From Simulation to Reality

Physical-realistic simulation
(not photo-realistic)

AutoSens

YOUR effect ONE effect

Nvidia Keynote from CEO Jen-Hsun Huang,
https://www.youtube.com/watch?v=Z2XINfCtxwI

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AutoSens

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Astigmatism*

Sharpness gradient

* Blurred in one direction, sharp(er) in the other

AI Performance

… this arrow?

Is this arrow…

… easier / same / harder to recognise than …

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Simulating tests to test simulation

AutoSens

$\Delta z = -0.5$

$\Delta z = +0.5$

Road markings — an opportunity to change reality

The BELLAROMA Project

Road markings

https://images.app.goo.gl/J4xzfn5o9dGCdKvu8

Safety relevant

https://images.app.goo.gl/PtvWeeoNuYDXPfmz9

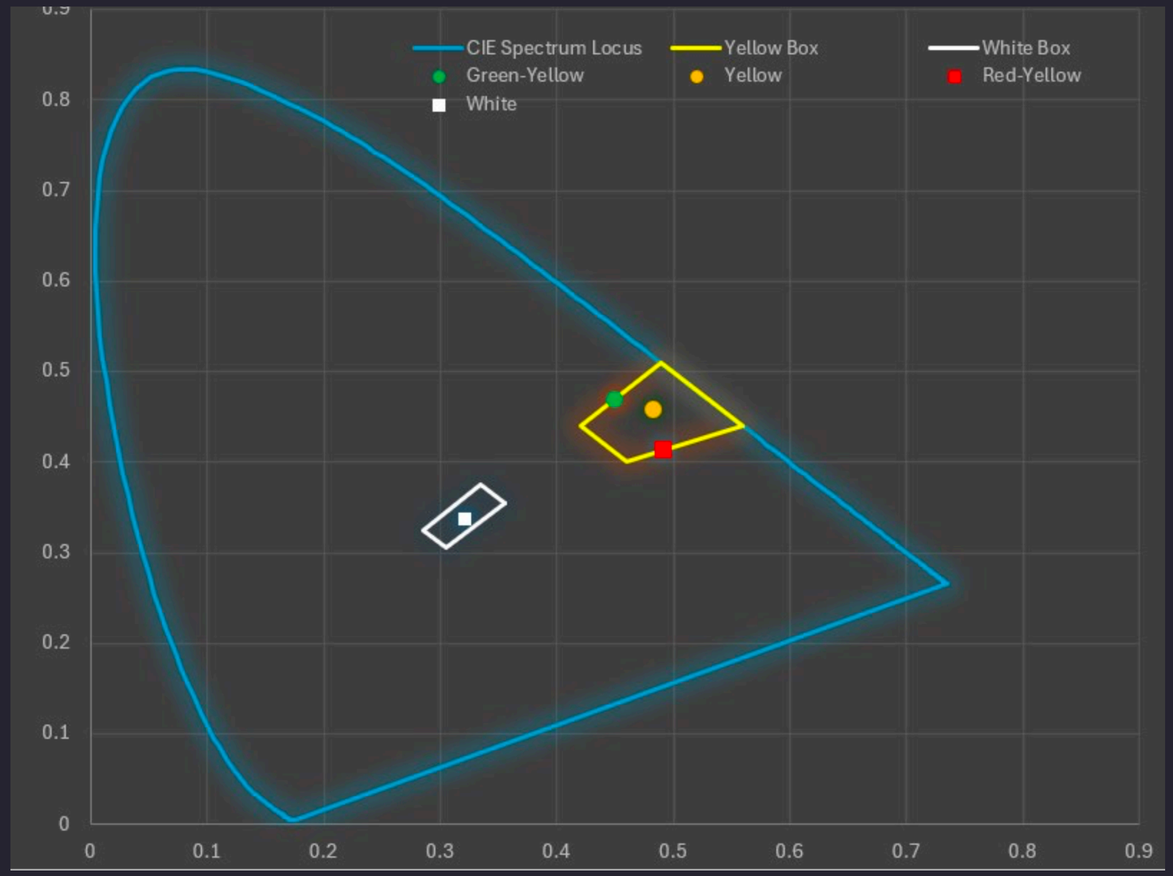
Fast turn-around: every three years, five the latest!

Goal: improve road-markings for camera consumption by standardizing both road markings and the observer

Specified in color space

Which one is better for camera visibility? Interaction with IR-cut filter?

