

LimeCam - Efficient Characterization of Light-Installations

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Informative: 2D-light-distributions, maps, photos, database with all light points, 3D-coordinates, illuminance, analysis of savings potentials

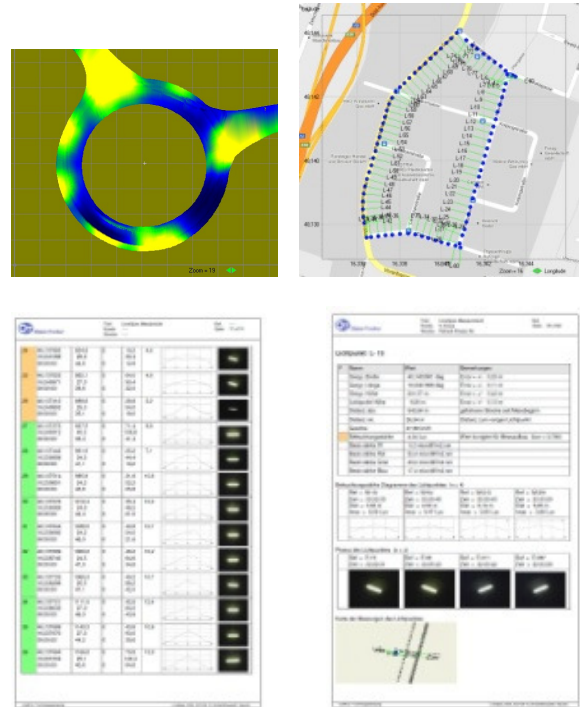
Innovative: State of the art technology (Gps, image processing, sensor-fusion)

Easy: No need to close-off streets, one lane per acquisition

Save: Technician save in vehicle, not exposed to traffic

Fast: Up to 200 light points / hour

Scaleable: Project size 100 – 10000 LP



OVERVIEW

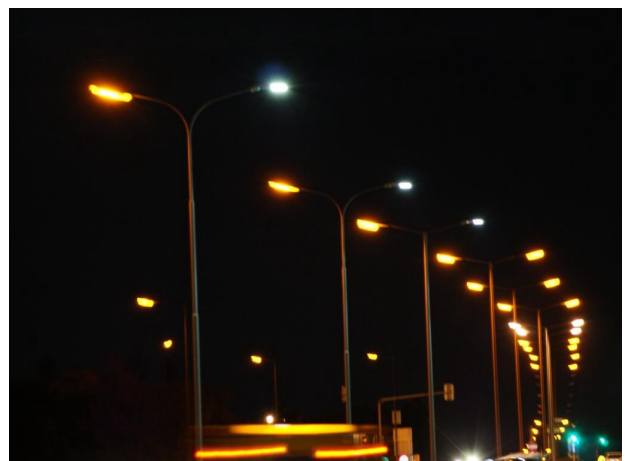
LimeCam is an innovative solution for the fast and cost-efficient characterization of light installations.

LimeCam yields reliable information on which customers can build their plan to service, upgrade, or renew a light installation: 2D-light-distributions, light maps, photos, a database with details of all light points like 3D-coordinates and illuminance measures, and an analysis of energy savings potentials. Customers receive the results of a LimeCam measurement campaign in the form of digital maps, tables, reports, and GIS data sets.

The LimeCam system is typically mounted to a vehicle. The acquisition of key-variables of illumination is performed at night while the vehicle is moving with velocities of up to 80 km/h with the regular traffic flow. There is no need to close-off streets for the measurement, as is common practice when performing measurements manually.

LimeCam has a measurement capacity of up to 200 light points per hour, which is 20 times faster than manual acquisition methods. As such it can easily handle projects with several thousand light points. And LimeCam is safe, because the technician is operating inside a vehicle, protected from the passing traffic.

Typical application areas of LimeCam include: The measurement of street illumination in cities and in smaller communities, of national roads and highways, of industry terrains and parking areas, parks, and monuments.



TECHNICAL DESCRIPTION

LimeCam measures a unique combination of light- and geometrical / geographical variables for each light point:

- GPS coordinates of the light point
- Mounting height of light source
- 2-D illuminance distribution (in lux)
- Irradiance-spectrum
- Photographic documentation

LimeCam has a modular construction. It consists of a support structure, the LimeCam Sensor-Rack, to which a variety of sensor-modules can be attached, each measuring a different aspect of the illumination infrastructure. All acquired data are fused and stored in a common database.

LimeCam Sensor-Rack

The Sensor-Rack serves as mounting structure for sensor- and acquisition modules. It is reliably mounted to the vehicle with 2 suction pads, and can be horizontally aligned with lockable joints. The standard configuration includes several light sensors, a GPS receiver, a power supply, data acquisition electronics, and memory. Several sizes are available to fit the system to the requirements of the task.



