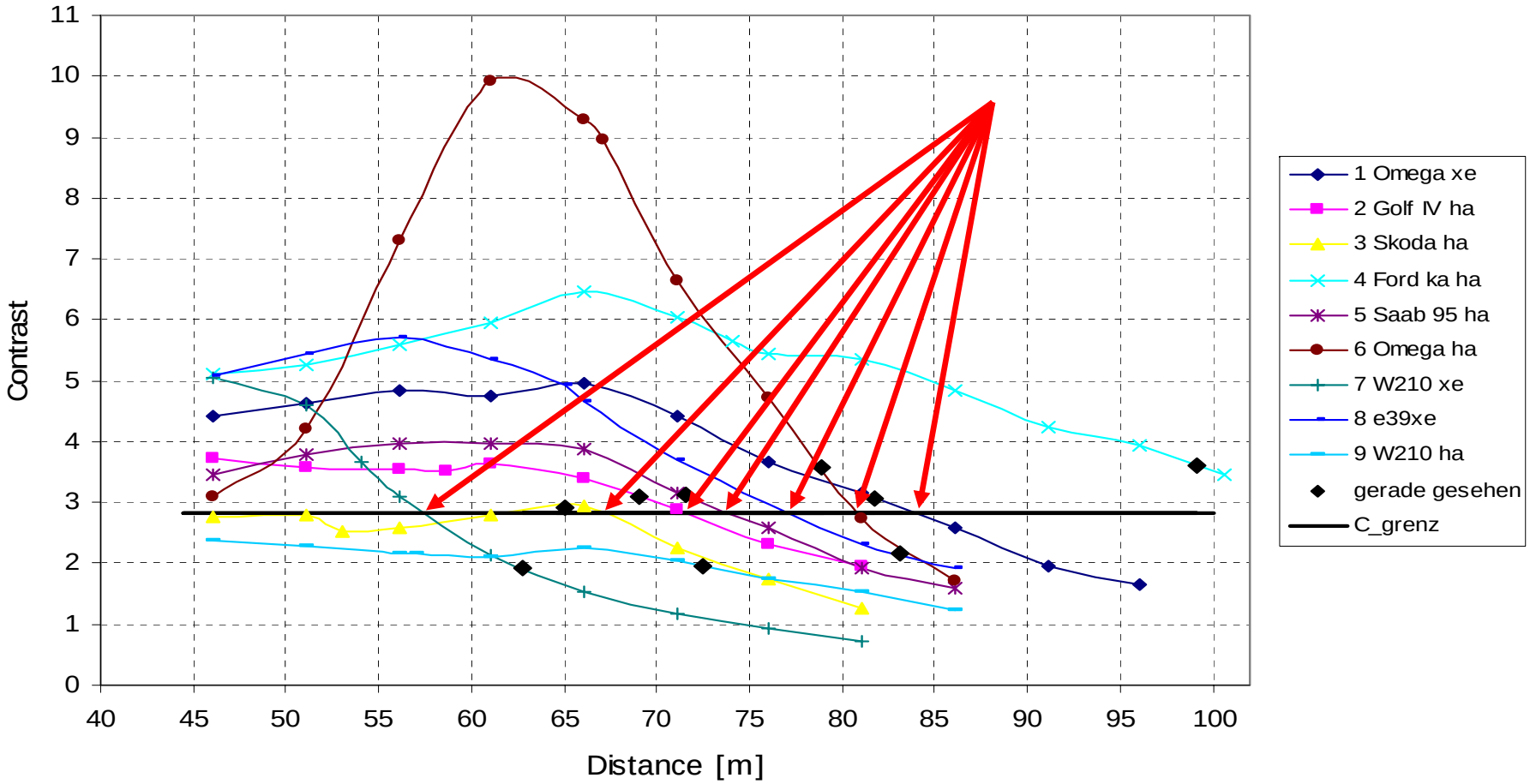
Courses of contrast

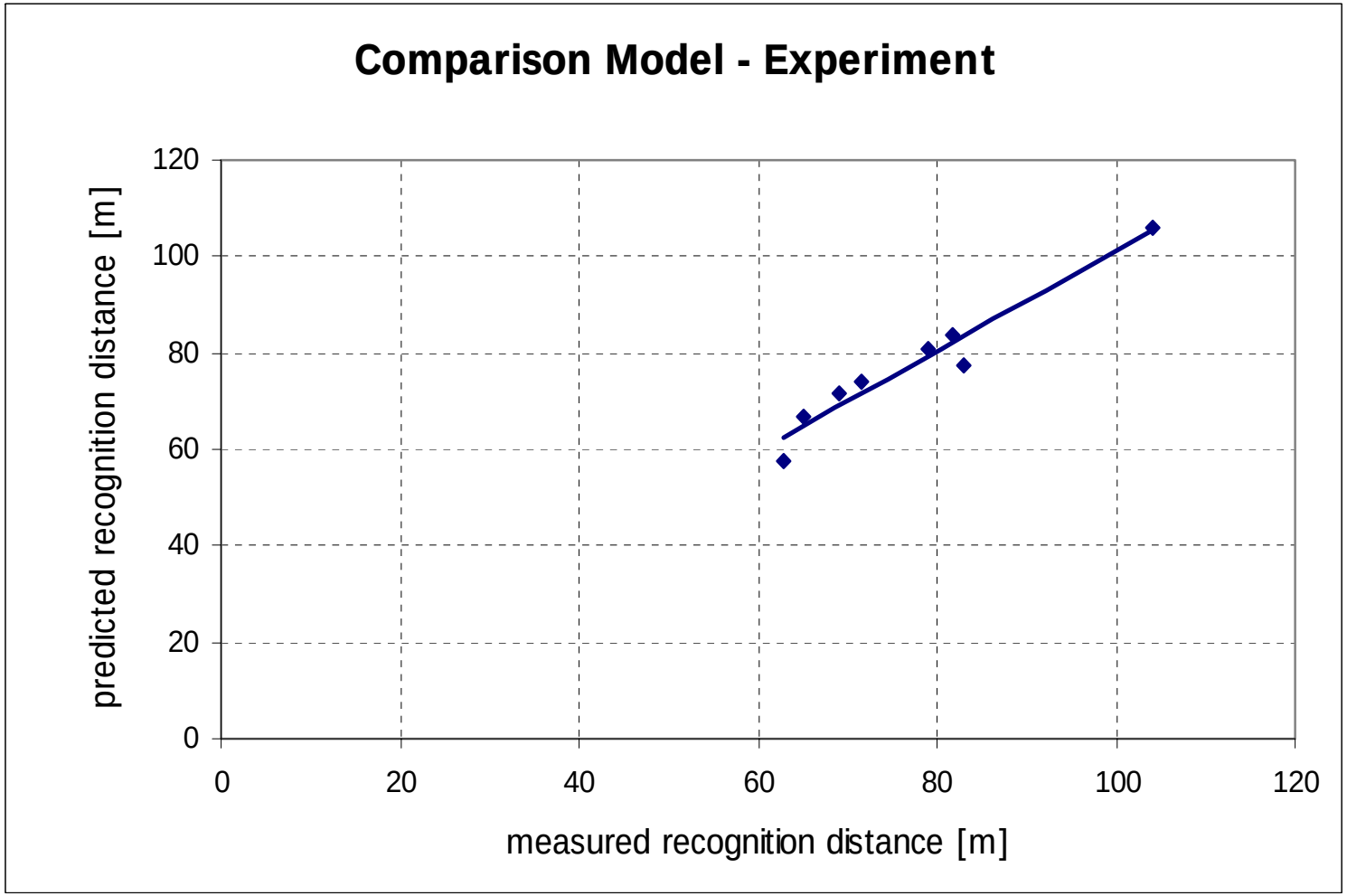


Courses of contrast + recognition distances