Actual samples produced for the BELLAROMA project



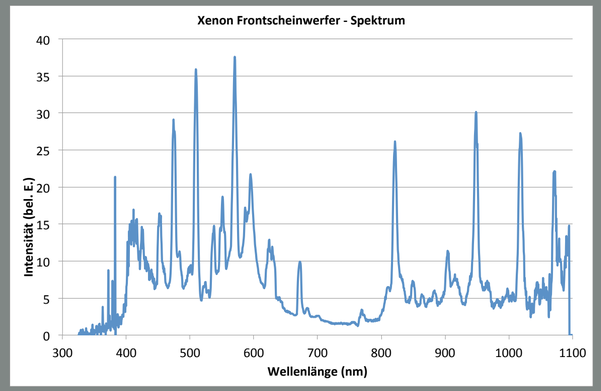
What about IR?

https://en.wikipedia.org/wiki/Infrared#/media/File:Atmosfaerisk_spredning-en.svg

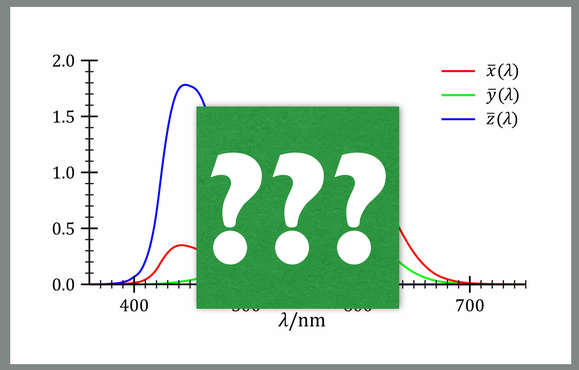
https://www.lynred.com/e-learning/infrared-detection-basics

How to measure color

Measure a **Spectrum**



Define a new standard **non-biological observer**



Integrate for **Color Values**

$$X = \int_\lambda L_{\mathrm{e},\Omega,\lambda}(\lambda)\,\overline{x}(\lambda)\,d\lambda,$$

$$Y = \int_\lambda L_{\mathrm{e},\Omega,\lambda}(\lambda)\,\overline{y}(\lambda)\,d\lambda,$$

$$Z = \int_\lambda L_{\mathrm{e},\Omega,\lambda}(\lambda)\,\overline{z}(\lambda)\,d\lambda.$$

Non-biological observer
Official CIE Research Forum!

ASAM

Join us!

IS IT TIME FOR A NON-BIOLOGICAL REFERENCE OBSERVER?

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Abstract

Advanced Driver Assistance Systems (ADAS) play a relevant role in compensating for human physical limitations and increasing road safety. Cameras and sensors (e.g., lidar) are crucial for a vehicle to sense and perceive road surroundings and act to increase driving safety. Thus, driving is no longer a human-only visual task. Camera systems have been developed over many decades with the human visual system as a reference, both as a technical basis (e.g., the choice of colour filter arrays) as well as the final application, providing an image to the driver. Increasingly, this reliance on the human visual system limits the development and performance of ADAS functionality, as the consumption of the images by a computer vision algorithm has distinctly different requirements than the human visual system. In this article, we detail these differing requirements with examples from automotive applications, to support the need for a new non-biological reference observer like the CIE photometric reference observer for colours.

https://store.accuristech.com/cie/standards/cie-x050-op029?product_id=2578999

cie

International Comm ation
Commission Interna ge
Internationale Bele n

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TOWARD A NEW CIE REFERENCE OBSERVER NON-BIOLOGICAL

RF Number RF-06
The scope of this Research Forum is to aggregate all interested parties and provide a road map for the definition of a new reference non-biological observer, especially for road applications.

To apply to participate in this RF please complete the CIE Technical Committee and Research Forum Membership Application Form, sending it to the CIECB for follow-up with the RF Convener.