Figure 1: LimeCam Sensor-Rack, attached to vehicle.

LimeCam Cameras

Calibrated cameras are used to determine the position of the Sensor-Rack relative to the light points, and to measure the mounting height of

light sources. Cameras are either mounted to the Sensor-Rack, or inside the vehicle.



Figure 2: LimeCam calibrated cameras

LimeCam Logistics

The LimeCam Sensor-Rack and cameras are mounted to the vehicle and are aligned. The measurement drive is performed at night with the vehicle moving with velocities of up to 80 km/h with the regular traffic flow. There is no need to close-off streets for the measurement. At the end of the measurement, recorded data are transferred to the LimeCam server and processed with LimeCam software. Reports, maps, analysis, and data sets are generated automatically with little user interaction.

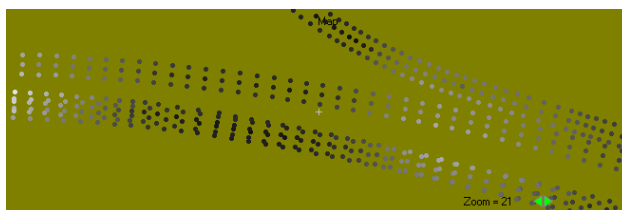


Figure 3: Track of light measurements, distance between measurement points is approx. 50 cm.

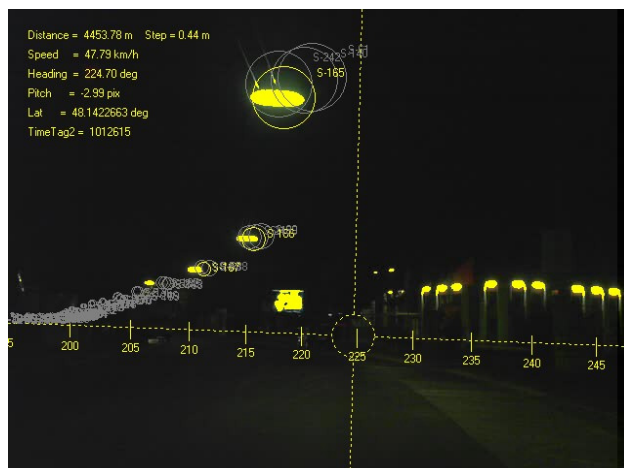


Figure 4: Screenshot of LimeCam image processing program: Automatic tracking of light points in a sequence of images, followed by the calculation of light point position and mounting height above ground.

Illuminance measurements, which are performed at a distance of 75 cm from the street surface, are mathematically corrected to reflect the illuminance level on the street surface. The absolute positioning accuracy of light maps is determined by the Gps-receiver and is typically better than 1.5 meters. The positioning accuracy / repeatability of light measurements relative to the light points is determined by the photogrammetric camera measurement and better than 50 cm.

LimeCam - Output

LimeCam results are presented and delivered to the customer in several formats:

- Detailed reports (PDF)
- Table of identified light points with light-technical and geographical details
- Light maps with illuminance values and light points (JPG), map format A0 - A4, 600 dpi, super-imposed on street maps and/or aerial images.
- Data sets for import in GIS systems (CSV)

Light maps are 2-dimensional renderings of the illuminance distribution (lux) in either gray-level or false color. They provide an excellent overview of the lighting situation in the investigated locations, clearly highlighting regions with intensive / low / missing illumination.

