Which ies/eulumdat fits the given geomery of street lighting best? Selecting a luminaire from thousands of luminaire photometries

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Abstract

Using a programme ies2tab and bash scripts running it, the whole world market with luminaires can be used to find the best working and least harming solution for any continuous street-lighting case – providing that the photometric files are available.

When a street is to be lit or its lighting system reconstructed, the usual way is that the engineer takes some luminaire from his/her preferred producer. Then he/she guesses which geometry might suite the lighting task and computes the results by some proprietary software. If the result is not satisfactory, another geometry is tried, or perhaps still another. So the geometry of poles and overhangs is optimised somehow for the selected luminaire and its tunable photometric properties.

A much better way to find the best geometry of the new installation, when one or several luminaires and their photometries are preselected, is using a programme Easy Light – Save the Sky [1]. The results show an electric consumption per kilometre of the street, so the most suitable luminaire can be picked up from the preselected set. To compute the impact of the chosen solution on the sky luminance, programme Roadpollution is to be used [2].

When old luminaires are to be replaced by new ones, another task is to be solved. The geometry is maintained and a luminaire suiting excellently the lighting demands and producing minimum harm (least light outside the target area etc., least electric consumption) should be searched for. Such a software has been developed in 2007, based on a programme ies2tab [3].

The first version of the programme from 2001 was primarily a tool to make a human-readable table out of the photometric file in a *.ies format. The table is preceded by summary parameters computed from the file. Apart from usual ones, some numbers relevant for sky luminance are added, if the luminaire is not fully shielded – if it sends some light over 90º from nadir. And example:

```
# Source file: ies/35617.ies
# Luminaire flux =  5371 lm,
#                   82.6 % of the bulb flux
# between 75 and 90:  9.7 % of the luminaire flux
#  - this part causes just GLARE in case of road lighting and similar purposes
# 80deg and above:  max 370.0 cd / 1000 lm ,  3.1 % of the luminaire flux
# 90deg and above:  max   3.0 cd / 1000 lm ,  0.5 % of the luminaire flux
# CutOff Type: Non-CutOff

#  Increase of Sky Luminance due to light going
#    from the luminaire directly above horizon, as compared with the
#    luminance produced by the light dispersed from the ground:  13 %
#  Increase of Sky Luminance in Distant Places by light below 15.0 degrees
#    due to light going from the luminaire directly above horizon:  49 %
#  (for the zenith luminance such an angle suits places up to  19 km distance)
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```
#   The increases concern the following situation:
#    Albedo = 0.10
#    Zenith Extinction = 0.30 mag (i.e., direct light remaining  76 %)
#    Indicatrix type =0 (0: acc. to P.Cinzano, 4..6: CIE sky types)
#   (the downward-scattered part of lambertian uplight is 0.1108 then)

# 62.5 deg to <67.5 deg:   max   398 cd / 1000 lm,
# 67.5 deg to < 76  deg:   max   997 cd / 1000 lm,
# maximum spec. lum. intensity   997 cd / 1000 lm
```

Later, eulumdat photometric format and the conversions between formats have been added. Then an illuminance plot. And an option to compute illuminance by a continuous row of equidistant luminaires, this being the most common situation in real world. The programme is an open source under GNU public license, and can be run online too [4]. It might be a good aid for anybody interested in lighting and light pollution computations.

Finally, a bash script rect_ilc.sh [5] has been written, which sorts the luminaires according to the minimum illuminance in a strip representing the street (the higher the minimum illuminance, the better). Using it several times, with more and more strict requirements, can iterate a reasonably small set of the best performing luminaires for the given geometry of the street and lighting infrastructure. An example of results of such a search is given within [6], for more discussion see [7].

The basic illuminance plots are for (unrealistic) “unit” case that luminaires would have lamps producing 1 klm, would be point-like and just 1 m over the terrain. For a real luminaire height and a real lamp, see an example for a 9 W LED array in a directory referenced in [8].

References

[1] D. Bonata, “Easy Light - Save the Sky 4.0 - inglese,” 2008, <http://tinyurl.com/stsen> .

[2] P. Cinzano, “Roadpollution User Manual,” 2006, <http://www.lightpollution.it/roadpollution/> .

[3] J. Hollan, “ies2tab programme: photometric properties of luminaires,” 2001-2012, <http://amper.ped.muni.cz/light/ies2/> .

[4] J. Hollan, “Online computing of summary results from photometric files of luminaires and of plots of ground illuminance by them,” 2007, <http://amper.ped.muni.cz/light/ies2/online/> .

[5] J. Hollan, “A bash script sorting the luminaires according minimum illuminance of the road,” October 2007, <http://amper.ped.muni.cz/light/ies2/scripts_bat/rect_ilc.sh.txt> .

[6] J. Hollan, “The selection of best performing luminaires for a street in Ostopovice,” 24 October 2007, <http://amper.ped.muni.cz/light/ies2/EasyLight-SaveTheSky/ostopovice.htm> .

[7] J. Hollan, “Choosing the best-suiting outdoor luminaire,” 27 October 2007, <http://amper.ped.muni.cz/light/ies2/EasyLight-SaveTheSky/ch_best.htm> .

[8] J. Hollan, “Re: Batlamp - the ultimate LED streetlight for protecting the night sky?,” 2 October 2012, <http://amper.ped.muni.cz/darksky/2012/000092.html> .