Courses of contrast + recognition distance

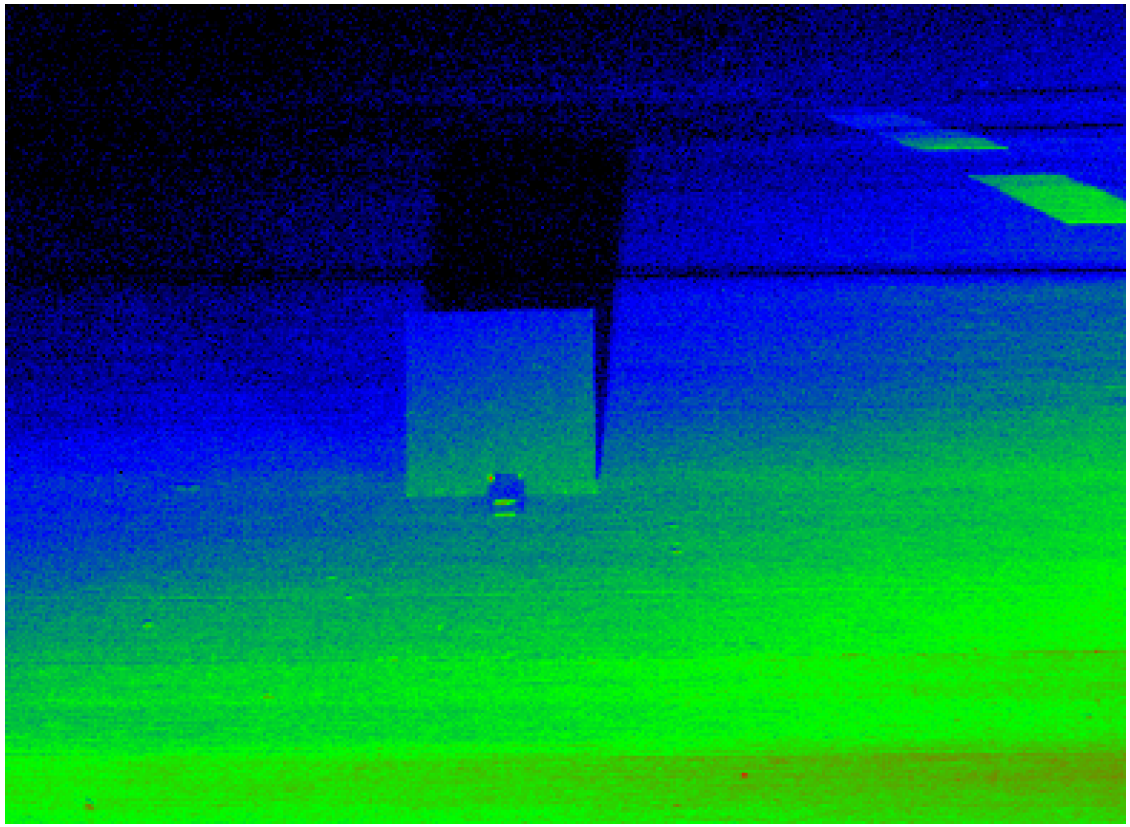




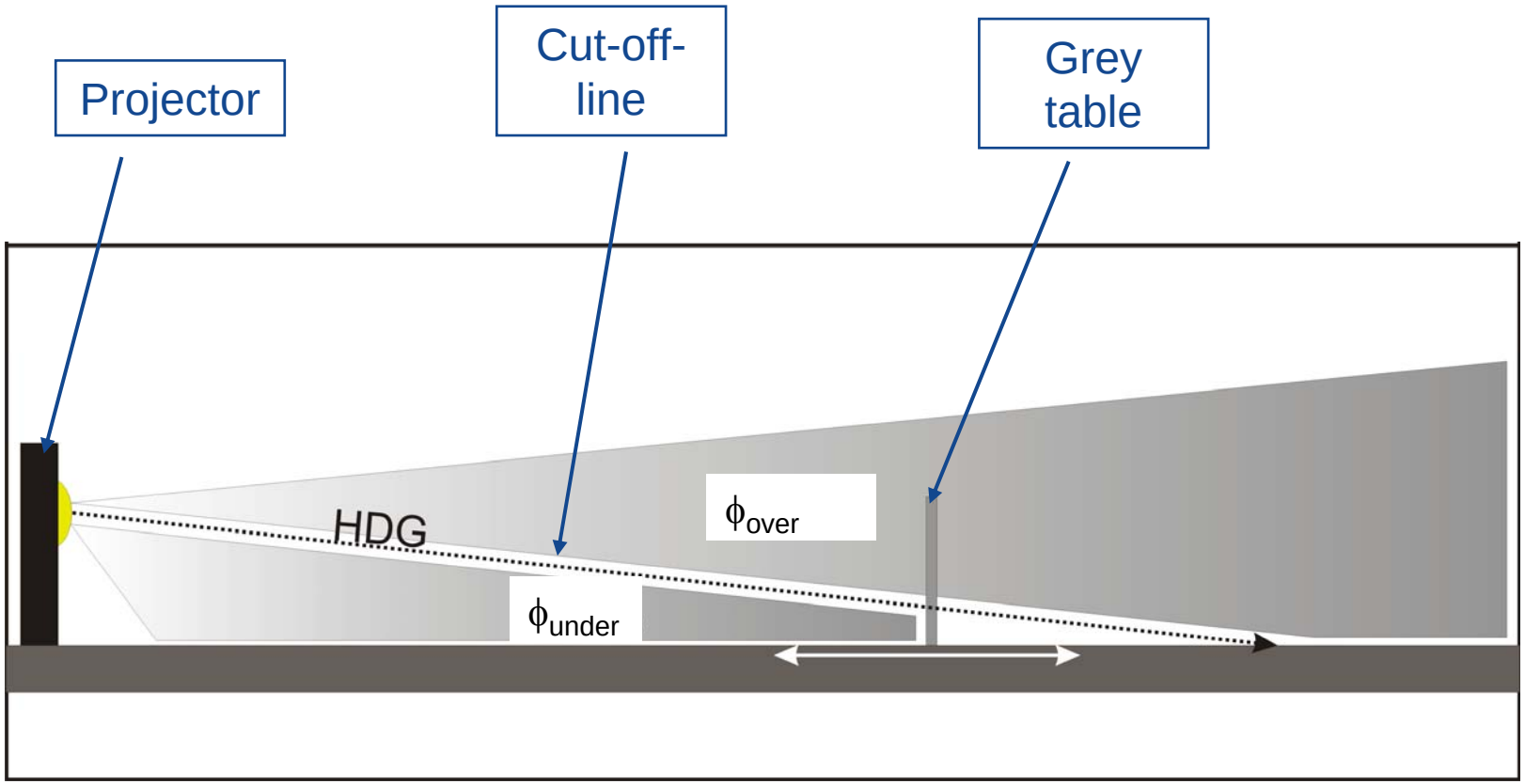
Planned Examinations

