Article: DIAL**ux** evo – New calculation method
Characters: 21.059 (incl. space character, headline and table) + 7 pictures
Words: 4843
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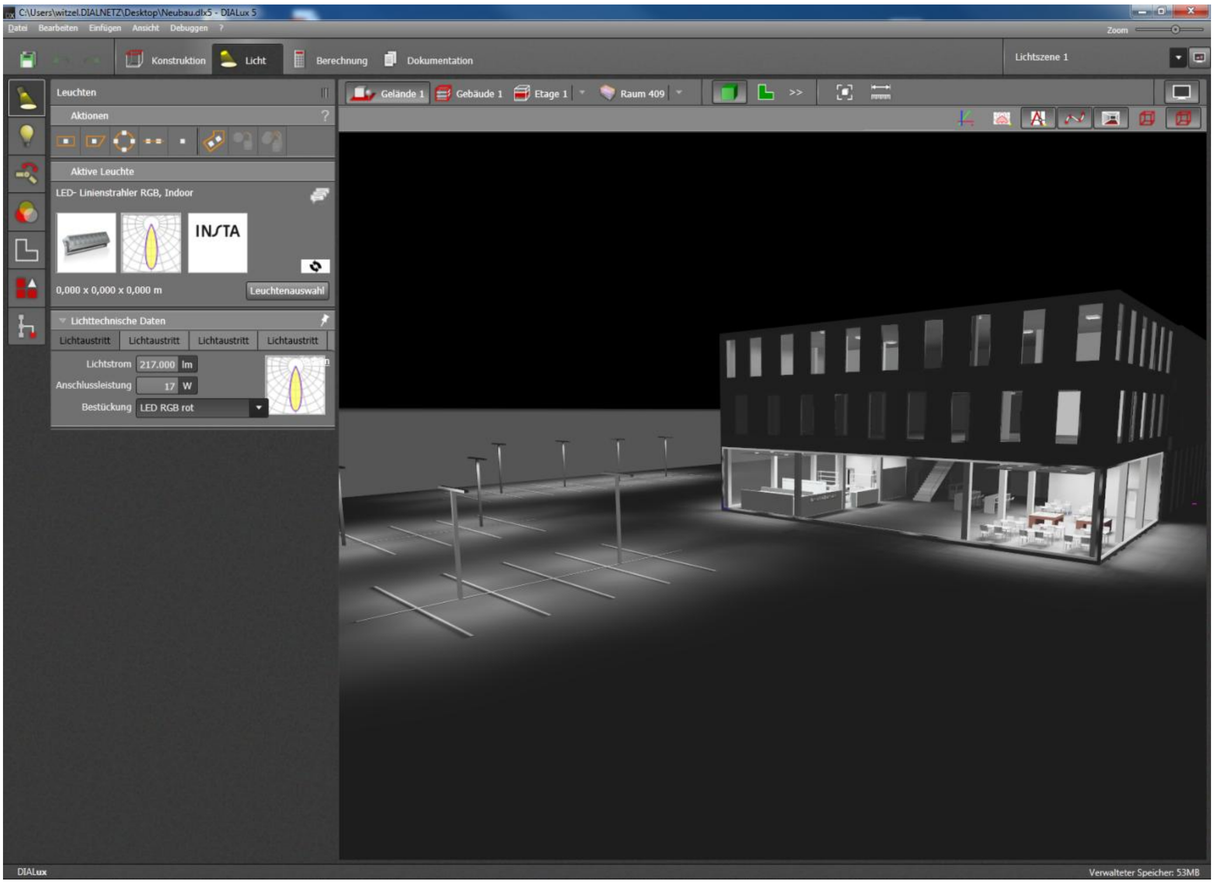
DIALux evo – new calculation method

DIALux evo

The new generation of DIALux - DIALux evo - has been available since October 2012. As well as providing new software for architecture the objective of the new version was to enable the planning of complete buildings. The frontier between indoor and outdoor planning would be removed and buildings would no longer be seen as the sum of individual rooms but be calculated and presented as a complete unit. Glass is playing an increasingly important role in modern architecture so this means that individual rooms and the outdoor area have to be photometrically integrated into each other.

Furthermore, almost all existing elements of DIALux had to be created anew. The operation of the software had to be adapted to the new requirements, the CAD had to have a substantially better performance than the technology previously used and the calculation kernel had to be able to calculate much larger and more complex scenes. When dealing with a whole building, lighting scenes obviously play a much more significant role. This also had to be taken into account when recreating the conceptual design.



Previously the radiosity [1,2] method was used in DIALux and many other lighting calculation programmes. With this method the energy exchange between each surface in the scene is calculated. In order to visualise the exact light distribution on the individual surfaces of the scene, the individual surfaces are divided up into patches. Using "adaptive meshing" the software ensures that the surfaces are not statically divided within fixed grids but are divided up very finely where large differences in the illuminance arise. Thus a high resolution visualization is achieved in as short a calculation time as possible. However, this method is in direct contrast to the usual standard calculation methods where fixed grids of measuring points as in EN 12464-1 are prescribed. In order to fulfil these requirements, either calculation points must be determined in addition to the calculation of the surfaces or the results at the calculation points must be interpolated from the results on the surfaces.

