



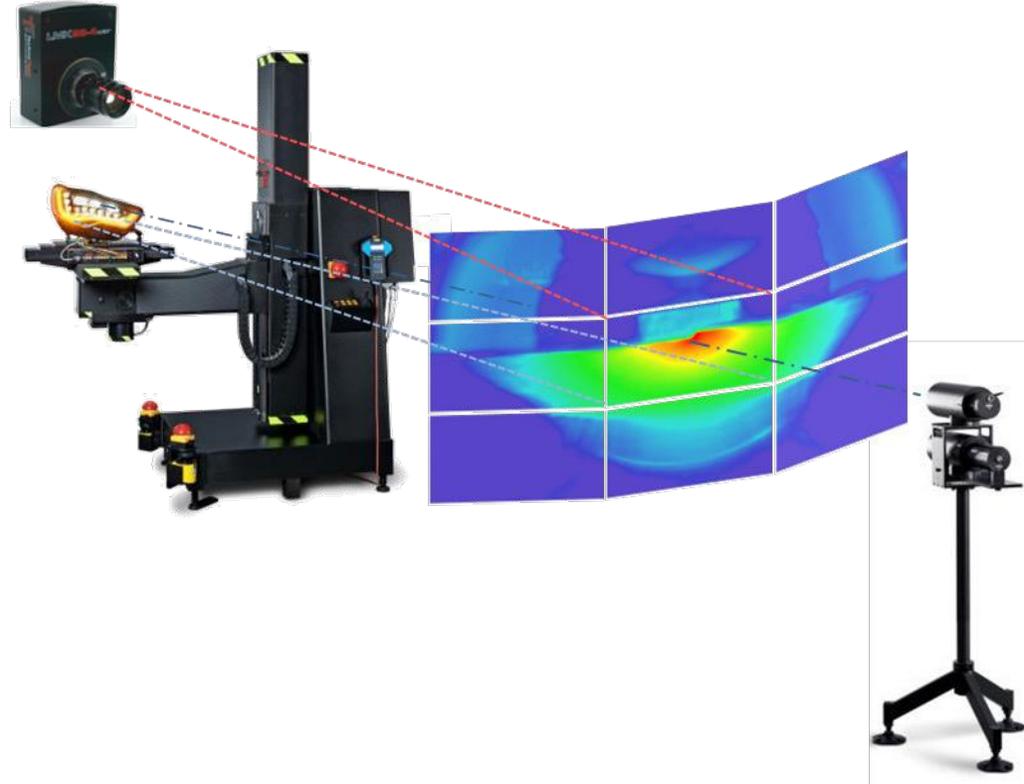
Rapid Camera-Based Innovations in Automotive Lighting Measurement: ADB, Exterior

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Jason Adams – TechnoTeam USA



Content

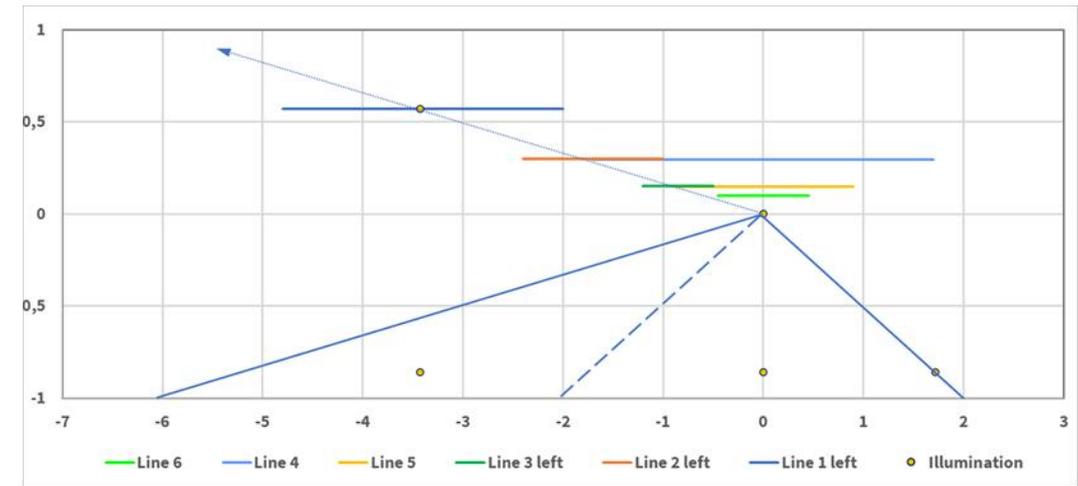
- ADB Goniophotometric Challenges
- ILMD Technology for Vehicle Lighting Goniophotometry
- Application Examples





AFS/ADB Goniophotometry: ECE 123 – FMVSS 108 2022

tabled requirements expressed in lux @ 25m		Position /deg		passing beam										
		horizontal		vertical	class C		class V		class E		class W			
No	Element	at/	from to	at	min	max	min	max	min	max	min	max		
1	B50L	4/	L 3.43		U 0.57	0.4		0.4	0.7	8/		0.7		
2	HV	4/	V		H	0.7		0.7						
3	BR	4/	R 2.5		U 1	0.2	2	0.1	1	0.2	2	0.2	3	
4	Segment BRR	4/	R 8	R 20	U 0.57		4		1		4		6	
5	Segment BLL		L 8	L 20	U 0.57		0.7		1		1		1	
6	P		L 7		H		0.1				0.1		1	
7	Zone III (as specified by Table 3 of this annex)													
8a	S50, S50LL, S50RR	5/			U 4	0.1	7/			0.1	7/		0.1	7/
9a	S100, S100LL, S100RR	5/			U 2	0.2	7/			0.2	7/		0.2	7/
10	50 R		R 1.72		D 0.86								6	
11	75 R		R 1.15		D 0.57		12						18	
12	50 V		V		D 0.86		6						12	
13	50 L		L 3.43		D 0.86		4.2	15 9/					8	
14	25 LL		L 16		D 1.72		1.4						1	
15	25 RR		R 11		D 1.72		1.4						1	
16	Segment 20 and below it		L 3.5	V	D 2								20	
17	Segment 10 and below it		L 4.5	R 2.0	D 4								8	
18	Emax	3/				20	50	10	50	20	90	8/	35	