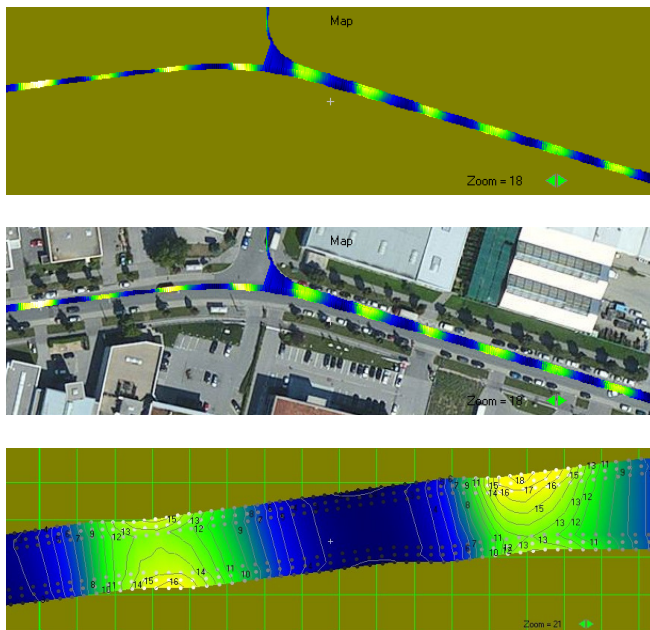


Figure 5: 2-D Illuminance distribution maps

OT Object-Tracker		Titel		LimeSpec Messbericht		Ref.	
		Kunde	Strecke			Seite	
		Richard Strauss Str.				17 of 74	
24	48,137863 16,341068 00:00:00	834,9 26,9 44,6	0 0 0	19,2 30,4 12,8	4,6		
25	48,137625 16,340971 00:00:00	862,1 27,3 39,6	0 0 0	64,0 90,4 32,0	4,8		
26	48,137412 16,340852 00:00:00	888,6 25,3 35,1	0 0 0	28,8 54,0 18,0	3,2		
27	48,137373 16,340312 00:00:00	937,5 40,2 36,4	0 0 0	71,4 109,8 41,4	9,8		
28	48,137443 16,339999 00:00:00	961,9 24,5 41,1	0 0 0	25,2 44,4 19,2	7,1		
29	48,137514 16,339691 00:00:00	985,9 24,2 43,8	0 0 0	31,8 52,2 25,8	10,6		
30	48,137576 16,339389 00:00:00	1012,4 24,9 44,4	0 0 0	35,4 46,2 21,0	10,2		
31	48,137644 16,339060 00:00:00	1036,5 24,2 46,3	0 0 0	40,8 54,0 21,6	10,7		
32	48,137699 16,336740 00:00:00	1060,6 24,5 47,0	0 0 0	46,2 84,6 34,8	10,2		
33	48,137725 16,338398 00:00:00	1085,3 25,5 47,1	0 0 0	49,2 88,2 42,0	10,7		
34	48,137721 16,338035 00:00:00	1111,5 27,0 46,3	0 0 0	42,6 84,0 43,8	12,4		
35	48,137689 16,337670 00:00:00	1140,3 27,3 44,2	0 0 0	43,8 93,0 39,6	10,8		
36	48,137664 16,337334 00:00:00	1166,8 25,1 40,6	0 0 0	79,8 140,4 64,8	13,9		

OT Object-Tracker		Titel		LimeSpec Messprotokoll		Ref.		
		Kunde	Strecke	In-house		Seite		
		Richard Strauss Str.				35 of 82		
Lichtpunkt L-15								
F	Name	Wert	Bemerkungen					
	Geogr. Breite	48,1403901 deg	Error = +/- 0,33 m					
	Geogr. Länge	16,3421566 deg	Error = +/- 0,11 m					
	Geogr. Höhe	201,57 m	Error = +/- 5,43 m					
	Lichtpunkt Höhe	8,80 m	Error = +/- 0,13 m					
	Distanz abs.	543,84 m	gefährte Strecke seit Messbeginn					
	Distanz rel.	26,94 m	Distanz zum vorigen Lichtpunkt					
	Geschw.	47,66 km/h						
	Beleuchtungsstärke	4,04 Lux	Wert korrigiert für Messaufbau (korr = 0,786)					
	Bestr.stärke IR	0,0 microW/m2.nm						
	Bestr.stärke Rot	32,4 microW/m2.nm						
	Bestr.stärke Grün	43,2 microW/m2.nm						
	Bestr.stärke Blau	17,4 microW/m2.nm						
Beleuchtungsstärke Diagramme des Lichtpunktes (n = 4)								
Ref = M-18	Zeit = 22:22:33	Dist = 5,83 m	Ref = M-94	Zeit = 22:25:45	Dist = 2,53 m	Ref = M-213	Zeit = 22:30:43	Dist = 6,19 m
	Imax = 6,56 Lux			Imax = 6,47 Lux			Imax = 3,65 Lux	Ref = M-291
								Zeit = 22:33:39
								Dist = 5,85 m
								Imax = 3,96 Lux
Photos des Lichtpunktes (n = 4)								
Ref = P-15	Zeit = 22:22:31	Ref = P-93	Zeit = 22:25:43	Ref = P-211	Zeit = 22:30:42	Ref = P-287	Zeit = 22:33:38	
Karte der Messungen des Lichtpunktes								

Figure 6: Excerpt of LimeCam report, showing light point summary and details.



Figure 7: Street map with light point

CONTACT

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REFERENCES

LimeCam received the 1st price in the RIZ Genius Competition 2012 of the county of Niederösterreich (Austria).

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The Magistrat 39, Test- and Certification Office of the City of Vienna (A) supported the development of LimeCam with practical measurements in their laboratory.