a) Effect of perspective on recognition distance

different angles of view → different shadows

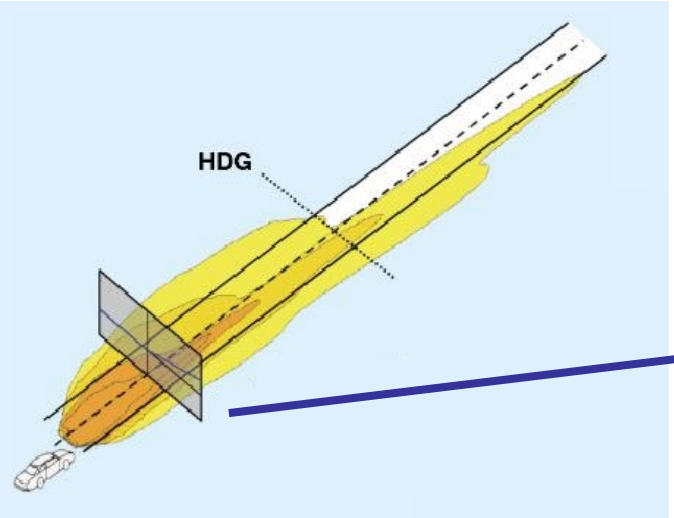


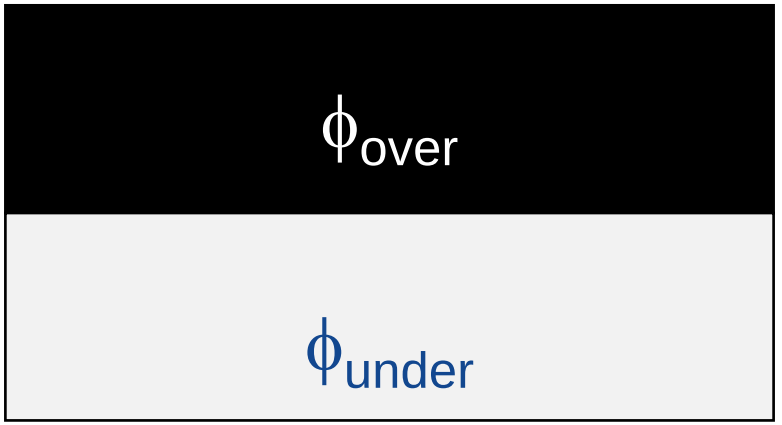
b) Luminous flux over & under the cut-off-line



Planned Examinations

Projected figure on a vertical wall in 25 m:



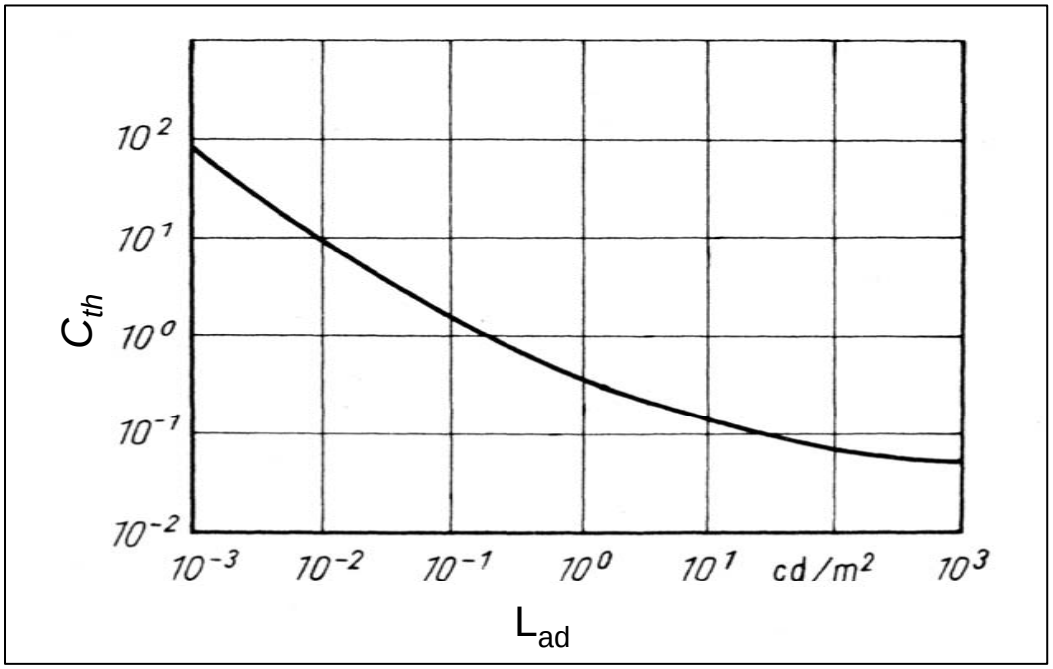


Describing quantity for recognition distance:

$$\frac{\phi_{over}}{\phi_{under}}$$

c) Effect of adaptation luminance on recognition distance

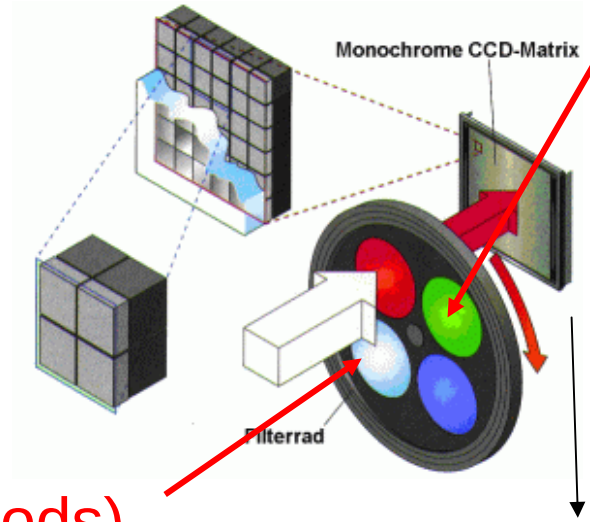
What is the adaptation luminance?



2. Evaluation of brightness

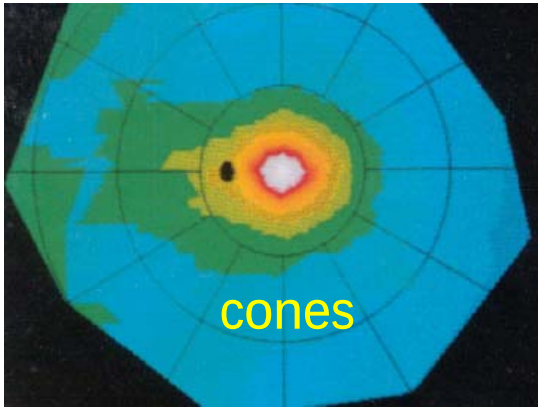
New measuring systems for mesopic conditions: Imaging luminance measurement device