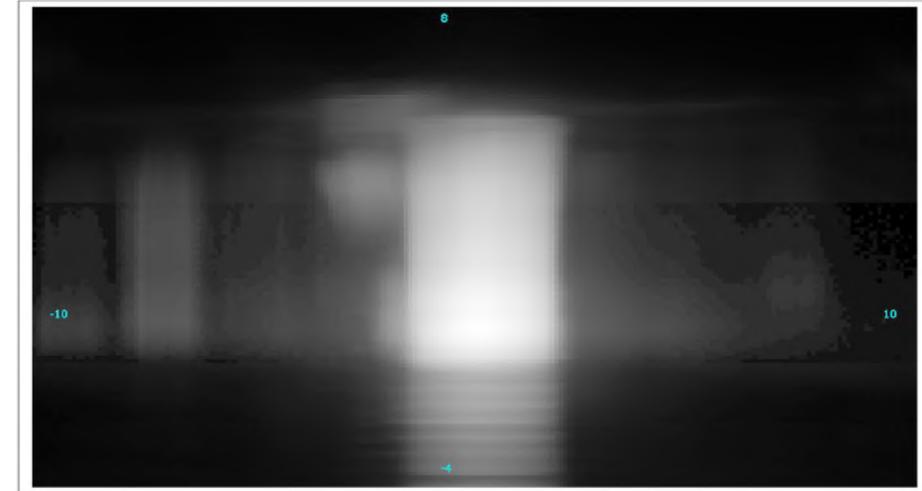
- **ECE 123 classes** C, V, E, W and bending modes
- Additional above cut-off lines for glare evaluation
- System approach requires measurement and averaging of light distributions for different driving situations from both left and right side with subsequent computation of tables.

- **FMVSS 108 2022** (Laboratory Testing) different types ADB of beams classified
- All conceivable real world upper beam/lower beam/ADB scenarios can be tested
- The issue then becomes which fixed test point falls within an area of reduced intensity, an area of unreduced intensity, or a transition zone.
- Transition zone limited to 1° between shaded and unshaded



Dynamic Lighting features require high speed goniophotometric methods

- ADB/MATRIX/PIXEL technology introduces even more complexity with an unlimited number of potential light distributions to be tested
- **Traditional goniophotometric scanning methods are too slow**
- **Rapid capture of light distributions is a must have for goniophotometric laboratories**

