Evalgiare 2.0 – new features 

... faster ... and more robust HDR-image evaluation

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Content

Introduction – What is evalglare?
Bug fixes since version 1.11
New metrics and evaluation methods
New safety features for HDR-image evaluations
Repair function to sun induced pixel overflow
Speed improvement
Introduction – What is evalglare?

So far:
It is a Tool for performing a glare analysis of an Radiance-based HDR scene

It
- detects glare sources in HDR images
- calculates solid angles from pixels/glare sources
- calculates vertical illuminance from image
- calculates various glare metrics (DGP, UGR, VCP, DGI, CGI…)
- can cut the field of view

The phases for daylight calculation increased from 3 to 6 in the last years

But for evalglare???
The metrics were the same in the last years…

Therefore: New metrics are included!!!
Introduction – What is evalglare?

*With the release of version 2.0 evalglare becomes a tool to perform luminance based evaluations of HDR images.*

*Following evaluations are possible now:*

- (simple) statistical analysis of the image or parts of the image (mean, median, 95 percentile, 75 percentile, standard deviation)
- Zonal evaluation (two circular zones possible, horizontal band)
- Masking within evalglare

*Various evaluations possible now.*
Content

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Bug fixes since version 1.11

• **Calculation of the background luminance**

  Up to version 1.16: \(L_b = \frac{E_i}{\Pi}\)

  \(L_b\): Background luminance
  \(E_i\): Indirect Illuminance

  -> Pixel luminance is cosinus weighted!

  From version 1.17 on:
  \(L_b\) is not cosinus weighted any more, now average luminance of the non-glare source pixels

  -> Influences DGI and UGR calculation

• **Removal of the age-correction function**

  Re-analysis of the data did not show significant results
  Although there might be an effect, it cannot be quantified at the moment

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Content

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Repair function to sun induced pixel overflow
Speed improvement
Evalglare 2.0 – new metrics and evaluation methods

Following new metrics are included:

Within standard calculation, displayed in the last line only with the –d output option. Glare source section remains similar.

• **UGP**: Unified glare probability according to Hirning
• **DGI\text{mod}**: Modified DGI according to Fisekis
• **UGR\text{exp}**: Experimental UGR according to Fisekis
• **av\_lum\_pos**: Average luminance of image, pixels are weighted by the position index, Osterhaus
• **av\_lum\_pos2**: Average luminance of image, pixels are weighted by the squared position index, Osterhaus
• **med\_lum, med\_lum\_pos, med\_lum\_pos2**: Median, position weighted- and squared position weighted median luminance
Evalglare 2.0 – new metrics and evaluation methods

**Horizontal band evaluation:**

activated by \(-B\) angle [rad]
e.g. for \(\pm 20^\circ\) from horizontal line («40°-band») -> \(\text{angle}=0.349\)

Output in separate line (first line). Following values within the band are calculated:

- `band_omega`: solid angle of band [sr]
- `band_av_lum`: average luminance of band [cd/m²]
- `band_median_lum`: median luminance of band [cd/m²]
- `band_std_lum`: standard deviation of luminance,
- `band_perc75`: 75 percentile luminance of band [cd/m²]
- `band_perc95`: 95 percentile luminance of band [cd/m²]
- `band_min_lum`: minimum luminance of band [cd/m²]
- `band_max_lum`: maximum luminance of band [cd/m²]

Example
Evalglare 2.0 – new metrics and evaluation methods

Zonal evaluation:

Needed for example when performing a contrast evaluation

activated by

-`l xpos ypos angle` : single zone
-`-L xpos ypos angle1 angle2` : two zones

Angles in [rad]
Evalglare 2.0 – new metrics and evaluation methods

Zonal evaluation:

activated by

-L xpos ypos angle  : single zone
-L xpos ypos angle1 angle2  : two zones

Angles in [rad]

Output in separate lines (first lines).
Following values within the zones z1,z2 are calculated:

\( z1(2)_\text{omega} \): solid angle of zone [sr]
\( z1(2)_\text{av_lum} \): average luminance of zone [cd/m²]
\( z1(2)_\text{median_lum} \): median luminance of zone [cd/m²]
\( z1(2)_\text{std_lum} \): standard deviation of luminance of zone,
\( z1(2)_\text{perc75} \): 75 percentile luminance of zone [cd/m²]
\( z1(2)_\text{perc95} \): 95 percentile luminance of zone [cd/m²]
\( z1(2)_\text{min_lum} \): minimum luminance of zone [cd/m²]
\( z1(2)_\text{max_lum} \): maximum luminance of zone [cd/m²]

Let’s do an example evaluation .....
Evalglare 2.0 – new metrics and evaluation methods

