Improve Sectional Tone Mapping for HDR Imagery

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High Dynamic Range Imagery

Global Tradeoff:

A) Maintain Detail
B) Maintain Contrast
History of Approaches

- Stockham (1972)[1]: simple logarithmic relation
- Drago (2003)[2]: adaptive logarithmic mapping
- Lenzen (2016)[3]: modify Drago to allow region-specific adaptation

\[ L_d = \frac{\log(L_w + 1)}{\log(L_{\text{max}} + 1)} \]

\[ L_d = \frac{L_{d_{\text{max}} \cdot 0.01}}{\log_{10}(L_{w_{\text{max}} + 1})} \cdot \frac{\log(L_w + 1)}{\log\left(2 + \left(\frac{L_w}{L_{\text{max}}}ight)^{\frac{\log(6)}{\log(0.5)}}\right) \cdot 8} \]

\[ Y_{\text{out}}(x, y) = \frac{1}{\log_{10}(Y_{w_{\text{max}}}(x, y) + 1)} \cdot \frac{\log(Y_{w_{\text{in}}}(x, y) + 1)}{\log\left(2 + \left(\frac{Y_{w_{\text{in}}}(x, y)}{Y_{w_{\text{max}}}(x, y)}\right)^{\frac{\log(b)}{\log(0.5)}}\right) \cdot 8} \]


Sectional Tone Mapping
Sectional Tone Mapping: Visual Example

- Virtual aperture algorithm:
  - Computed for global image and sections
  - Original paper: blend factor based on empirical results
  - Simple log luminance mean / stddev time averaging enables basic flicker reduction

Sectional Tone Mapping – Algorithm Overview
(Sanity back-up for embedded videos)

• Global: https://dolby.box.com/s/938bh1nkxgva36tptucybagc6dz1todi
• Sectional: https://dolby.box.com/s/ggnkbi50hiyxwa8mfgk4zirm13av3e10
Sectional Tone Mapping – Algorithm Overview

• Focus for improvement:
  • Choice of image regions for computing sectional luminance ranges
  • Blending method for luminance range regions
Proposed Improvement: Edge Aware Filtering

Use the edges to guide sections:

• Normalized Convolution Domain Transform
• Interpolated Convolution Domain Transform
• Local Laplacian Filter
Evaluation

Created Flicker Probability Finder:

- Tracks Ratio = Orig/Proc
- Probability > when ratio changes

<table>
<thead>
<tr>
<th>Filter Type</th>
<th>Flicker Probability</th>
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<tbody>
<tr>
<td>NC DT</td>
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<tr>
<td>IC DT</td>
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<tr>
<td>Laplacian</td>
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Further Work:

1) Run video with chosen filter

2) Expand test scene collection to ensure robustness against scene changes

3) Evaluate with a subjective experiment