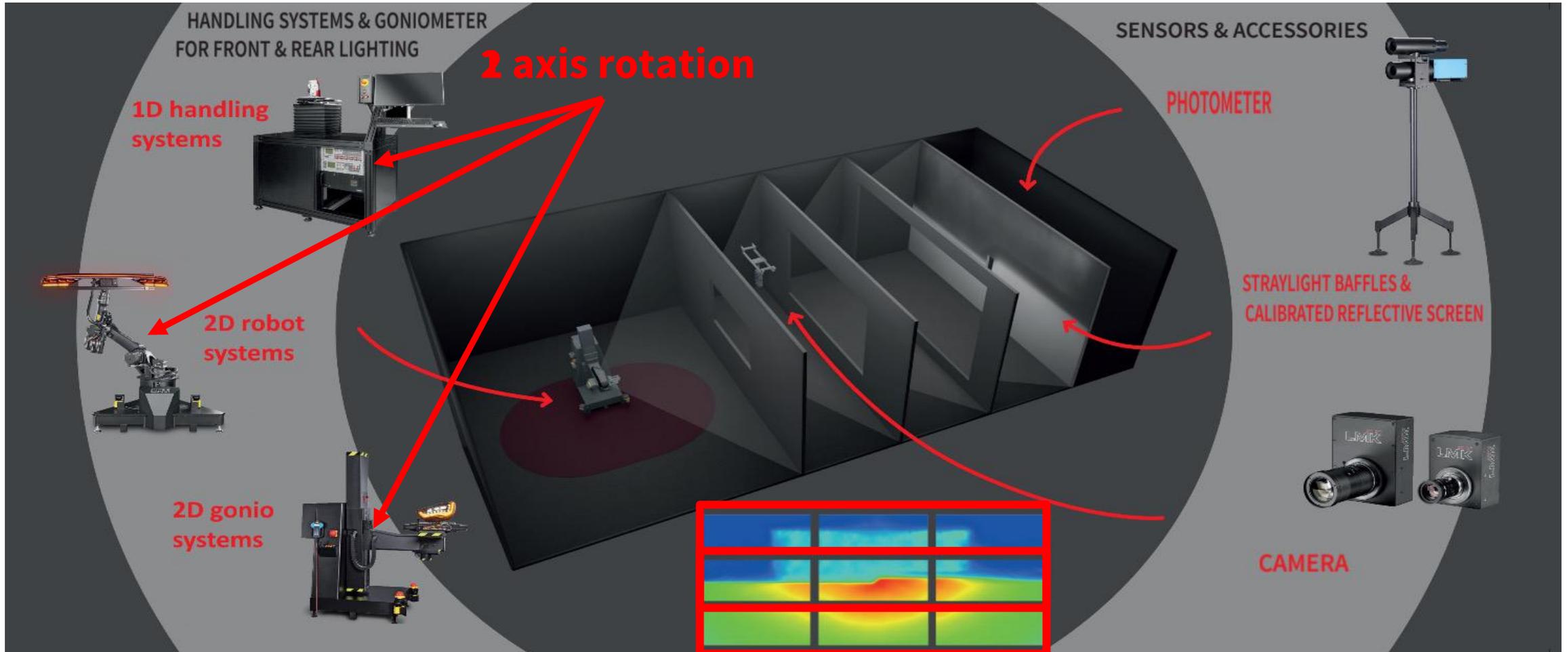


- High contrast transition zones/cut-off lines require sufficient dynamic range of the sensors employed



The Best of two Worlds – camera-based rapid screen goniophotometry

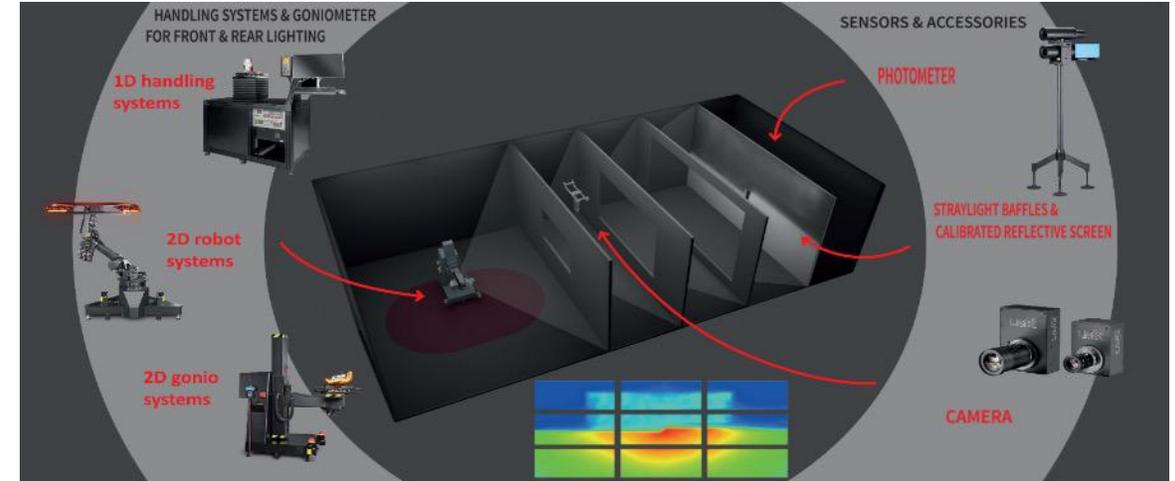
Combination of goniophotometers and ILMD: Light Distribution Generation in a fraction of the time