Establishment:
Wednesday, February 21, 2024
Convener Name: Paola Iacomussi

https://cie.co.at/researchforum/rf-06

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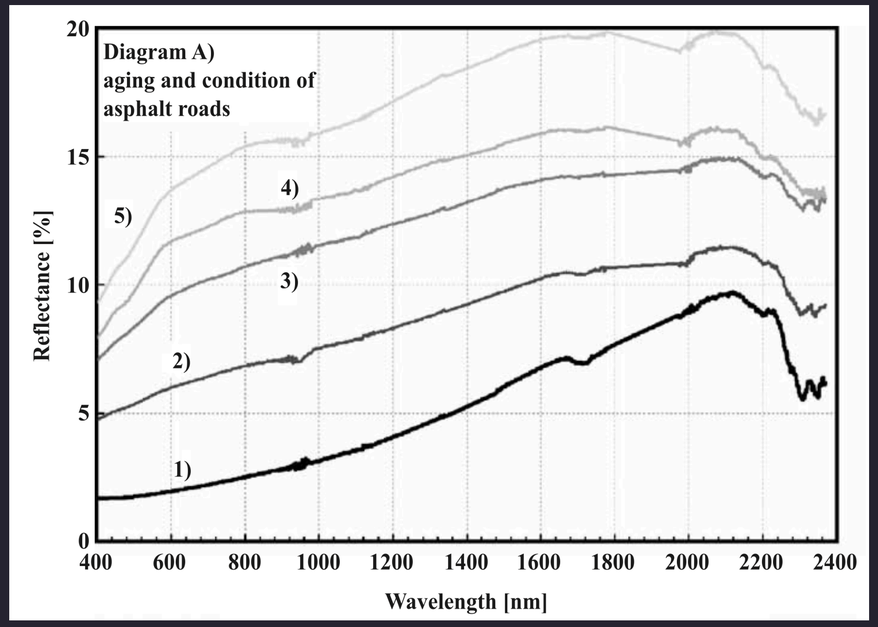
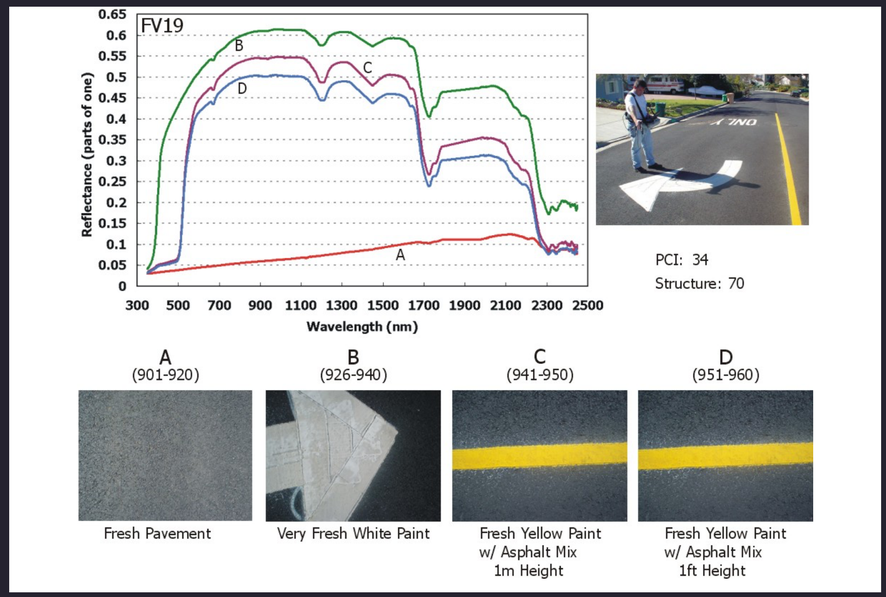
First simulation results