This procedure is well-proven and in many case provides a sufficiently exact calculation. Why then do we need a new procedure? Radiosity has two weaknesses: on the one hand the calculation of large scenes can tke a very long time. Individual and simple rooms can be calculated very quickly using radiosity, but for complex geometries or whole buildings the calculation time is to lng. On the other hand the calcualtion method takes only diffusely reflecting materials into consideration. A simple calculation of transmission and mirroring surfaces is only possible by employing a few tricks.

After experiments with several alternative calculation methods, photon shooting was decided upon. According to the light distribution light is distributed on the visible surfaces. From these surfaces photons are sent out or diffusely passed on or, depending on the material properties, transmitted or absorbed. The photons are gathered on the surfaces affected and an evaluation of the density is made. From the number of photons per surface and their energy content the luminance or iluminance is determined. The benefit of this principle is obvious: It is roughly approximate to the distribution of light in reality. It is simple to draw parallels from this procedure.

What are the disadvantages of this principle?

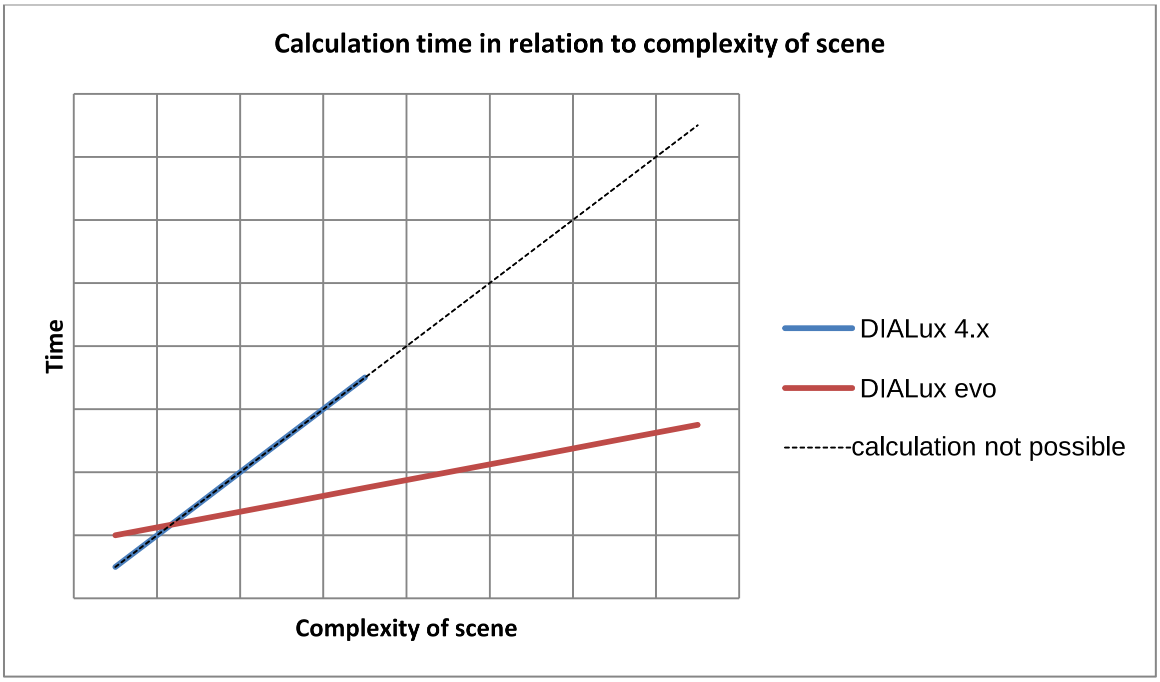
Firstly, simple geometries take a relatively long time when compared with the radiosity method because the number of photons used is bound to be relatively high. Secondly, it might well be that , despite the large number of photons, small surfaces are not hit or are insufficiently hit by the photons. With future optimisation of the photon shooter the aim is to emit a sufficiently large number of photons or adapt the number of photons dynamically to the given situation.

Calculating with control groups

Whatever method is used, calculations take time. Therefore it is a pity, when , after a successful calculation, a completely new calculation is required when individual lighting scenes are adapted in order, for example, to optimise the energy consumption or to a achieve a specific lighting effect. DIALux is treading a completely new path: for each lighting scene the lighting designer defines luminaire groups which he would like to dim or set independently of each other in each respective lighting scene. Prior to calculation DIALux evo identifies from all the lighting scenes the control groups which are necessary for these lighting scenes. Thus DIALux evo prevents a luminaire group from acquiring different dimming levels within one lighting scene. Each control group is now calculated separately by DIALux evo. In doing this the calculation time is initially multiplied. However, this method means that the result of a lighting scene can be adjusted later. The results of the individual control groups are added after each adjustment. Instead of having to run through the whole calculation again, it is now only necessary to recreate the lighting textures on the surfaces.

The calculation kernel in practice

The strengths and weaknesses in the new calculation kernel have proved in practice to be as expected. For individual rooms the calculating time with the photon shooter is longer than with the radiosity calculation kernel. For more complex scenes the benefits of the new method are clear. The calculation time for such scenes is much shorter than with the old method. For very complex scenes which it was previously not possible to calculate results can now be calculated in a reasonable period of time.



Test case 1 - uniform distribution

In Karlsruhe a few years ago a simple test case was developed for lighting calculation software. For this test an artificial light source was placed in a 5mx5mx5m room, the reflection coefficient for each surface was 50%. Theoretically the uniform illuminance calculated for each surface in the room should have been 200lx, 100lx through directly distributed light and 100l through indirect lighting.