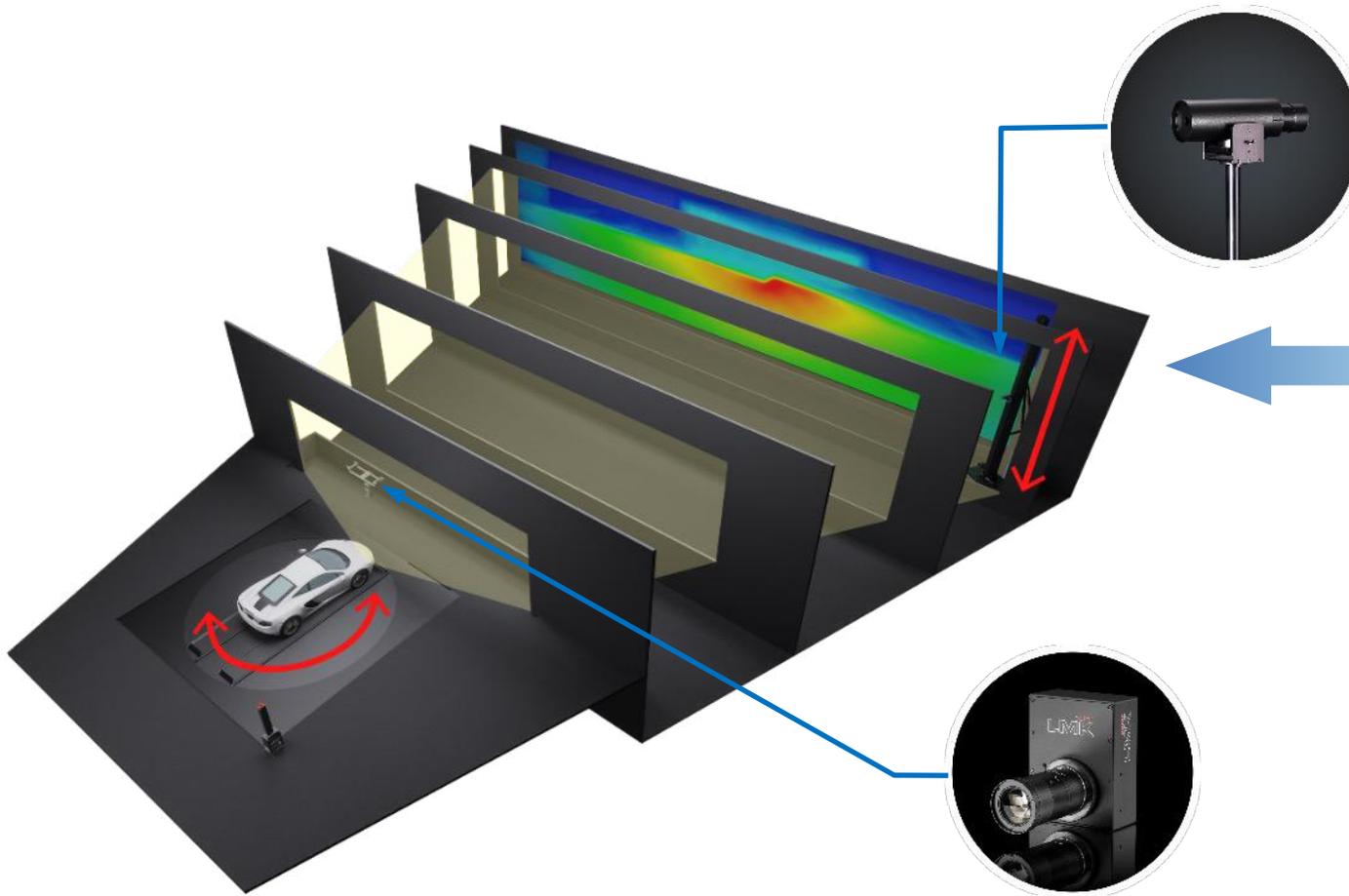


The Best of two Worlds – camera-based rapid screen goniophotometry

- Classical goniophotometer
 - Superb spectral matching
 - High contrast capability
- Camera-based screen photometry
 - Speed
 - Fast PWM mode
 - High resolution
- Requirements from ILMD type II contrast indices
 - Spectral mismatch correction with photometer/colorimeter possible
 - Goniometer angular resolution
 - Geometry and angular screen reflection must be fully characterized



Dynamic Lighting features require on-vehicle level testing: LMT VELAS

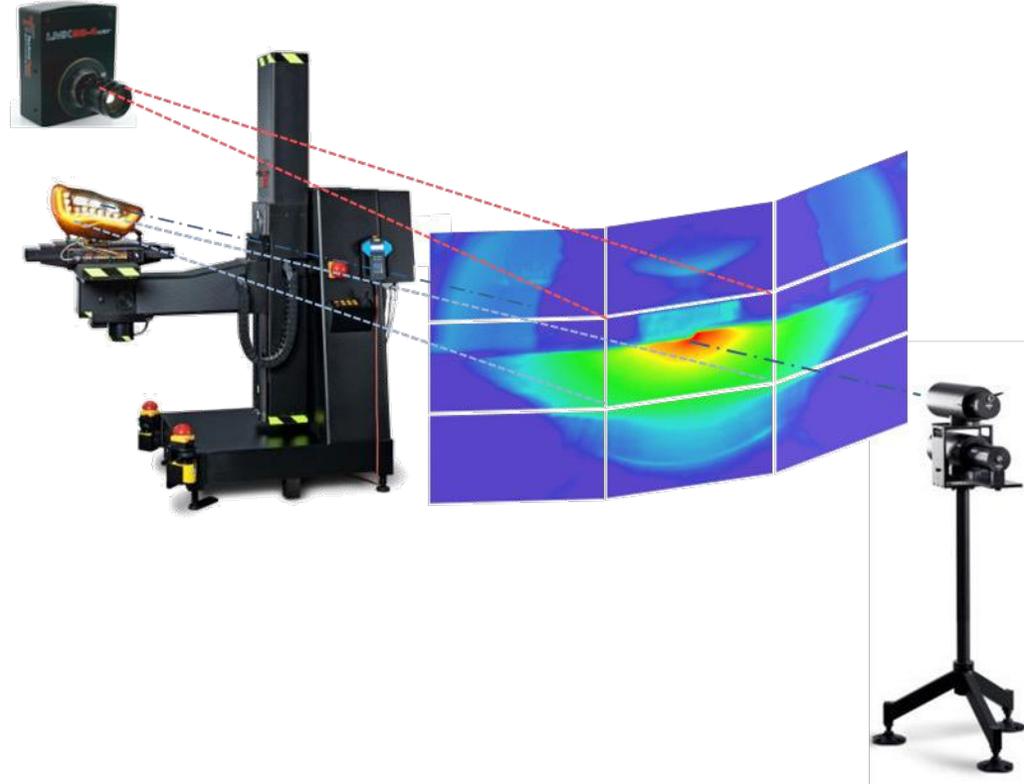


- On-Vehicle goniophotometry under lab conditions
- Standard testing system for C-NCAP
- LMK with screen is essential for speed of measurement
- Photometer assures high accuracy when measuring glare values
- VELAS is modular system
 - 2-axis: turntable + photometer
 - 1-axis: turntable + LMK & screen
 - 0-axis: LMK & screen