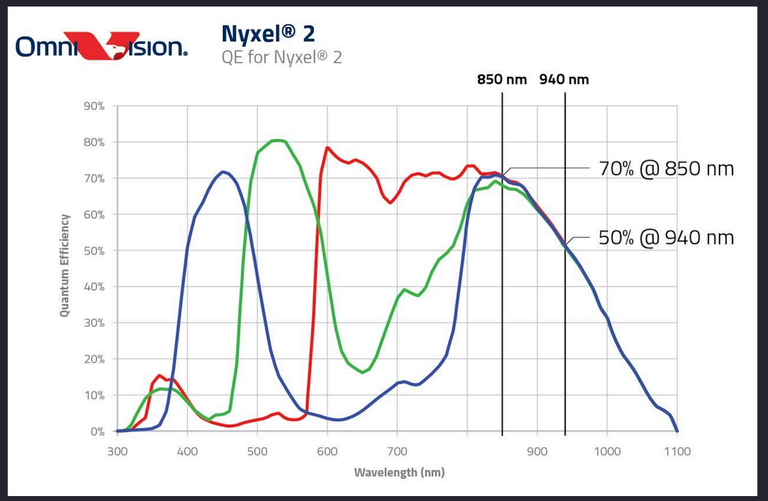
Different Road Surfaces and Aging



Different Lane Markings



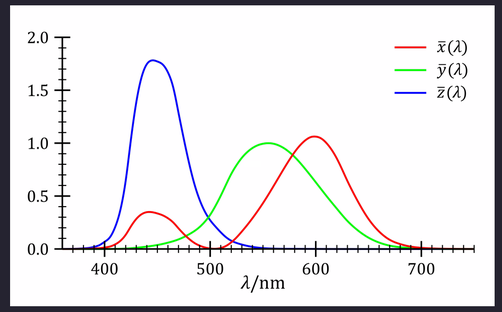
Different CFAs with IR



From simulation to reality

Basic research for direct application

- **Physical-realistic**, not photo-realistic
- Road markings are a great opportunity to **improve safety in reality by simulation**
- **Don’t constrain** technical systems by human limitations



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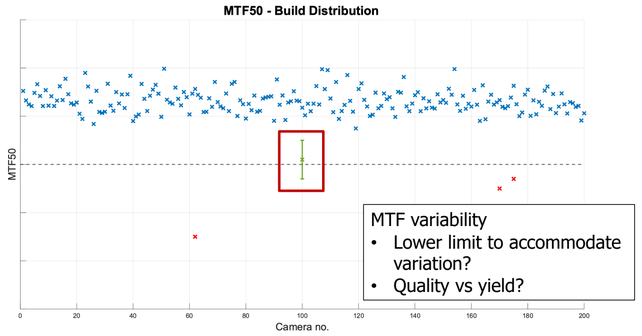
Danke Schön