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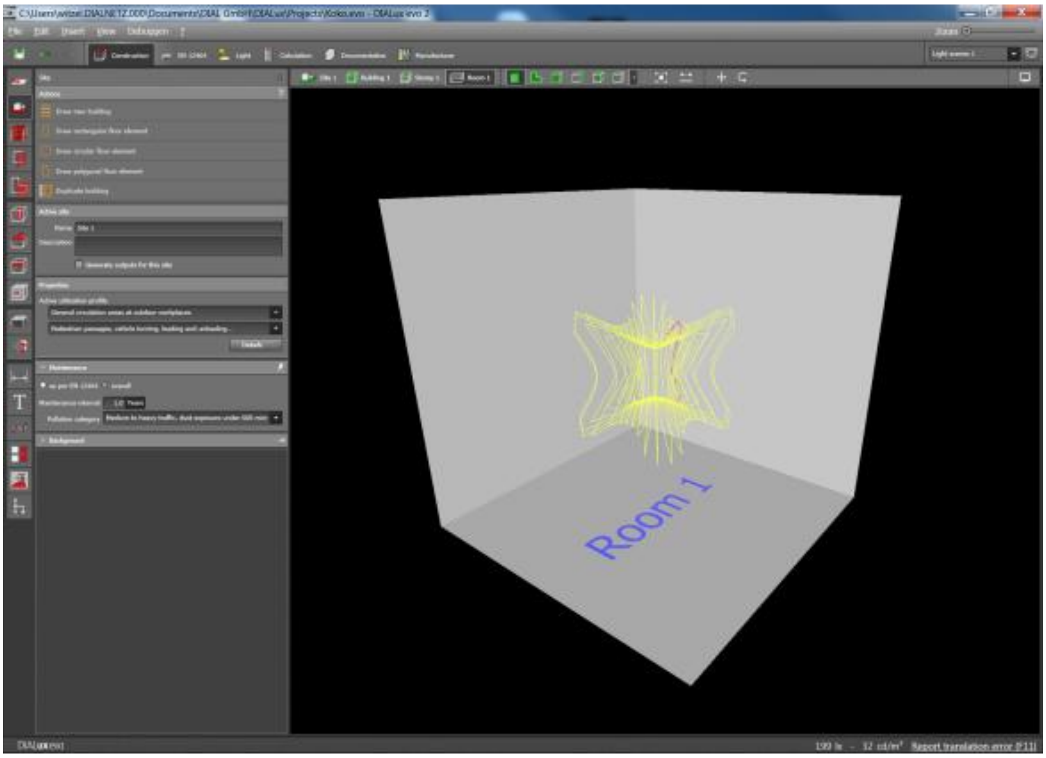