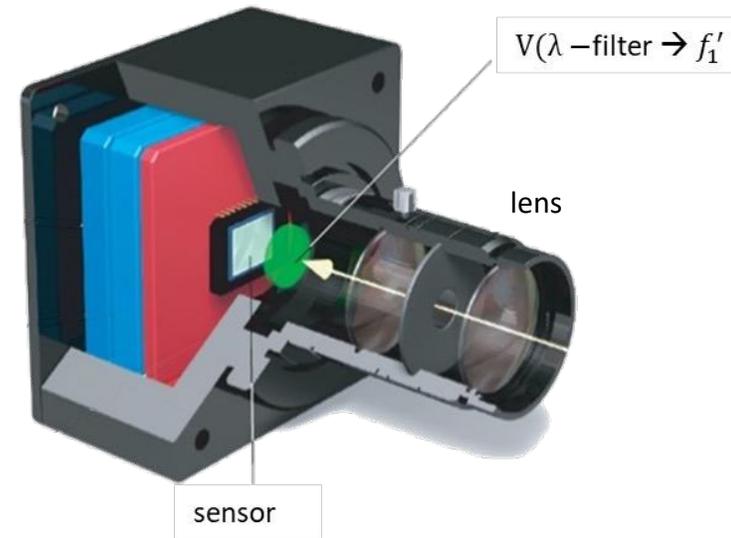
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Imaging Luminance Measurement Devices (ILMDs)

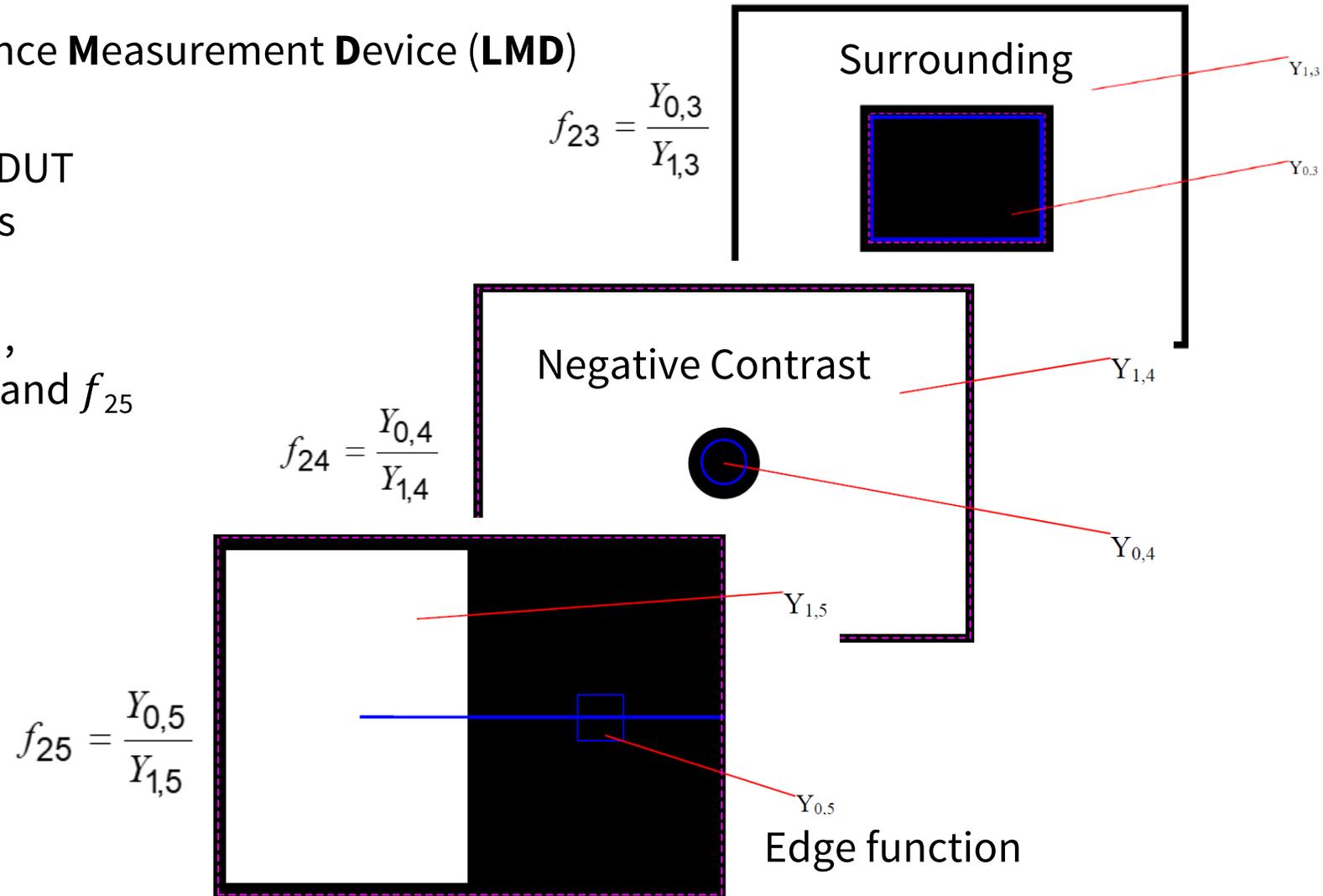
- Spot luminance meter - **Luminance Measurement Device (LMD)**
→ one measurement value
- an **ILMD** samples an area of the DUT
→ Matrix of measurement values





Imaging Luminance Measurement Devices (ILMDs)

- Spot luminance meter - **Luminance Measurement Device (LMD)**
→ one measurement value
- an **ILMD** samples an area of the DUT
→ Matrix of measurement values
- In addition to the well known f_1' , new quality indices like f_{23} , f_{24} and f_{25} are introduced
- relevant for high contrast applications
- Dynamic 1:10,000,000
Contrast f_{24} 1:100; f_{25} 1:1000