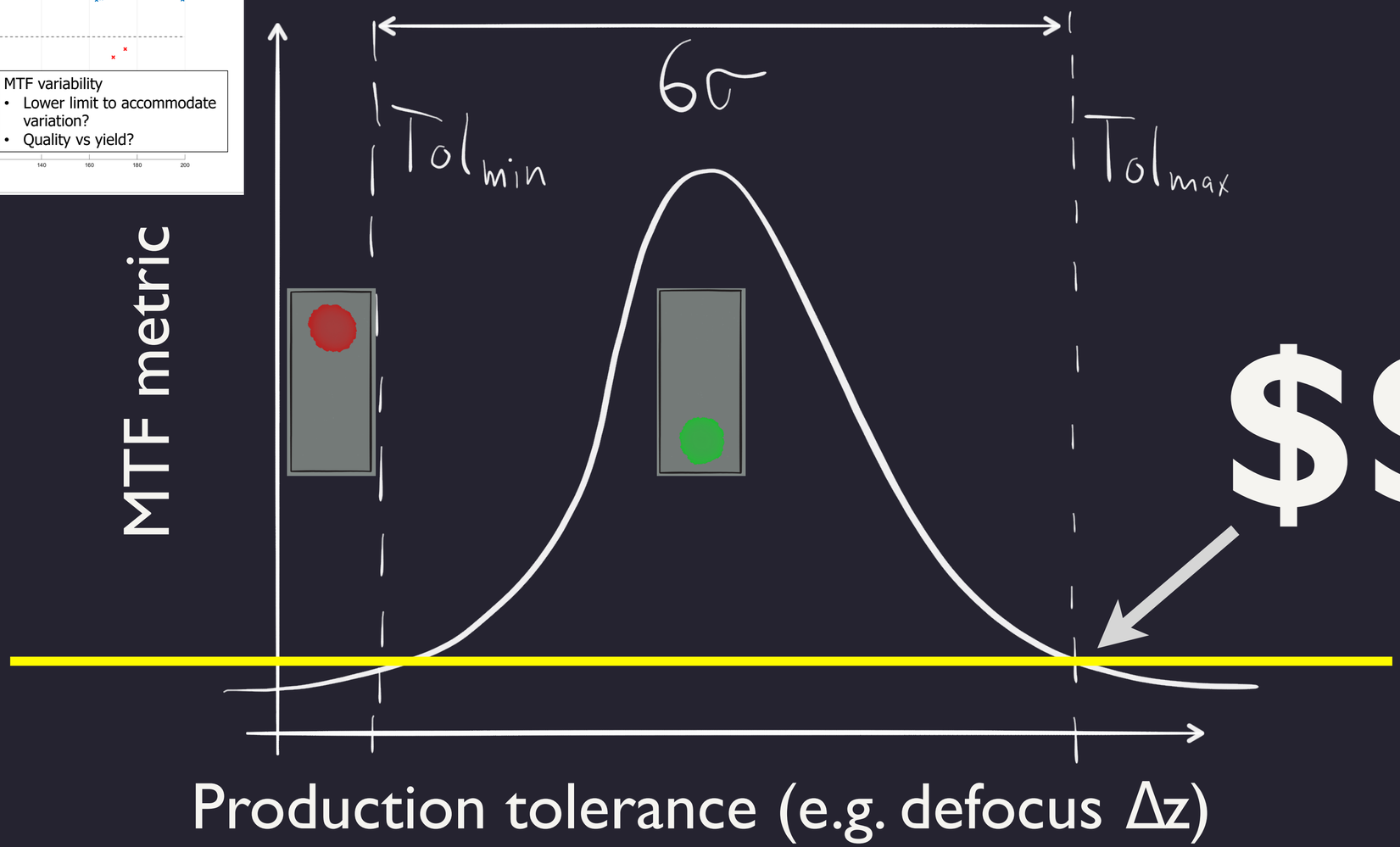
Contact info

ASAM

MTF = MONEY

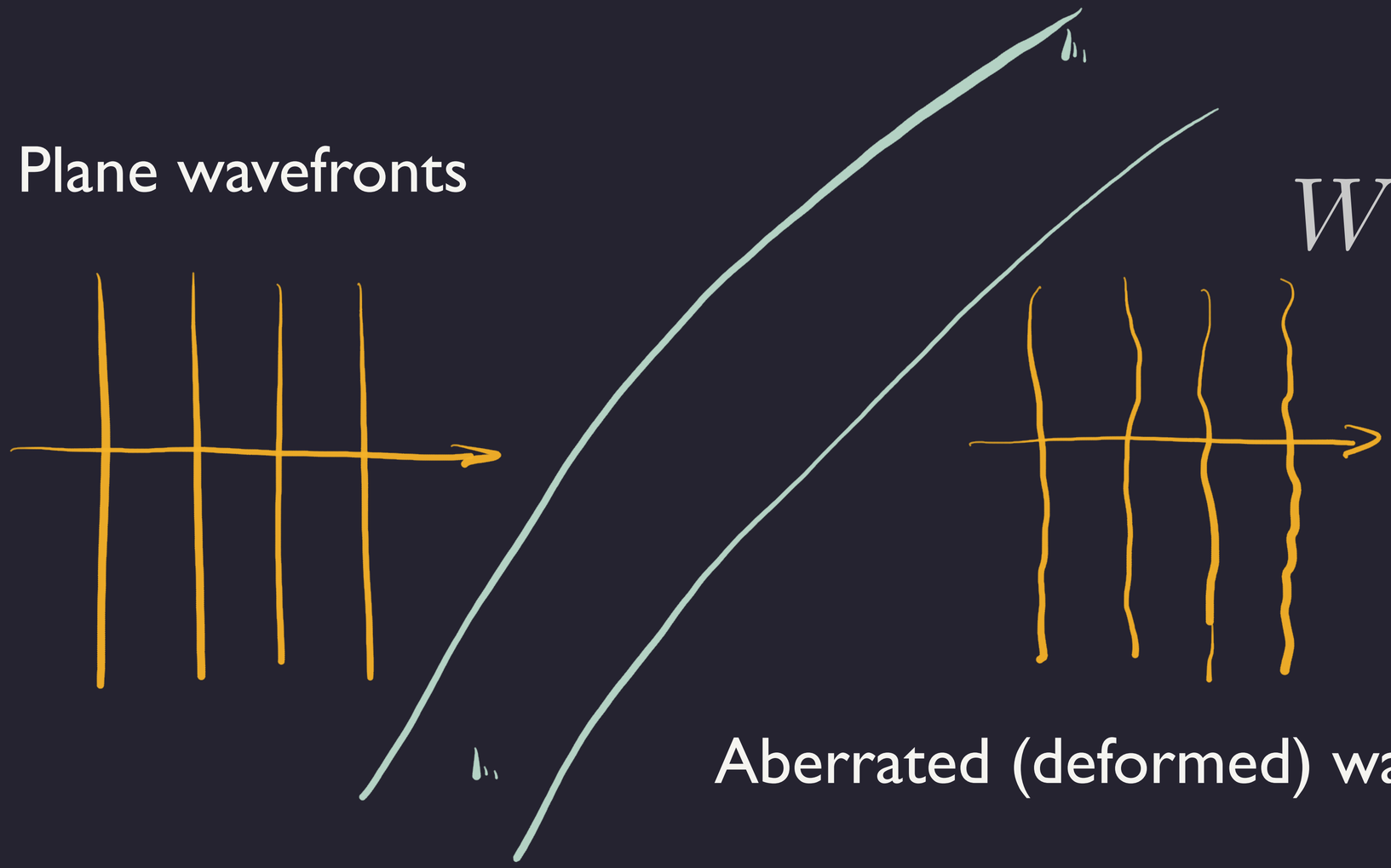
End of Line Test – MTF variability





Wavefronts