Illustration 1: First test case - before calculation

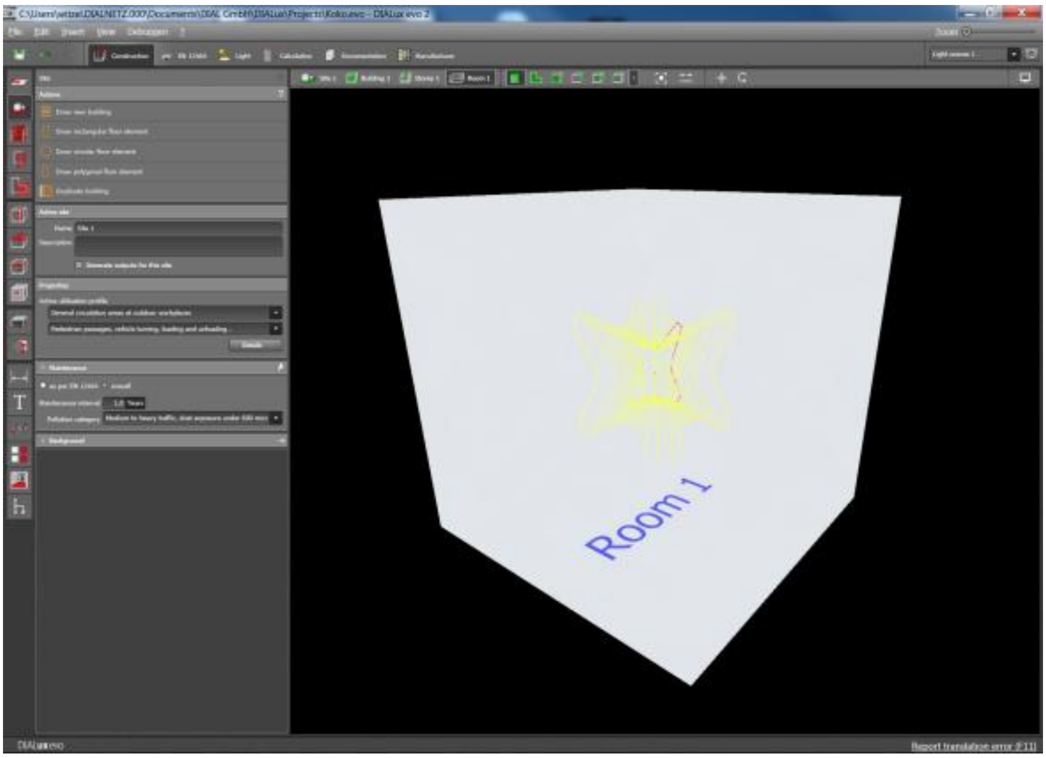

Illustration 2: first test case - after calculation

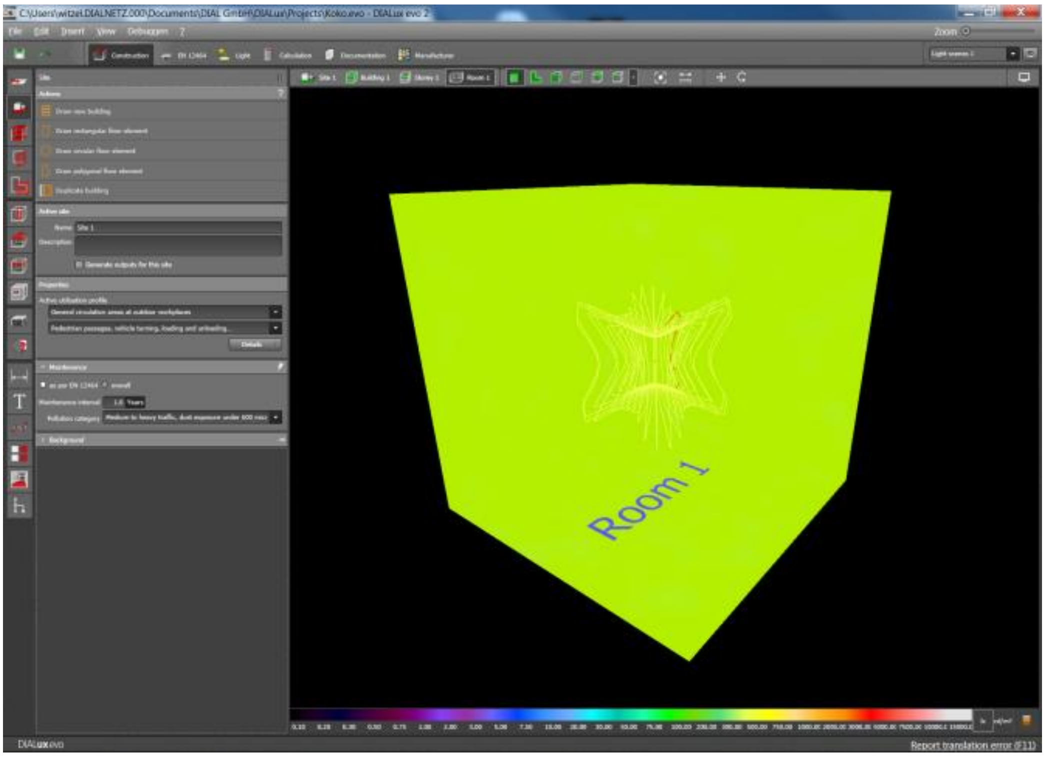

Illustration3 3: first test case - false colour rendering

Calculation points - surface of floor – indirect lighting

Position	0,25	0,75	1,25	1,75	2,25	2,75	3,25	3,75	4,25	4,75
0,25	99,9	100,1	100,4	99,8	99,9	100,1	99,8	99,8	99,9	100,7
0,75	100,2	99,9	100,2	100,0	100,2	99,9	100,1	100,0	100,1	100,1
1,25	100,3	100,0	100,1	100,0	100,0	100,1	100,1	99,9	100,0	99,6
1,75	99,8	99,9	99,9	100,0	100,0	100,0	100,1	99,9	99,9	99,8
2,25	99,6	99,8	99,8	100,0	100,0	100,0	100,0	100,0	99,8	99,6
2,75	99,3	99,7	100,0	99,8	99,9	100,0	99,9	99,9	99,8	100,2
3,25	99,7	99,8	99,9	100,1	99,9	100,0	100,0	100,0	100,0	99,9
3,75	99,8	99,9	99,9	100,0	99,9	100,0	100,0	100,0	100,1	100,1
4,25	100,3	100,0	99,9	99,9	100,1	99,8	100,1	100,0	100,4	100,4
,75	99,9	99,8	99,8	99,7	99,9	99,9	100,1	100,3	100,6	100,5

Calculation points- surface of floor – direct lighting

Position	0,25	0,75	1,25	1,75	2,25	2,75	3,25	3,75	4,25	4,75
0,25	100,5	100,5	100,4	100,4	100,4	100,4	100,4	100,4	100,5	100,5
0,75	100,5	100,5	100,4	100,5	100,4	100,4	100,5	100,4	100,5	100,5
1,25	100,4	100,4	100,4	100,5	100,4	100,4	100,5	100,4	100,4	100,4

1,75	100,4	100,5	100,5	100,4	100,3	100,3	100,4	100,5	100,5	100,4
2,25	100,4	100,4	100,4	100,3	100,4	100,4	100,3	100,4	100,4	100,4
2,75	100,4	100,4	100,4	100,3	100,4	100,4	100,3	100,4	100,4	100,4
3,25	100,4	100,5	100,5	100,4	100,3	100,3	100,4	100,5	100,5	100,4
3,75	100,4	100,4	100,4	100,5	100,4	100,4	100,5	100,4	100,4	100,4
4,25	100,5	100,5	100,4	100,5	100,4	100,4	100,5	100,4	100,5	100,5
4,75	100,5	100,5	100,4	100,4	100,4	100,4	100,4	100,4	100,5	100,5

The visualization itself shows the uniformity to be as expected. The charts indicate that the deviation from the theoretically correct value is less than 1% at all measuring points.

