



KUCERA INTERNATIONAL INC.

GEOGRAPHIC INFORMATION PROFESSIONALS / PHOTOGRAMMETRISTS

Aerotriangulation Report Scott County, IA 2009

This report summarizes the aerotriangulation (AT) results of 0.4' GSD (Ground Sample Distance) color digital aerial photography captured for the Scott County, IA. The photography was acquired using a Leica ADS40 digital camera, sensor head 30104. Mission dates were April 8th, 9th, 11th, and 15th 2009. The photography consisted of 57 flight lines and covered Scott County its entirety.

The AT referenced the NAD83(96) State Plane Coordinate System, Iowa South Zone (1402). The vertical reference datum used was NAVD88(Geoid03). The measurement units used were US survey feet.

The AT project was set up as four separate sub-blocks. The sub-blocks were controlled with a combination of airborne GPS/INS data and ground-based control points. The airborne GPS data was post-processed using TerraTecAS TerraPos v1.3.2 and Applanix POSGNSS v4.4. Inertial navigation system (INS) data was coupled with the processed GPS data using Leica IPAS Pro v1.33. APM (Automated Point Matching) measurements were generated to tie image strips and bands within strips together relatively using Leica GPro v3.3.1. Upon completion of APM, AT processing was performed using Leica ORIMA/CAP-A v9.1. Controls are measured and bundle adjustments are run using the controls to define the datum. Throughout an adjustment's iterations, statistical measures are used to detect and remove blunders in the APM and to refine the image coordinate measurements, ending with a final adjustment to the block of photography. After each adjustment, the resulting block statistics are thoroughly analyzed. These statistics provide a check on the quality of automatic and manual point measurements, ground controls, GPS/INS data, and the resulting exterior orientation parameters. This process ultimately produces a refined, final adjustment for the block of photography meeting all standards for photography at the scale it was flown.

There were 64 control points supplied for the project. All controls were measurable and used in the AT.

The achieved results for each component of the AT are included in the table below. These values are taken or computed from the block printouts. Sigma0 is a measure of the overall adjustment. GPS and IMU RMS reflect the remaining random errors in those components. Tie point RMS values reflect the average accuracy which was achieved at all terrain points. Control point RMS values reflect an average movement of the controls and is computed from the residuals of all control points. Control points define the datum for the blocks and, because

of their importance, a more informative table containing all control points in US survey feet is also included.

The block printouts for each AT block are not included within this report. Their length and formatting do not lend themselves to proper viewing here. However, they are included along with this report and are best viewed in WordPad or NotePad with the wordwrap feature turned off.

	Block01	Block02	Block03	Block04
Sigma0 (mm)	1.4	1.3	1.9	2.1
GPS RMS X (m)	0.006	0.009	0.007	0.012
GPS RMS Y (m)	0.009	0.008	0.008	0.010
GPS RMS Z (m)	0.005	0.005	0.008	0.012
IMU RMS O (deg)	0.0012	0.0013	0.0011	0.0012
IMU RMS P (deg)	0.0010	0.0010	0.0010	0.0012
IMU RMS K (deg)	0.0116	0.0128	0.0057	0.0052
Tie points RMS X (m)	0.0346	0.0280	0.0312	0.0438
Tie points RMS Y (m)	0.0310	0.0250	0.0276	0.0310
Tie points RMS Z (m)	0.0554	0.0503	0.0626	0.1004
Control Points RMS X (m)	0.0384	0.0329	0.0338	0.0226
Control Points RMS Y (m)	0.0372	0.0280	0.0326	0.0204
Control Points RMS Z (m)	0.0256	0.0372	0.0238	0.0469

AT Control Residuals Scott County, IA

Horizontal datum: NAD83(1996), SPCS IA-S (1402)

Vertical datum: NAVD 88 (Geoid03)