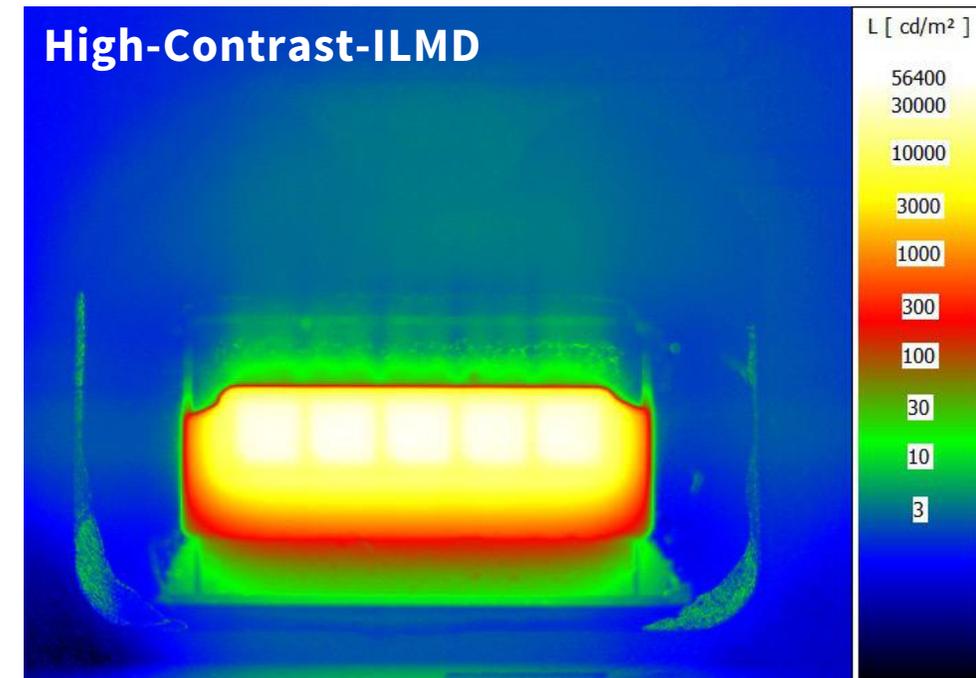
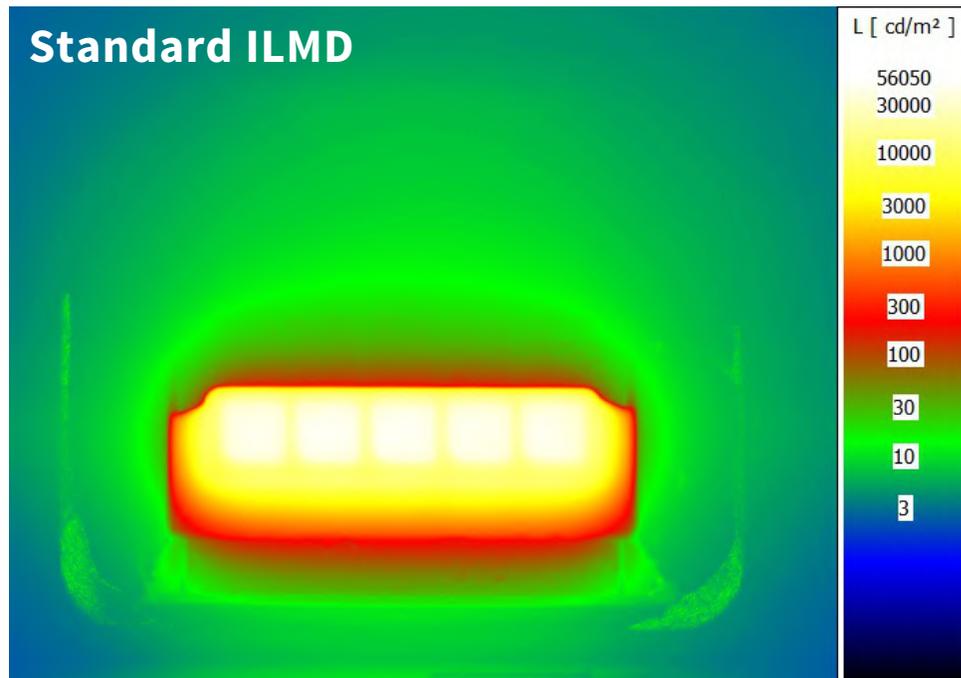




Contrast measurement

- True contrast values measured in light sources used for road illumination applications are crucial for optic development