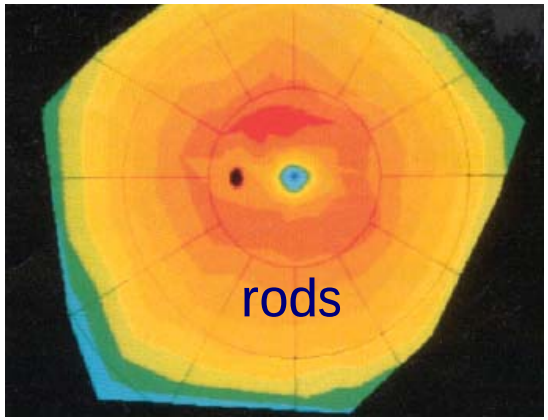
L (of cones)



L’ (of rods)

Can combine both pictures according to the distribution of the receptors





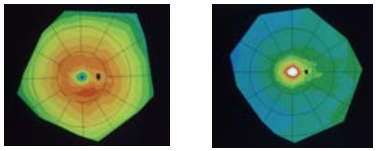
[Curcio90]

So we can consider:

1. different sensitivity of brightness (rods < 16 cd/m² cones > 0,01 cd/m²)
2. different spectral sensitivity (rods V'(); cones V())
3. different form sensitivity (interconnection of receptors)

model of the human eye

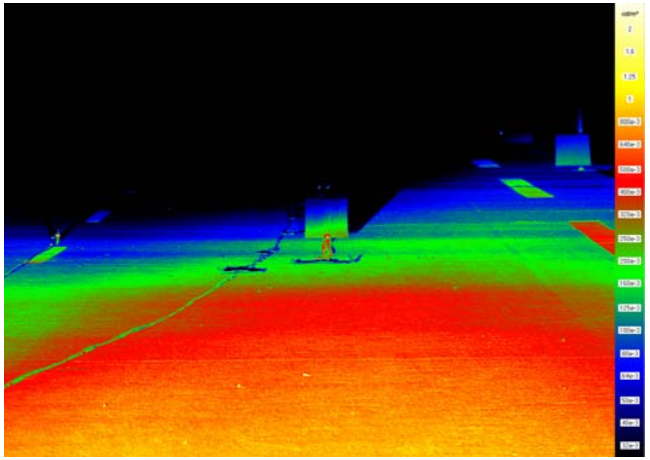
resolution of the retina and of the human eye



spectral sensitivity of the retina

stray light & diffusion

geometrical aberrations



luminance picture

MOVE - Mesopic Optimisation of Visual Efficiency

Results:

- Linear Model:
  - applicable in situations with broad spectral power distributions

$$M(x)\cdot V_{mes}(\lambda)=x\cdot V(\lambda)+(1-x)\cdot V'(\lambda)$$

$V_{mes}(\lambda)$ … relative spectral luminous efficiency function
M(x) ... normalizing function
x … $f(L_{BGr,ph},L_{BGr,scot})$

- Chromatic Model:
  - stimuli with narrow spectral power distribution

$$V_{mes}(\lambda)=a_1V(\lambda)+a_2V'(\lambda)+a_3\left|L(\lambda)-a_4M(\lambda)\right|+a_5S(\lambda)$$

new attempts

- MOVE:

visual performance
What can the human eye perceive? → general laws of perception, model of measurment

- new attempt:

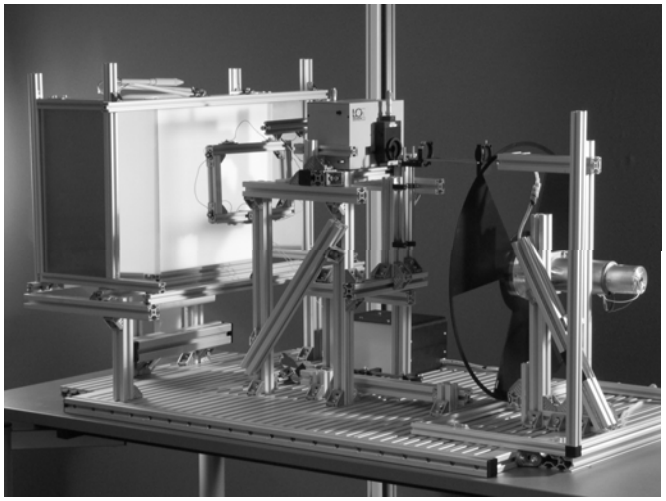
model of the human eye → What can the human eye recognise / perceive?

↓

modified luminance measurement

new attempts

- V(λ)-measurement
  - reproduce spectral luminous efficiency functions under several conditions:
    - photopic and mesopic up to 0.01 / 0.001 cd/m^2 adaptation luminance
    - several field sizes
  - methods of the heterochromatic brightness matching and flicker photometry



Thank you for your attention!