Unit: US Survey Foot

Block01		INPUT CONTROL			ADJUSTED CONTROL				Res. X	Res. Y	Res. Z
Type	PT ID	X	Y	Z	X	Y	Z				
Full	CP_103	2351592.109	591444.139	684.640	2351592.003	591444.263	684.737		-0.106	0.124	0.097
Full	CP_104	2382825.091	593210.439	733.821	2382825.148	593210.371	733.983		0.057	-0.068	0.161
Full	CP_106	2383698.651	572074.461	777.780	2383698.695	572074.533	777.839		0.043	0.072	0.059
Full	CP_127	2384055.240	543037.809	555.779	2384055.292	543037.764	555.704		0.052	-0.045	-0.075
Full	CP_601	2348166.411	656037.805	757.562	2348166.296	656038.050	757.470		-0.116	0.245	-0.091
Full	CP_602	2365341.018	656550.880	706.442	2365341.174	656550.839	706.342		0.157	-0.041	-0.100
Full	CP_603	2379851.717	651441.171	742.583	2379851.524	651440.987	742.588		-0.192	-0.184	0.004
Full	CP_614	2352408.280	624252.486	776.119	2352408.316	624252.627	776.151		0.036	0.140	0.032
Full	CP_615	2367917.135	624717.418	783.089	2367917.255	624717.315	783.146		0.120	-0.103	0.056
Full	CP_616	2382657.939	622437.539	670.250	2382657.736	622437.459	670.188		-0.203	-0.080	-0.063
Full	CP_631	2367473.385	592947.068	718.554	2367473.538	592947.007	718.470		0.153	-0.060	-0.083
								RMSE	0.126	0.122	0.084

Block02		INPUT CONTROL			ADJUSTED CONTROL				Res. X	Res. Y	Res. Z
Type	PT ID	X	Y	Z	X	Y	Z				
Full	CP_402	2423779.442	599539.907	734.551	2423779.392	599539.844	734.644		-0.050	-0.063	0.093
Full	CP_409	2414963.028	590456.695	744.630	2414963.259	590456.708	744.565		0.230	0.013	-0.065
Full	CP_410	2420354.858	586386.777	722.860	2420354.879	586386.665	722.807		0.022	-0.111	-0.053
Full	CP_417	2420861.314	570549.213	741.010	2420861.210	570549.112	741.053		-0.104	-0.101	0.043
Full	CP_420	2431643.700	557647.933	556.119	2431643.813	557648.084	556.262		0.113	0.151	0.143
Full	CP_421	2421257.586	556796.263	614.010	2421257.515	556796.144	613.963		-0.071	-0.118	-0.047
Full	CP_641	2413467.804	547252.181	652.776	2413467.899	547252.204	652.576		0.095	0.023	-0.200
Full	CP_104	2382825.091	593210.439	733.820	2382825.197	593210.561	733.955		0.106	0.122	0.135
Full	CP_106	2383698.650	572074.460	777.780	2383698.593	572074.510	778.071		-0.057	0.050	0.290
Full	CP_127	2384055.241	543037.809	555.781	2384055.205	543037.880	555.959		-0.036	0.070	0.178
Full	CP_603	2379851.717	651441.171	742.583	2379851.584	651441.318	742.605		-0.132	0.147	0.022
Full	CP_607	2397113.997	640045.243	645.269	2397114.069	640045.223	645.215		0.072	-0.020	-0.054
Full	CP_609	2427115.953	649119.574	681.771	2427115.870	649119.562	681.688		-0.084	-0.012	-0.083
Full	CP_616	2382657.938	622437.541	670.249	2382657.840	622437.669	670.346		-0.098	0.128	0.097
Full	CP_617	2398325.228	622907.286	737.971	2398325.196	622907.375	738.063		-0.032	0.089	0.092
Full	CP_618	2413792.665	623374.799	757.869	2413792.820	623374.760	757.692		0.155	-0.038	-0.177
Full	CP_619	2430616.071	623959.596	774.250	2430615.852	623959.635	774.189		-0.220	0.039	-0.061
Full	CP_634	2399446.034	577396.909	748.449	2399445.964	577396.834	748.441		-0.070	-0.075	-0.008
Full	CP_636	2407314.498	599369.313	726.941	2407314.661	599369.141	726.861		0.163	-0.171	-0.080
Full	CP_640	2400238.528	547046.281	711.012	2400238.557	547046.324	711.003		0.030	0.043	-0.009
Full	CP_642	2408149.673	655956.012	640.804	2408149.671	655955.904	640.600		-0.002	-0.108	-0.204
Full	CP_643	2430549.587	664846.416	661.434	2430549.560	664846.362	661.379		-0.027	-0.054	-0.054
								RMSE	0.108	0.092	0.122