Calculation comparison with CIE

As already mentioned, the strength of the photon shooter is in the calculation of complex scenes. Therefore the comparatively simple test scenes in CIE TC 3.33 are not ideal for testing a photon shooter. Nevertheless a lighting calculation software is expected to fulfil these requirements.

CIE test case 4.1

A simple rectangular room of 6,78 x 6,72 with a room height of 3,24 is used for the first comparative test. The luminaires are fluorescent lamps in a 2x2 grid. The exact description of the experiment can be found in CIE171:2006.

Photon shooter – calculation points 4.1

Position	Sensor					
	1	2	3	4	5	6	7
TE UL	91	107	115	118	116	107	93
MB UL	85	100	108	110	108	100	87
1	70,3	80,2	85,8	87,6	86,9	78,8	67,0
MB LL	65	77	83	85	83	77	67
TE LL	59	70	75	77	76	70	61
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	103	124	130	129	129	124	105
MB UL	96	116	122	120	121	116	98
2	77,9	85,8	99,0	95,6	97,7	91,0	76,9
MB LL	74	89	94	93	93	89	75
TE LL	67	81	85	84	84	81	68
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	112	132	141	141	141	131	113
MB UL	105	123	132	132	132	122	106
3	84,1	100,3	105,0	105,1	104,6	96,6	87,3
MB LL	81	95	101	102	101	94	81
TE LL	73	86	92	92	92	86	74
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	115	133	143	146	143	133	116

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MB UL	108	124	133	137	133	124	108
4	87,9	99,1	107,3	112,4	108,0	99,9	86,0
MB LL	83	96	103	105	103	96	83
TE LL	75	87	93	96	93	87	76
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	113	132	141	140	141	132	112
MB UL	105	124	131	131	131	123	105
5	86,3	96,1	104,6	105,2	104,8	99,0	84,6
MB LL	81	95	101	101	101	95	81
TE LL	74	86	92	92	92	86	73
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	103	124	130	127	130	123	104
MB UL	97	116	121	119	121	115	97
6	78,8	92,6	98,2	100,3	97,9	92,4	79,8
MB LL	74	89	93	92	93	89	75
TE LL	68	81	85	83	85	81	68
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	92	108	116	117	115	108	92
MB UL	86	100	108	109	107	100	86
7	69,4	78,4	86,2	87,5	88,5	80,4	67,9
MB LL	66	77	83	84	83	77	66
TE LL	60	70	76	76	75	70	60

In the above chart the upper and lower limits of the prescribed measuring points are given. TE UL: upper limit of the total error tolerance, + 10,5%

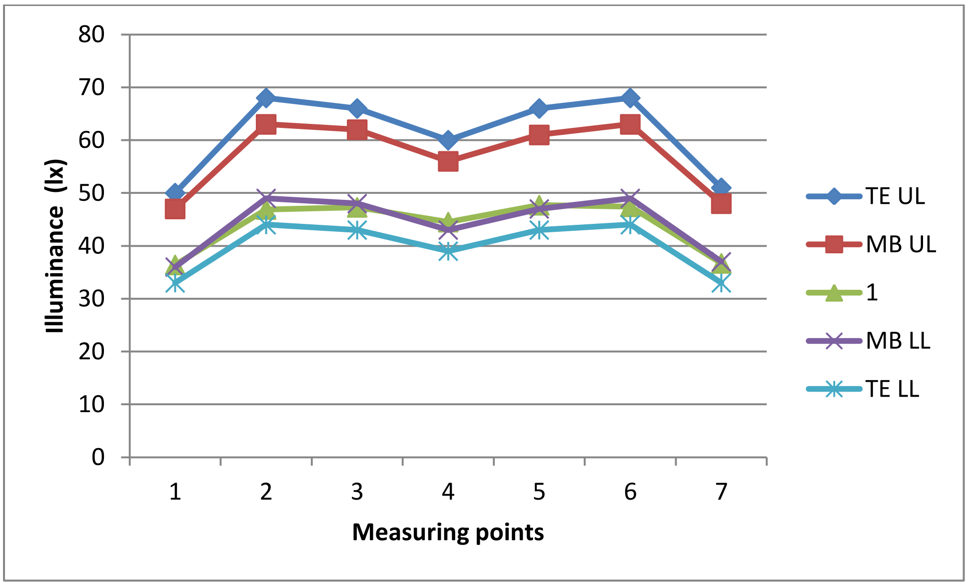
TE LL: lower limit of total error tolerance, -10,5%

MB UL: upper limit of measuring tolerance, + 6,7%

MB LL: lower limit of measuring tolerance, - 6,7%

The value calculated by the photon shooter at each position is shown in the middle. It is clear that all the values lie within the admissible error tolerance, with the exception of two calculation points even within the measuring tolerance.

Display of calculated values within the measuring / error tolerance for position 1



CIE test 4.2

For the second comparative test lamps emitting diffused light were used instead of fluorescent lamps.