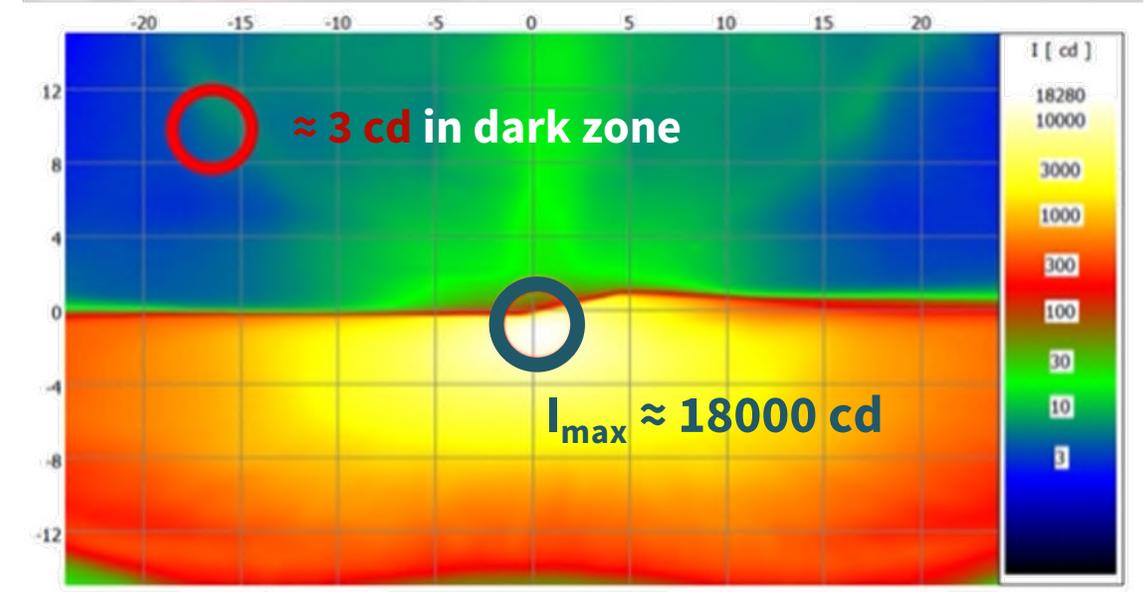
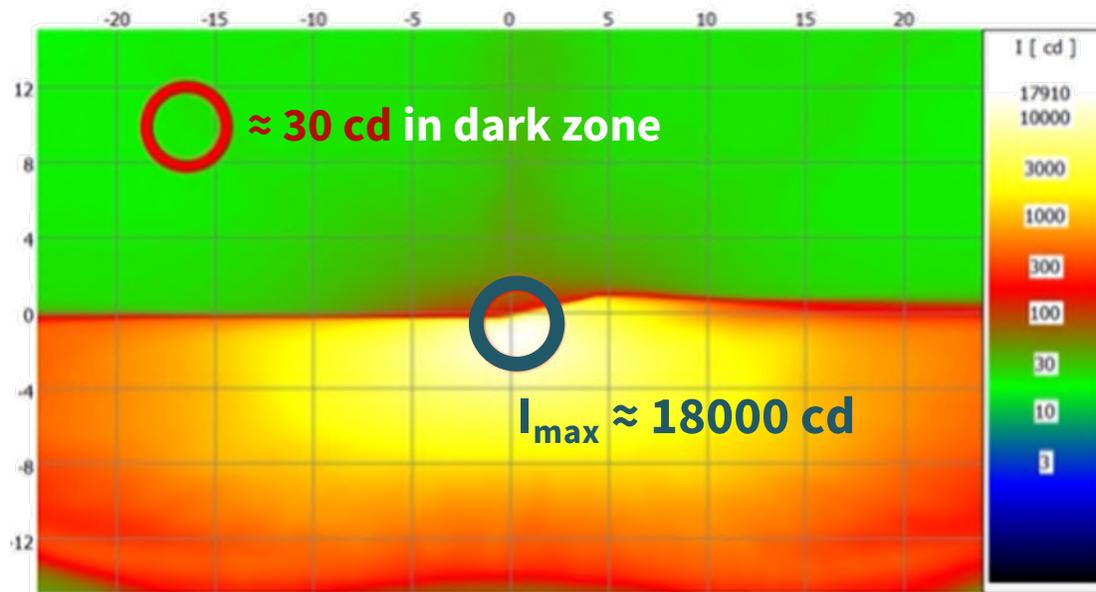
Analysis of LEDs with build-in cut-off





Contrast measurement

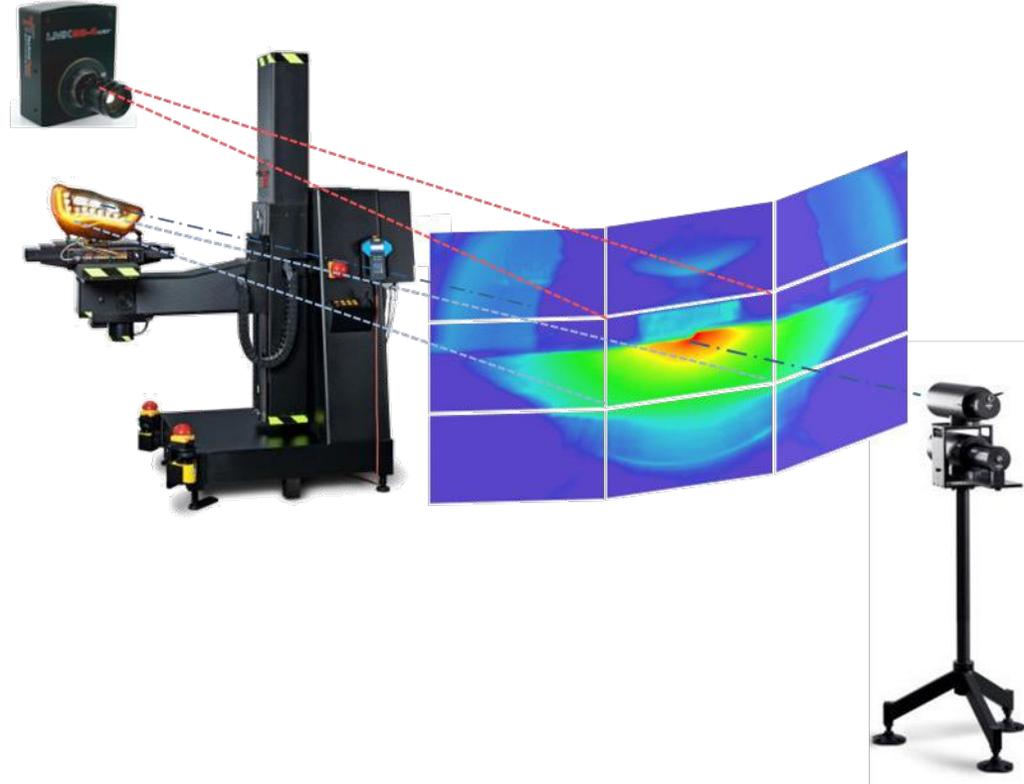
- True contrast values measured in light sources used for road illumination applications are crucial for optic development
- Good contrast indices in indirect goniophotometry of low-beam light distributions are essential for correct glare measurement