Block03

INPUT CONTROL

ADJUSTED CONTROL

Type	PT ID	X	Y	Z	X	Y	Z		Res. X	Res. Y	Res. Z	
Full	CP_403	2436403.485	602883.974	746.809	2436403.464	602883.665	746.761		-0.021	-0.308	-0.048	
Full	CP_404	2447062.591	600531.560	743.280	2447062.560	600531.751	743.257		-0.031	0.191	-0.024	
Full	CP_408	2433619.995	589502.901	734.331	2433619.896	589502.891	734.283		-0.099	-0.010	-0.048	
Full	CP_413	2458522.046	585228.980	700.612	2458522.106	585228.932	700.544		0.060	-0.048	-0.067	
Full	CP_414	2447241.018	579353.013	635.430	2447240.969	579352.910	635.496		-0.049	-0.103	0.066	
Full	CP_415	2455348.169	574806.100	675.169	2455348.087	574806.182	675.109		-0.082	0.082	-0.060	
Full	CP_416	2433861.805	573757.191	718.680	2433861.746	573757.216	718.669		-0.059	0.025	-0.010	
Full	CP_419	2443658.596	568252.518	561.179	2443658.606	568252.498	561.095		0.010	-0.021	-0.084	
Full	CP_420	2431643.698	557647.934	556.119	2431643.681	557648.093	556.215		-0.018	0.158	0.096	
Full	CP_1201	2450083.930	594374.960	740.171	2450083.945	594374.919	740.117		0.015	-0.041	-0.054	
Full	CP_1204	2465630.030	606869.471	774.521	2465630.044	606869.614	774.539		0.014	0.142	0.018	
Full	CP_2003	2465242.320	523827.211	665.222	2465242.327	523827.261	665.162		0.007	0.050	-0.061	
Full	CP_2006	2470834.327	543762.115	569.646	2470834.330	543762.081	569.702		0.003	-0.034	0.056	
Full	CP_610	2448749.456	648973.852	673.747	2448749.587	648973.850	673.658		0.131	-0.002	-0.088	
Full	CP_611	2461574.336	649122.245	613.343	2461574.398	649122.165	613.327		0.061	-0.080	-0.016	
Full	CP_619	2430616.069	623959.597	774.250	2430615.800	623959.507	774.314		-0.269	-0.091	0.064	
Full	CP_620	2446800.082	627491.602	794.065	2446800.281	627491.467	794.111		0.199	-0.135	0.045	
Full	CP_621	2462336.021	627489.308	745.155	2462336.127	627489.330	745.302		0.107	0.022	0.147	
Full	CP_643	2430549.587	664846.417	661.434	2430549.373	664846.356	661.613		-0.215	-0.061	0.179	
Full	CP_1015	2470997.350	586854.702	699.491	2470997.554	586854.805	699.508		0.205	0.103	0.017	
Full	CP_1033	2466087.119	569227.531	565.021	2466087.024	569227.613	565.151		-0.094	0.082	0.130	
Full	CP_1	2443059.132	664205.714	622.743	2443059.148	664205.711	622.640		0.015	-0.003	-0.103	
Full	CP_2	2469491.959	665293.072	643.791	2469492.070	665293.154	643.781		0.112	0.082	-0.010	
									RMSE	0.111	0.107	0.078