Fundamental description of light

Plane wavefronts



$W(\rho, \phi)$

Aberrated (deformed) wavefronts

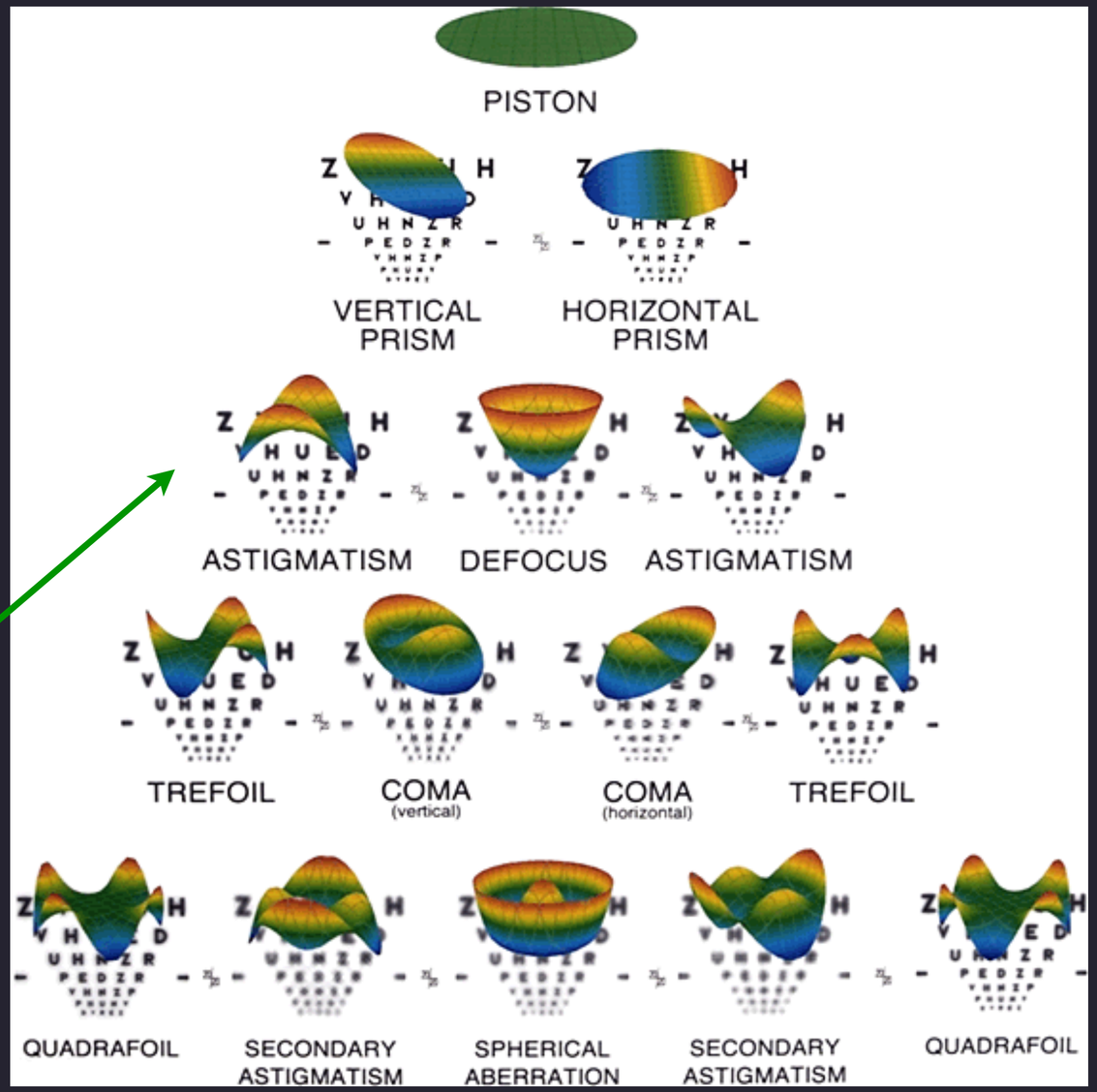
Zernike Polynomials

$$W(\rho, \phi) = \sum_{n=0}^{\infty} c_n Z_n(\rho, \phi)$$

ANY arbitrary wavefront

Zernike polynomial

https://www.allaboutvision.com/conditions/aberrations.htm



Zernike Polynomials

Unique!

Orthogonal!