Photon shooter – calculation points 4.2

Position	Sensor					
	1	2	3	4	5	6	7
TE UL	50	68	66	60	66	68	51
MB UL	47	63	62	56	61	63	48
1	36,4	46,9	47,3	44,5	47,7	47,4	36,7
MB LL	36	49	48	43	47	49	37
TE LL	33	44	43	39	43	44	33
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	65	93	88	77	87	93	67
MB UL	61	87	83	72	81	87	62
2	46,8	63,0	62,0	56,0	62,6	64,0	47,5
MB LL	47	67	64	55	63	67	48
TE LL	43	61	58	50	57	61	44
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	65	90	87	77	85	90	66
MB UL	61	84	81	72	80	84	62
3	47,1	62,0	62,0	57,6	63,1	63,5	48,5
MB LL	47	65	62	56	61	65	48
TE LL	42	59	57	50	56	59	43
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	61	79	77	72	77	79	61
MB UL	57	74	72	67	72	73	57

4	44,2	56,0	57,5	55,7	59,5	59,0	46,6
MB LL	44	57	55	52	55	56	44
TE LL	40	52	50	47	50	51	40
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	66	89	85	75	83	87	64
MB UL	61	83	79	70	78	82	60
5	47,1	62,0	62,4	59,0	66,2	67,3	51,1
MB LL	47	64	61	54	60	63	46
TE LL	43	58	55	49	54	57	42
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	65	92	85	74	83	89	63
MB UL	61	86	80	69	78	83	59
6	46,6	63,0	62,5	58,2	67,0	69,3	51,3
MB LL	47	66	61	53	60	64	46
TE LL	43	60	56	48	54	58	41
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	50	66	64	57	62	64	48
MB UL	47	62	60	54	58	60	45
7	36,2	47,0	48,0	46,2	51,1	51,4	39,7
MB LL	36	48	46	41	45	46	35
TE LL	33	43	42	38	41	42	31

Again most of the calculated values lie within the admissible error limits. 58% of the values are even within the measuring tolerance.

CIE test 4.3

In this test case luminaires with matt gloss reflectors were used. As the chart shows, all the values were within the prescribed measuring tolerance.

Photon shooter – calculation points 4.3

Position	Sensor						
	1	2	3	4	5	6	7
TE UL	178	279	265	222	265	279	180
MB UL	166	261	248	207	248	261	168
1	161,6	254,4	232,4	192,8	239,2	253,0	157,9
MB LL	128	201	191	159	191	201	130
TE LL	116	182	173	145	173	182	118
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	206	312	305	258	308	317	214
MB UL	192	291	285	241	288	296	200
2	185,5	274,8	258,6	218,0	257,6	263,7	176,8

MB LL	148	224	219	186	222	228	154
TE LL	135	203	199	169	201	207	140
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	229	353	337	281	342	358	232
MB UL	214	330	315	262	319	334	217
3	203,5	314,2	294,9	245,2	296,1	308,3	200,3
MB LL	165	254	242	202	246	257	167
TE LL	149	230	220	183	223	234	152
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	209	310	303	265	311	315	207
MB UL	195	290	283	247	290	294	193
4	185,4	279,7	262,0	224,9	265,5	274,8	180,4
MB LL	150	223	218	191	224	227	149
TE LL	136	203	198	173	203	206	135
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	230	358	345	286	344	356	229
MB UL	215	334	322	267	321	332	214
5	203,0	310,7	289,5	243,6	298,5	308,6	199,3
MB LL	165	257	248	206	247	256	165
TE LL	150	234	225	187	225	232	150
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	221	329	317	264	312	317	209
MB UL	206	308	296	247	291	296	196
6	181,9	272,8	258,2	221,8	268,5	278,9	186,3
MB LL	159	237	228	190	224	228	151
TE LL	144	215	207	173	204	207	137
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	188	289	273	229	274	283	180
MB UL	176	270	255	214	255	264	168
7	164,3	255,6	235,3	196,2	241,8	255,3	162,1
MB LL	135	208	196	165	197	204	129
TE LL	123	189	178	150	179	185	117

CIE test 4.4

In this test case the reflection factor of the walls was reduced to 4%, of the ceiling to 3% and of the floor to 6%. As in the first test case, fluorescent lamps were used. Three values are within the permissible error tolerance, all other values are within the measuring tolerance.

Photon shooter - calculation points 4.4

Position	**Sensor**						

	1	2	3	4	5	6	7
TE UL	30	32	39	43	40	33	31
MB UL	28	29	37	40	38	30	29
1	25,7	28,6	34,3	36,6	33,7	28,9	26,0
MB LL	22	23	28	31	29	23	22
TE LL	20	21	26	28	26	21	20
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	31	32	39	42	41	33	31
MB UL	28	30	37	39	38	31	29
2	27,9	30,2	36,1	39,3	36,0	30,5	28,0
MB LL	22	23	28	30	29	24	23
TE LL	20	21	26	28	27	21	21
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	39	41	51	54	51	40	38
MB UL	36	38	48	51	47	38	35
3	33,6	37,1	44,3	48,4	44,0	37,2	34,2
MB LL	28	29	37	39	37	29	27
TE LL	25	27	33	36	33	26	25
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	43	46	57	62	57	46	43
MB UL	40	43	53	57	53	43	40
4	36,4	41,1	49,2	52,3	48,7	41,2	36,6
MB LL	31	33	41	44	41	33	31
TE LL	28	30	37	40	37	30	28
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	38	40	51	54	51	41	38
MB UL	35	38	48	51	48	38	36
5	33,7	36,7	43,9	48,0	43,5	36,8	33,4
MB LL	27	29	37	39	37	29	28
TE LL	25	26	33	35	34	27	25
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	31	33	41	43	40	33	31
MB UL	29	30	39	40	38	31	29
6	28,3	30,7	36,7	39,8	36,3	30,6	28,2
MB LL	23	23	30	31	29	23	23
TE LL	20	21	27	28	26	21	20
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	31	33	42	44	41	33	32
MB UL	29	31	39	41	38	31	30
7	26,4	29,3	34,6	37,4	34,8	29,2	26,3

MB LL	22	24	30	32	29	24	23
TE LL	20	21	27	29	26	22	21

CIE test 4.5

In this case, as in 4.4., the reflection factors were reduced to 6%, the luminaires used are as in 4.2.. The chart shows that only two values are within the permissible error tolerance, all other values are within the measuring tolerance.