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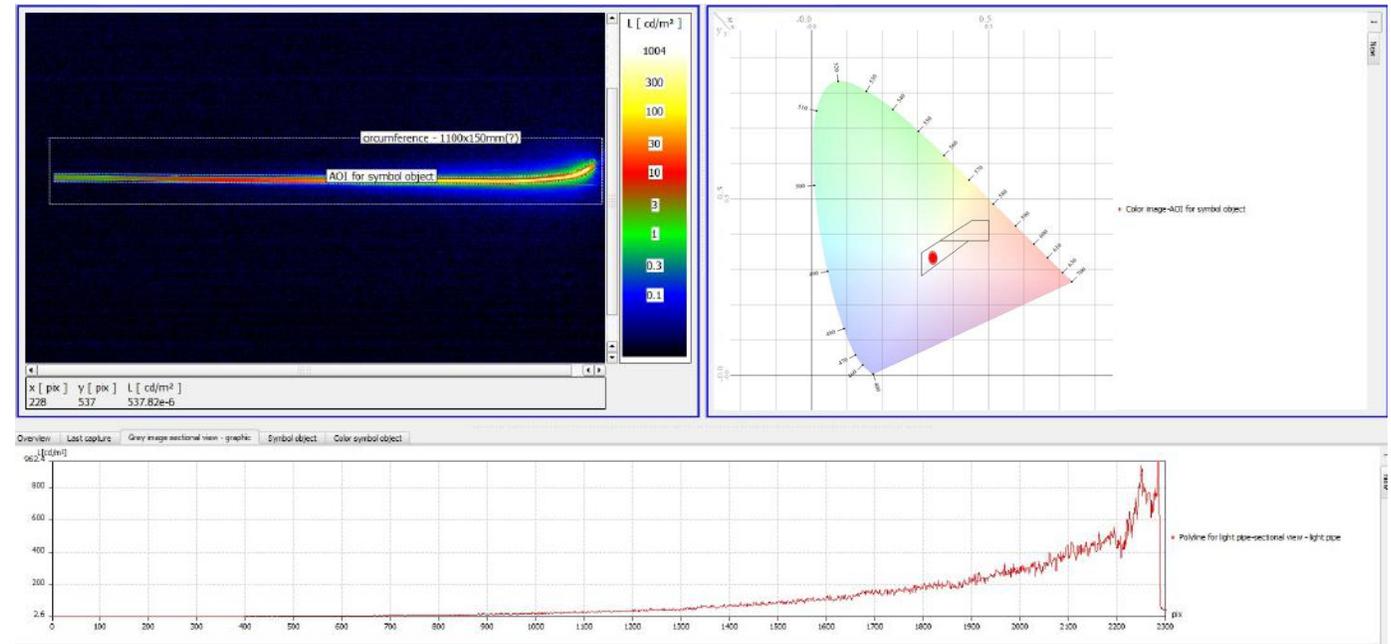
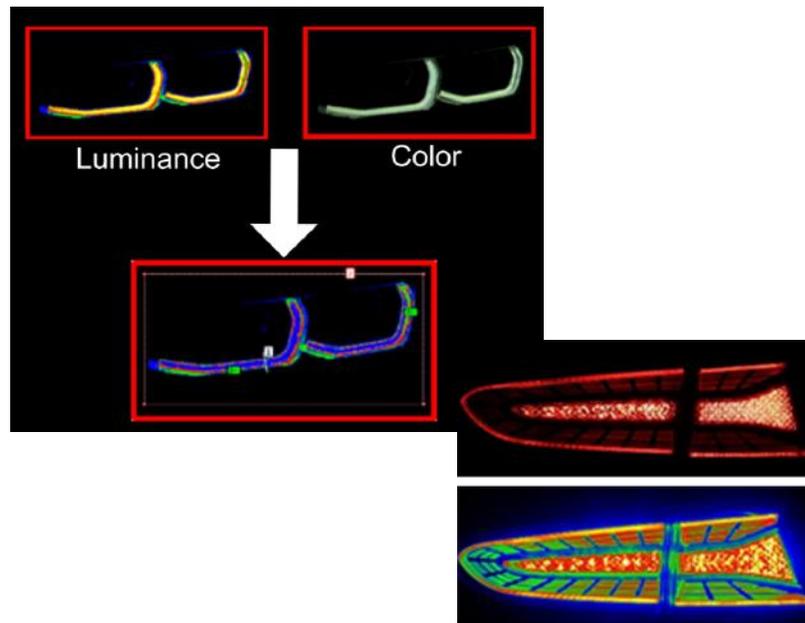
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LMK Table-Cam: camera-based exterior/interior lighting

- Direct measurement evaluations of luminance, chromaticity, uniformity, contrast, hot spots, dead spots, viewing angle, BlackMURA, sticking image, Sparkle (AGL effect)



- Quantification for headlamps, taillamps, running lights, light guides, indicators, cabin lighting, and displays

Thank you for your attention!



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