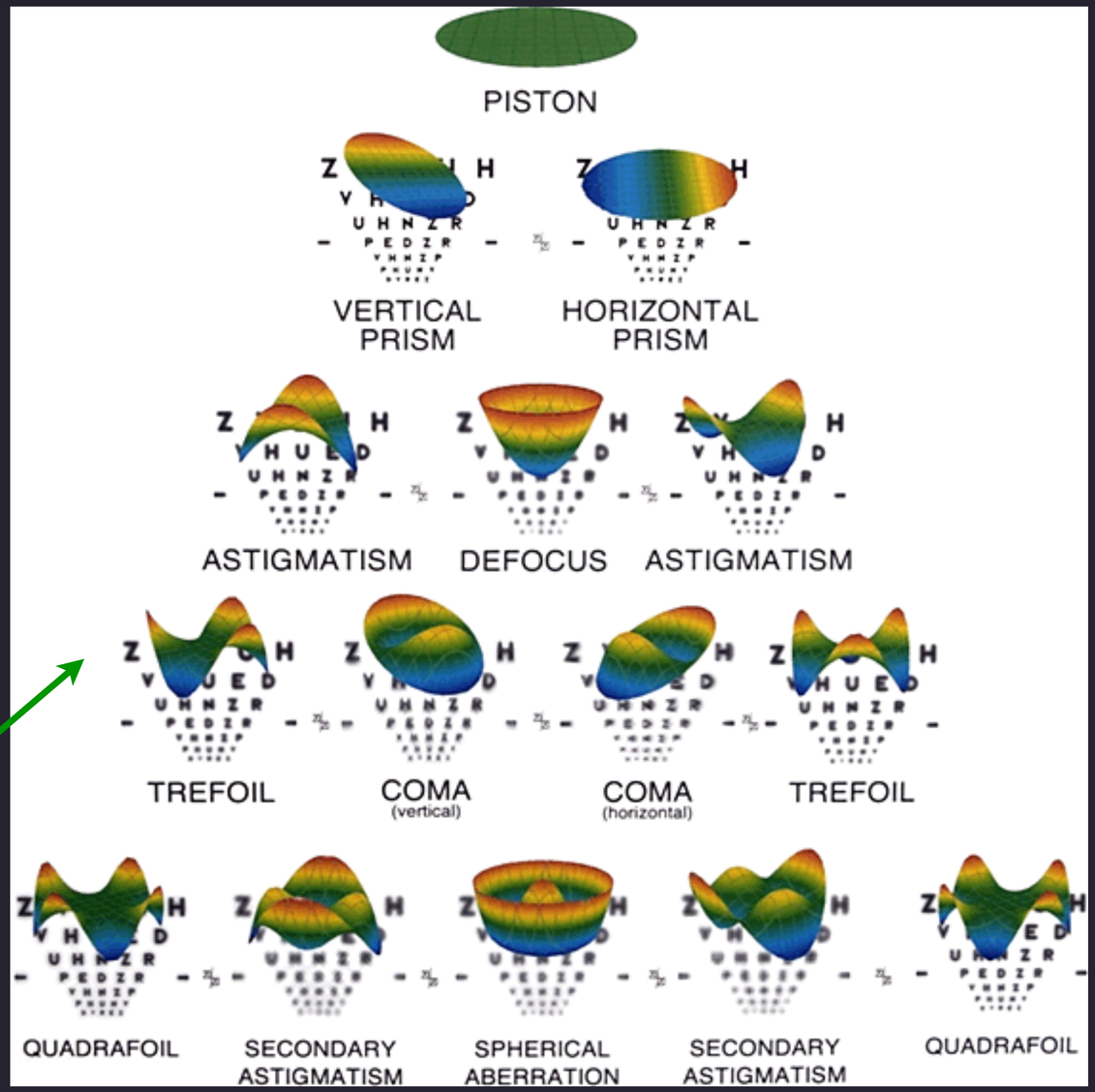
$$c_n := \langle W, Z_n \rangle$$

$$W(\rho, \phi) = \sum_{n=0}^{\infty} c_n Z_n(\rho, \phi)$$

ANY arbitrary wavefront

Zernike polynomial

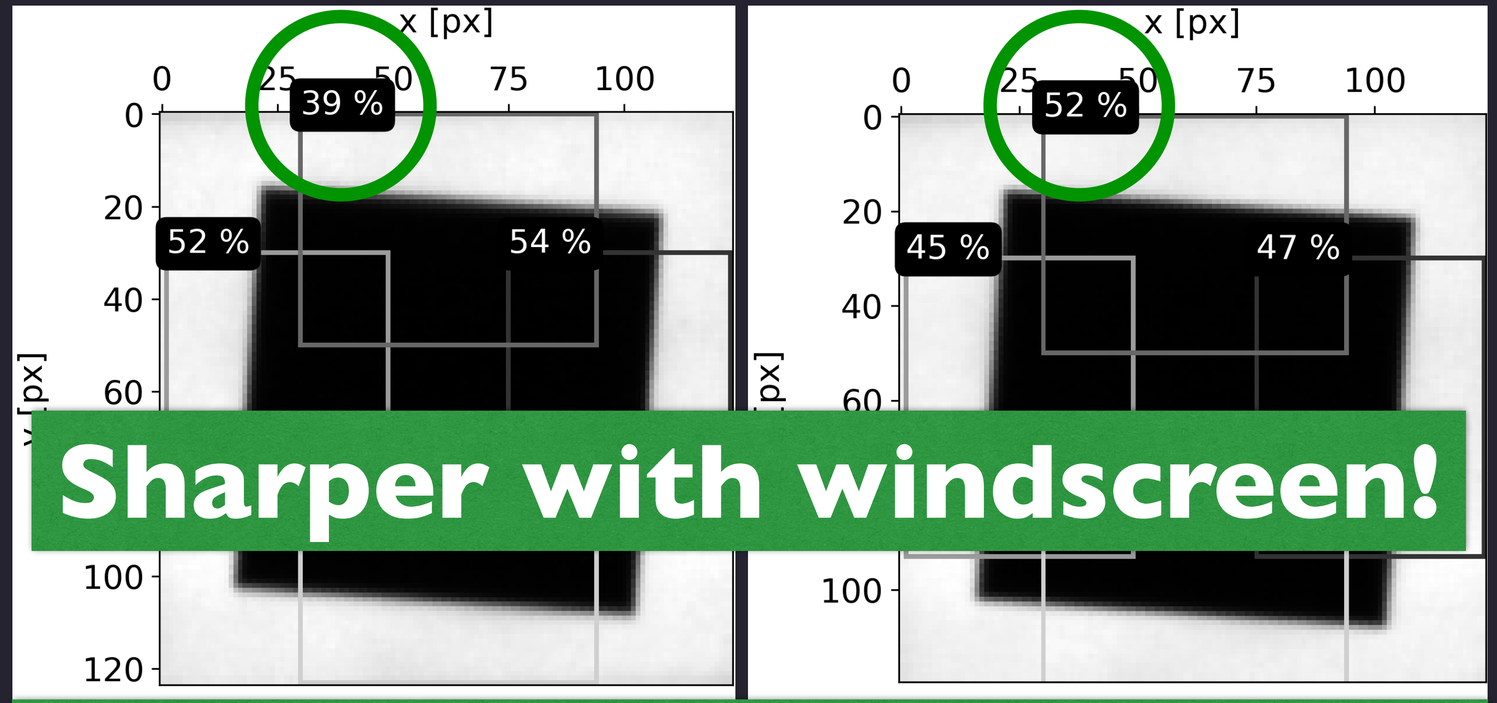
https://www.allaboutvision.com/conditions/aberrations.htm



Windscreen as prescription glasses

Without windscreen

With windscreen



Sharper with windscreen!

Individual Part Tolerances!