Workshop ICC/ISO130/CIE D1

Colour-difference magnitude

Ronnier Luo, Guihua Cui and Haoxue Liu
Experiment 1 - Planning

- 75 colour centres
  - L*: 30, 50, 70
  - C*ab: 0, 20, 40, 60
  - h: 8 hues 45° apart from 0°.

- 100 samples randomly generated surrounding each colour centre to have the same $\Delta E^{*}_{ab}$ of 0.2, 3.0, 7.0, 10.0, 20.
## Experiment 1 - results

<table>
<thead>
<tr>
<th>CIELAB</th>
<th>0.2</th>
<th>3</th>
<th>7</th>
<th>10</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean $\Delta E_{00}/\Delta E^*$</td>
<td>0.68</td>
<td>0.68</td>
<td>0.67</td>
<td>0.67</td>
<td>0.67</td>
</tr>
<tr>
<td>Maximum</td>
<td>1.18</td>
<td>1.12</td>
<td>1.05</td>
<td>1.00</td>
<td>0.88</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.52</td>
<td>0.51</td>
<td>0.51</td>
<td>0.52</td>
<td>0.52</td>
</tr>
<tr>
<td>Ratio</td>
<td>2.27</td>
<td>2.20</td>
<td>2.06</td>
<td>1.92</td>
<td>1.69</td>
</tr>
<tr>
<td>Std dev</td>
<td>0.13</td>
<td>0.12</td>
<td>0.11</td>
<td>0.11</td>
<td>0.09</td>
</tr>
<tr>
<td>CV</td>
<td>19</td>
<td>18</td>
<td>16</td>
<td>16</td>
<td>14</td>
</tr>
</tbody>
</table>
Experiment 2 - Planning

CAPP 2012- Haoxue Liu et al, A discussion on printing color difference tolerance by CIEDE2000, Beijing, China

- 7 colour centres
  - L*: 18-89
  - C*<sub>ab</sub>: 0-93
  - h : 7 primaries

- 26 samples generated surrounding each colour centre to have the same ∆E*<sub>ab</sub> of 5, which is the tolerance set for graphic art industry.
## Experiment 2 - results

Tab. 4 Average CIEDE2000 color difference and standard deviation of 7 color centers

<table>
<thead>
<tr>
<th></th>
<th>K</th>
<th>C</th>
<th>M</th>
<th>Y</th>
<th>R</th>
<th>G</th>
<th>B</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4.86</td>
<td>3.04</td>
<td>3.13</td>
<td>2.45</td>
<td>3.26</td>
<td>3.18</td>
<td>3.17</td>
<td>3.30</td>
</tr>
<tr>
<td>Stdev</td>
<td>0.77</td>
<td>0.99</td>
<td>1.09</td>
<td>0.55</td>
<td>1.03</td>
<td>1.08</td>
<td>0.68</td>
<td>0.88</td>
</tr>
<tr>
<td>Upper</td>
<td>5.63</td>
<td>4.03</td>
<td>4.22</td>
<td>3.00</td>
<td>4.29</td>
<td>4.26</td>
<td>3.85</td>
<td>4.18</td>
</tr>
</tbody>
</table>

**Ratio of $\Delta E_{00}/\Delta E^*_{ab} = 0.66$ (i.e. 3.3/5.0)**
Research challenges

- Lighting module with the freedom of spectrum tuneability by mixing light in the way without colour shadow
  - Optimise the **visibility** of certain features by tuning the spd
  - Create surgical light that is integrated in the OR infrastructure
  - Quantify **shadow** measurement
  - Operation luminaries with dedicated colour rendering for organs
  - Quantify **colour rendering** perception
  - Operation luminaries for good texture visibility
  - Quantify **texture visibility** perception
Preparation

- To understand the extent of appearance changes according to different parameters (illuminance, CCT, beam shape, distance, etc),

- To establish methods for physical measurement, and

- To investigate methods for image capturing from a digital camera.