Block04

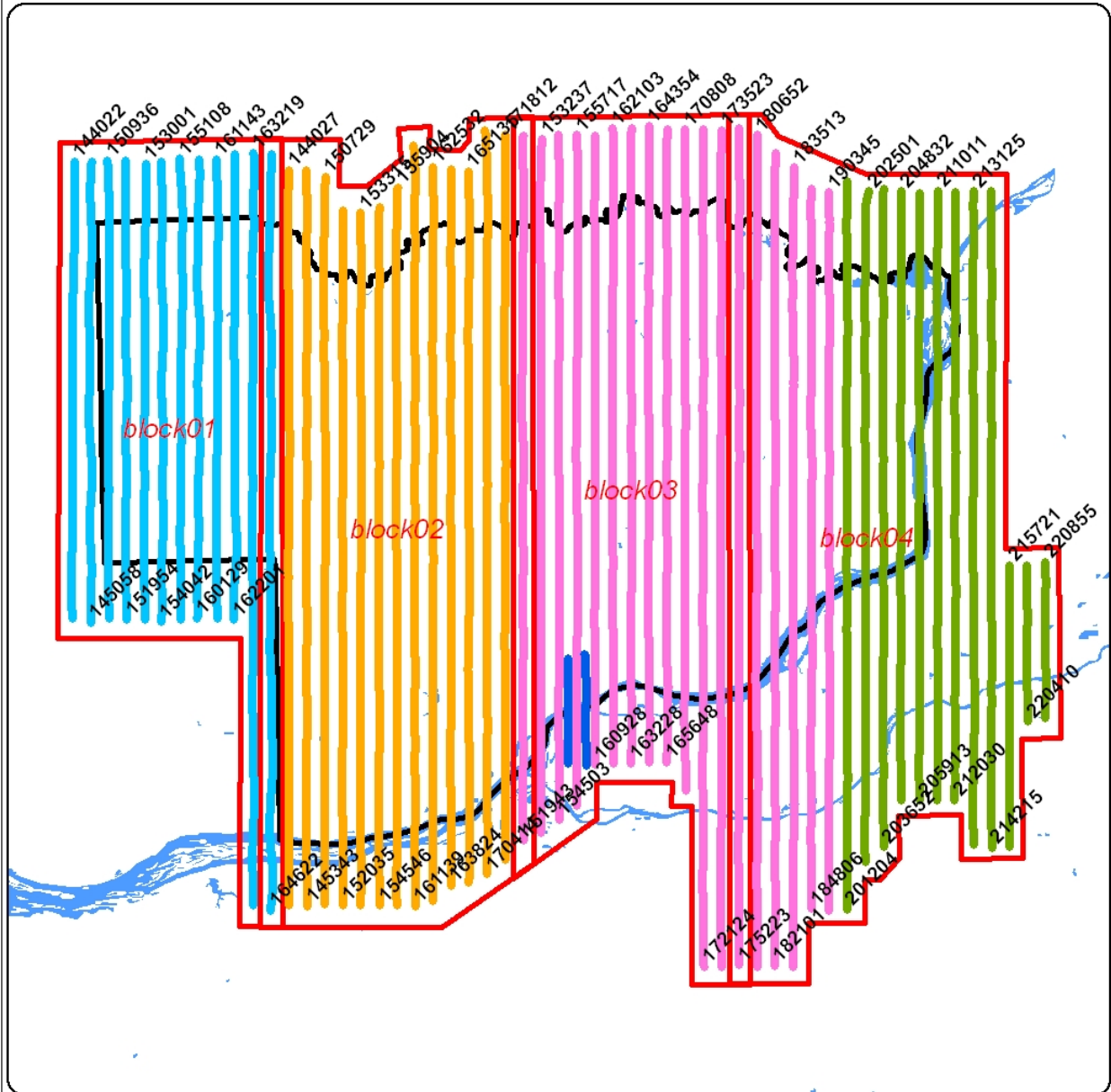
INPUT CONTROL

ADJUSTED CONTROL

Type	PT ID	X	Y	Z	X	Y	Z		Res. X	Res. Y	Res. Z	
Full	CP_2001	2523895.317	578155.247	580.179	2523895.292	578155.173	580.239		-0.025	-0.074	0.060	
Full	CP_2002	2495234.235	556244.466	585.692	2495234.271	556244.449	585.840		0.036	-0.017	0.149	
Full	CP_2004	2515235.747	546091.050	653.223	2515235.669	546091.023	653.323		-0.078	-0.027	0.100	
Full	CP_2005	2477715.049	524345.541	744.205	2477715.108	524345.523	743.986		0.059	-0.018	-0.220	
Full	CP_2006	2470834.331	543762.115	569.646	2470834.460	543762.101	569.424		0.129	-0.014	-0.222	
Full	CP_2007	2505191.401	568191.485	586.312	2505191.237	568191.490	586.460		-0.164	0.005	0.148	
Full	CP_2008	2488449.286	543589.724	700.297	2488449.285	543589.702	700.088		0.000	-0.022	-0.209	
Full	CP_612	2480567.906	644598.066	609.088	2480567.863	644598.021	609.122		-0.042	-0.045	0.035	
Full	CP_613	2498277.138	643214.783	592.454	2498277.147	643214.806	592.694		0.008	0.023	0.240	
Full	CP_622	2478187.570	629074.791	746.499	2478187.547	629074.856	746.355		-0.022	0.065	-0.143	
Full	CP_623	2499459.030	626206.767	697.378	2499458.963	626206.740	697.493		-0.067	-0.027	0.115	
Full	CP_630	2496088.599	610731.119	734.962	2496088.651	610730.989	735.046		0.052	-0.130	0.084	
Full	CP_1015	2470997.351	586854.700	699.489	2470997.497	586854.832	699.219		0.147	0.132	-0.270	
Full	CP_1206	2481565.981	605529.019	761.859	2481565.991	605529.038	761.842		0.009	0.020	-0.017	
Full	CP_1209	2493480.140	591629.641	585.810	2493480.079	591629.510	585.987		-0.060	-0.131	0.177	
Full	CP_1016	2478940.591	587172.581	686.671	2478940.606	587172.652	686.829		0.015	0.071	0.157	
Full	CP_2	2469491.958	665293.070	643.789	2469492.035	665293.121	643.668		0.077	0.051	-0.120	
Full	CP_3	2489399.510	652842.134	618.086	2489399.520	652842.192	618.109		0.010	0.058	0.023	
Full	CP_4	2515425.888	653025.876	590.277	2515425.803	653025.955	590.191		-0.085	0.079	-0.085	
									RMSE	0.074	0.067	0.154