Example evaluation

No zonal evaluation

evalglare –T 384 289 0.9 -d –c output.hdr input.hdr

Delivers one glare source:

- 1 No pixels x-pos y-pos L_s Omega_s Posindx L_b L_t E_vert Edir Max_Lum Sigma xdir ydir zdir Eglare_cie Lveil_cie teta glare_zone
- 1 22804.000000 253.726604 380.657331 1594.290752 0.3456751723 1.645702 155.048325 215.517090 983.203954 437.027954 10225.375000 32.430944 0.534143 0.047862 0.844038 437.027954 4.155182 32.430944 0
Evalglare 2.0 – new metrics and evaluation methods

Example evaluation
One zone evaluation

evalglare -t 384 289 0.9 -l 384 289 0.9 -d
-c output.hdr input.hdr

Delivers data for the zone:

```
zoning:z1_omega,z1_av_lum,z1_median_lum,z1_std_lum,z1_perc_75,
z1_perc_95,z1_lum_min,z1_lum_max: 0.625647 215.517084 133.201172
351.694818 173.755859 1082.390623 13.678467 2533.968711
```

And delivers two glare sources:

- 2 No pixels x-pos y-pos L_s Omega_s Posindx L_b L_t E_vert Edir
  Max_Lum Sigma xdir ydir zdir Eglare_cie Lveil_cie teta glare_zone
- 1 20791.000000 244.894048 376.972998 1596.012599 0.3131968995
  1.759448 155.048325 215.517090 983.203954 437.027954 10225.375000
  34.597101 0.564329 0.062703 0.823165 34.597101 0
- 2 2013.000000 338.901363 416.186370 1577.686503 0.0324782728
  1.194143 155.048325 215.517090 983.203954 437.027954 10225.375000
  13.742772 0.218148 -0.094064 0.971372 0.000000 0.000000 13.742772
Evalglare 2.0 – new metrics and evaluation methods

Example evaluation
Two zones evaluation

evalglare -t 384 289 0.9 -L 384 289 0.9 1.5 -d
    -c output.hdr input.hdr

Delivers data for the zones:

zoning:z1_omega,z1_av_lum,z1_median_lum,z1_std_lum,z1_perc_75,
    z1_perc_95,z1_lum_min,z1_lum_max: 0.625647
    215.517084 133.201172 351.694818 173.755859
    1082.390623 13.678467 2533.968711

zoning:z2_omega,z2_av_lum,z2_median_lum,z2_std_lum,z2_perc_75,
    z2_perc_95,z2_lum_min,z2_lum_max: 1.060242
    397.341643 109.427734 559.723433 304.160156
    1717.281290 13.591064 4933.687511
Evalglare 2.0 – new metrics and evaluation methods

Example evaluation
Two zones evaluation

evalglare -t 384 289 0.9 -L384 289 0.9 1.5 -d
   -c output.hdr input.hdr

Delivers three glare sources:
3 No pixels x-pos y-pos L_s Omega_s Posindx L_b L_t E_vert Edir Max_Lum Sigma xdir ydir zdir Eglare_cie Lveil_cie teta glare_zone
1 11444.000000 217.984349 352.904716 1556.418219 0.1678747451
   2.364898 155.048325 215.517090 983.203954 437.027954 10225.375000 41.705430 0.648264 0.149599 0.746575 437.027954 2.512604 41.705430 0
2 9347.000000 275.979872 404.776444 1641.751643 0.1453221544 1.412642
   155.048325 215.517090 983.203954 437.027954 10225.375000 27.337378 0.457045 -0.044732 0.888318 0.000000 0.000000 27.337378 2
3 2013.000000 338.901363 416.186370 1577.686503 0.0324782728 1.194143
   155.048325 215.517090 983.203954 437.027954 10225.375000 13.742772 0.218148 -0.094064 0.971372 0.000000 0.000000 13.742772 1

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Evalglare 2.0 – new metrics and evaluation methods

Does the zonal evaluation influence other metrics??

Yes! -> glare sources are split up!

For our example:

<table>
<thead>
<tr>
<th>Zones</th>
<th>DGP</th>
<th>DGI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.240684</td>
<td>17.445793</td>
</tr>
<tr>
<td>1</td>
<td>0.240124</td>
<td>18.075613</td>
</tr>
<tr>
<td>2</td>
<td>0.240755</td>
<td>18.872232</td>
</tr>
</tbody>
</table>

-> influence is usually small
Evalglare 2.0 – new metrics and evaluation methods

Masking evaluation
e.g. for evaluation of an window area

Predicted Glare Sesation Vote PGSV (Iwata)
Evalglare loads and uses a masking image to cut an area
Important: masking image must have the same size!
Not together with zoning!
activated by -A mask.hdr

Output in separate line (first line).
Following values within the mask area are calculated:

- no_pixels: no of pixels in masking area
- omega: solid angle of zone [sr]
- av_lum: average luminance of zone [cd/m²]
- median_lum: median luminance of zone [cd/m²]
- std_lum: standard deviation of luminance of zone,
- perc75: 75 percentile luminance of zone [cd/m²]
- perc95: 95 percentile luminance of zone [cd/m²]
- min_lum: minimum luminance of zone [cd/m²]
- PGSV: Predicted Glare Sesation Vote
- PGSV_SAT: Saturation Predicted Glare Sesation Vote
Evalglare 2.0 – new metrics and evaluation methods

Masking evaluation – example

Steps to evaluate a window area
Evalglare 2.0 – new metrics and evaluation methods

Masking evaluation – example

• 1. Use Photoshop or similar to create mask
  
  Use ra_ppm to create a ppm file

• Everything not of interest should be black

• It MUST be really black (RGB 0 0 0 ) !

• Convert it back to hdr format by
  
  ra_ppm −r
Evalglare 2.0 – new metrics and evaluation methods

Masking evaluation – example

• 2. Run evalglare with –A mask.hdr

  evalglare –t 384 289 0.9 –A mask.hdr -d
  –c output.hdr input.hdr

  masking:no_pixels,omega,av_lum,median_lum,std_lum,
  perc_75,perc_95,lum_min,lum_max,pgsv,pgsv_sat:
  44732 0.675010 1178.508190 1065.609375 543.535164
  1459.968748 2164.781246 33.300294 7316.625082 -
  0.053004 1.475234
Evalglare 2.0 – new metrics and evaluation methods

Summary of new metrics included:

- **UGP**: Unified glare probability according to Hirning
- **DGI$_{mod}$**: Modified DGI according to Fisekis
- **UGR$_{exp}$**: Experimental UGR according to Fisekis
- **PGSV**: Predicted Glare Sesation Vote according to Iwata
- **Mean, median std of (lower) window area** (standards, Wymelenberg)
- **Mean, median, std of 40° band** (Wymelenberg)
- **av_lum_pos**: Average luminance of image, pixels are weighted by the position index, Osterhaus
- **av_lum_pos2**: Average luminance of image, pixels are weighted by the squared position index, Osterhaus
- **med_lum,med_lum_pos,med_lum_pos2**: Median, position weighted- and squared position weighted median luminance
Content

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Evalglare 2.0 – New safety features for HDR-image evaluations

Why?

Several users didn’t use «correct» headers. Evalglare results are completely wrong.

• Extended header check
• Check for fish-eye lens
Evalglare 2.0 – 2.0 – New safety features for HDR-image evaluations

New safety features for HDR-image evaluations

Reasons for «wrong» headers:

- using pcompos for cutting image without correcting header after
- fish eye lens is not automatically detected by photosphere or hdrgen

What happens?
- Exposure gets invalid
- View setting gets invalid (wa already checked since version 1.00)
Evalglare 2.0 – 2.0 – New safety features for HDR-image evaluations

Example
Evalglare 2.0 – New safety features for HDR-image evaluations

- **Extended header check** -> check for «valid» view and «valid» exposure
- **Check for fish-eye lens** -> check on black corners
Content

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**Repair function to sun induced pixel overflow**
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Evalglare 2.0 – Repair function to sun induced pixel overflow

Problem: HDR contains overflow pixels

How to find out??
Measured illuminance does not match calculated

Example:
\[ E_{\text{measured}} = 12000 \text{ lux} \]
\[ E_{\text{calculated}} = 6000 \text{ lux} \]
Evalglare 2.0 – Repair function to sun induced pixel overflow

How to solve?

It should be prevented from the beginning by the use of filters

But what to do when the measurements were already finished?
Evalglare 2.0 – Repair function to sun induced pixel overflow

Solution: Use the vertical illuminance to replace the «sun-pixels» to match the illuminance

New option in evalglare –N xpos ypos angle E
xpos: x-position of sun
ypos: y-pos of sun
angle: angle of sun disk (should contain also circumsolar area
E: measured Illuminance [lux]
Evalglare 2.0 – Repair function to sun induced pixel overflow

Result

Example
Content

Introduction – What is evalglare?
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Speed improvement
Evalglare 2.0 – speed improvement

Example

Algorithm for combining glare sources has been improved

In average factor 10 speed improvement!
The longer it took before, the more is the improvement.
The bad news: Not affecting the annual calculation, this was already optimized before..
Evalglare 2.0

The presented version is already as beta-version 1.31 in the head release since several weeks.

The official 2.0 release will be in the next days.

I´m thankful for any suggestion!
Open to discuss any other hdr-evaluation to include

Thank you for your attention!