Photon shooter - calculation points 4.5

Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	32	48	47	42	47	48	33
MB UL	30	44	44	40	44	45	31
1	24,4	34,9	35,7	33,1	36,0	35,3	24,8
MB LL	23	34	34	31	34	35	24
TE LL	21	31	31	28	31	31	22
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	46	73	70	60	69	74	48
MB UL	43	68	66	56	64	69	44
2	34,7	52,1	51,7	46,0	52,3	52,9	35,3
MB LL	33	53	51	43	49	53	34
TE LL	30	48	46	39	45	48	31
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	47	71	70	61	69	72	48
MB UL	44	66	65	57	65	67	45
3	35,5	51,8	52,5	48,3	53,5	53,1	36,6
MB LL	34	51	50	44	50	52	34
TE LL	30	46	45	40	45	47	31
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	43	61	62	56	61	61	43
MB UL	40	57	57	53	57	57	40
4	32,9	46,0	48,2	46,6	50,1	48,7	35,0
MB LL	31	44	44	40	44	44	31
TE LL	28	40	40	37	40	40	28
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	47	71	68	60	68	70	47
MB UL	44	66	64	56	63	65	43
5	35,4	51,7	52,9	49,7	56,5	56,7	38,9
MB LL	34	51	49	43	49	50	33
TE LL	31	46	44	39	44	46	30

Position	Sensor						
	1	2	3	4	5	6	7
TE UL	46	72	68	57	66	71	45
MB UL	43	67	63	54	62	66	42
6	34,5	52,0	52,2	48,0	56,4	57,9	38,5
MB LL	33	52	49	41	47	51	33
TE LL	30	47	44	37	43	46	30
Position	Sensor						
	1	2	3	4	5	6	7
TE UL	32	47	46	40	45	45	31
MB UL	30	44	43	38	42	42	29
7	24,4	34,9	36,2	34,7	38,9	38,7	27,1
MB LL	23	34	33	29	32	33	23
TE LL	21	30	30	26	29	30	20

CIE test 4.6

Again the reflection factors are below 6%, as in 4.4 and 4.5. As a luminaire the photometry as in 4.3 was used. Only one value is within the permissible total error range, all other values are within the measuring tolerance.

Photon shooter - calculation points 4.6

Position	Sensor						
	1	2	3	4	5	6	7
TE UL	146	249	237	197	237	252	149
MB UL	136	232	221	184	221	235	139
1	131,5	212,1	199,6	170,5	209,4	216,5	131,6
MB LL	105	179	170	142	170	181	107
TE LL	95	162	155	129	155	164	97
Position	Sensor						
	1	2	3	4	5	6	7
TE UL	172	288	282	236	284	294	179
MB UL	161	269	263	221	265	275	168
2	159,8	250,8	240,6	207,6	244,7	247,4	156,4
MB LL	124	207	202	170	204	211	129
TE LL	113	188	184	154	185	192	117
Position	Sensor						
	1	2	3	4	5	6	7
TE UL	195	329	313	258	317	335	196
MB UL	182	307	292	241	296	312	183
3	174,0	278,4	267,2	227,6	271,9	278,4	174,1
MB LL	140	237	225	185	228	241	141
TE LL	127	215	204	168	207	218	128
Position	Sensor						
	1	2	3	4	5	6	7
TE UL	178	287	278	242	285	290	176
MB UL	166	268	259	226	266	271	164

4	168,3	263,5	253,2	218,0	257,4	260,3	163,9
MB LL	128	206	200	174	205	209	126
TE LL	116	187	181	158	186	190	115
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	196	334	320	262	319	333	196
MB UL	183	312	299	244	298	311	183
5	179,4	284,5	270,1	229,6	274,0	278,2	172,8
MB LL	141	240	230	188	230	239	141
TE LL	128	218	209	171	208	217	128
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	186	306	292	242	287	292	175
MB UL	174	286	273	226	268	273	163
6	163,2	257,5	247,4	212,8	251,9	256,4	161,9
MB LL	134	220	210	174	206	210	126
TE LL	122	200	191	158	187	191	114
Position	**Sensor**						
	1	2	3	4	5	6	7
TE UL	155	258	241	202	242	251	146
MB UL	145	241	225	189	226	234	136
7	138,0	221,4	209,1	175,8	210,7	216,5	133,2
MB LL	111	186	173	145	174	180	105
TE LL	101	169	157	132	158	164	95

Further test cases

CIE 171:2006 test cases 5.2 to 5.7 are not based on physical scenarios. They examine the calculation accuracy analytically , based on theoretical observation with point light sources. For details of this experiment please see CIE 171:2006.