RMSE ALL	0.104	0.096	0.115
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Scott County IA - AT Block Layout

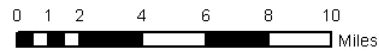


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- 041109_3547G_SH104_B_scan-on
- 041109_3547G_SH104_A_scan-on
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- 040809_3547G_SH104_scan-on
- ▭ AT block
- ▭ County boundary
- ▭ Water

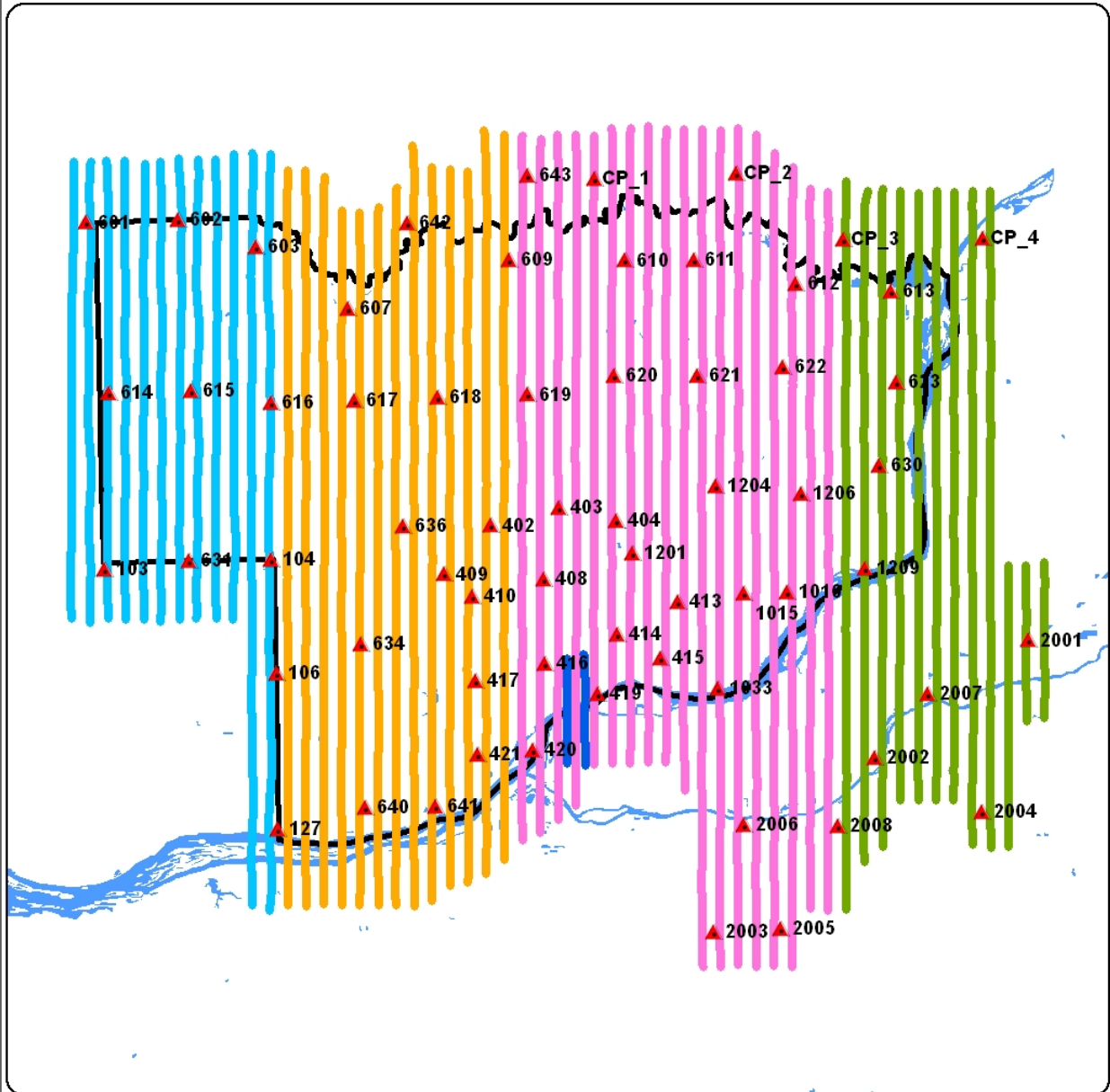


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Scott County IA - Control Layout



- ▲ Control point
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- 041109_3547G_SH104_B_scan-on
- 041109_3547G_SH104_A_scan-on
- 040909_3547G_SH104_scan-on
- 040809_3547G_SH104_scan-on
- ▭ County boundary
- ▭ Water



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