CIE test 5.2 - asymmetric CIE T9 photometry

Point	d (m)	Angle(°)	E (lx)	DIALux	Error (%)
A	3,000	0,000	111,110	111,5	0,4
B	3,041	9,460	122,250	122,7	0,3
C	3,162	18,430	124,080	124,5	0,4
D	3,354	26,570	117,310	117,7	0,3
E	3,082	13,260	113,650	113,8	0,1
F	3,202	20,440	113,410	113,5	0,1
G	3,391	27,790	102,740	102,5	-0,2
H	3,317	25,240	91,570	91,8	0,3
I	3,500	31,000	81,650	81,6	0,0
J	3,674	35,260	62,160	62,3	0,2

CIE test 5.2 - purely diffuse photometry

Point	d (m)	Angle(°)	E (lx)	DIALux	Error(%)
A	3,000	0,000	111,110	111,1	0,0
B	3,041	9,460	105,210	105,1	-0,1
C	3,162	18,430	90,020	90,0	0,0
D	3,354	26,570	71,110	71,0	-0,1
E	3,082	13,260	99,730	99,7	0,0
F	3,202	20,440	85,640	85,7	0,1
G	3,391	27,790	68,060	68,1	0,0
H	3,317	25,240	74,360	74,4	0,0
I	3,500	31,000	59,980	60,0	0,0
J	3,674	35,260	49,390	49,4	0,1

CIE test 5.3 - asymmetric CIE T9 photometry

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
E(lx)	56,73	122,10	126,95	108,61	86,13	66,07	99,62	115,53	119,34	113,80	99,97	81,98	63,30	47,39
DIALux	56,3	121,9	126,8	108,4	86,0	66,1	99,6	115,3	119,3	113,6	100,0	82,0	63,5	47,9
Error (%)	-0,8	-0,2	-0,2	-0,2	-0,1	0,0	0,0	-0,2	-0,1	-0,1	0,1	0,0	0,3	1,0

CIE test 5.3 - purely diffuse photometry

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
E (lx)	32,68	75,09	81,38	69,12	53,41	39,90	61,27	79,18	95,52	105,89	105,89	95,52	79,18	61,27
DIALux	32,6	75,2	81,3	69,0	53,4	40,0	61,4	79,2	95,6	105,7	105,7	95,6	79,2	61,4
Error (%)	-0,1	0,1	-0,1	-0,1	-0,1	0,2	0,2	0,0	0,1	-0,2	-0,2	0,1	0,0	0,2

CIE test 5.6.2.1 - surface 0,5m x 0,5m

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
E/(Ehz´ρ) (%)	0,246	0,58	0,644	0,556	0,433	0,325	0,491	0,639	0,778	0,864	0,864	0,778	0,639	0,491
DIALux	0,2	0,6	0,6	0,6	0,4	0,3	0,5	0,6	0,8	0,9	0,8	0,7	0,6	0,5
Error(%)	-4,7	0,6	0,0	0,6	-2,9	1,1	-0,4	-3,5	0,8	-0,7	-2,3	-4,4	0,5	-0,1

CIE test 5.6.2.2 - surface 4m x 4m

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
E/(Ehz´ρ) (%)	-	35,901	27,992	21,639	16,716	12,967	26,8	30,94	33,98	35,57	35,57	33,98	30,94	26,8
DIALux	-	36,5	28,1	22,1	17,0	12,7	27,6	30,1	34,6	35,5	35,9	33,7	30,7	26,7
Error(%)	-	1,6	0,5	2,0	1,7	-2,3	3,1	-2,8	1,7	-0,1	0,8	-0,9	-0,7	-0,3

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DIAL
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CIE 5.6.2.3 - surface 500m x 500m

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
E/(Ehz´ρ) (%)	3,08	9,10	14,72	19,77	24,16	27,90	10,95	13,26	16,21	20,00	24,80	30,77	37,87	45,84
DIALux	2,9	8,6	13,2	19,1	23,6	27,0	10,5	12,5	15,3	18,1	23,8	28,9	35,0	42,4
Error(%)	-7,1	-5,3	-10,6	-3,4	-2,3	-3,2	-4,1	-5,5	-5,7	-9,4	-4,0	-5,9	-7,5	-7,5

Summary

Based on the calculation comparisons presented here we show that Dialux evo provides calculation results of high accuracy and can bear comparison with standardized test procedures. However, we cannot exclude the possibility that in certain cases there may be deviations from reality. Here are some examples:

- the rule of photometric distance no along applies in near-fields
- the material model on which the calculation is based is very simplified, although directed reflectance, refraction index and transmission have been added to previous models
- the number of photons used is restricted by the available storage capacity and the accepted calculation time

Scenes with large surfaces in which very exact results are required on small surfaces are problematic for a photon shooter by reason of the system used. Since the number of photons is limited, the risk is present that insufficient photons reach the relevant small surface. CIE test 5.6.2.3 is such an example. If more accurate calculation results are required here, then we recommend placing calculation points.

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- Any situation simulated by software represents a simplified model of physical reality and can therefore not provide 100% calculation accuracy.

Complex scenes for which the new calculation kernel was optimized are not taken into consideration in CIE 171:2006.

The new photon shooter is an important development. For the very first time it is possible not only to visualize mirroring surfaces but also to take them into account exactly and sufficiently in photometric planning and calculation in a time frame which is acceptable in practice. There is continuing development in the design and planning of lighting systems in which there is a transition from looking at rooms, floors, buildings and outdoor scenes as single elements to viewing these as a whole together with their photometric interaction.

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