Effectiveness of 3VQM in Capturing Depth Inconsistencies

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1. A 3D Video Quality Measure (3VQM)
2. Validation of 3VQM
3. Performance Evaluation of 3VQM
A 3D Video Quality Measure (3VQM)

D. Temel
A 3D Video Quality Measure (3VQM)
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3D Wrapping

\[ X_v = X_r + s \frac{F_vB}{Z} + h, \quad h = -s \frac{FB}{Z_c} \]

\[ X_o = X_r + s \frac{F_vB}{Z_{ideal}} + h, \]

\[ Z_{ideal} = \frac{sF_vB}{(X_o - X_v) + s \frac{F_vB}{Z}} \]

\[ Z_{ideal} \approx \frac{sF_vB}{\alpha(I_0 - I_v) + s \frac{F_vB}{Z}} \]
\[ \Delta Z = |Z_{\text{ideal}} - Z| \]

**Spatial Outliers (SO)**

\[ \text{STD}(\Delta Z) \]

**Temporal Outliers (TO)**

\[ \text{STD}(\Delta Z_K - \Delta Z_{K-1}) \]

**Temporal Inconsistencies (TI)**

\[ \text{STD}(Z_K - Z_{K-1}) \]

**3VQM**

\[ K(1 - SO(SO \cap TO))^a(1 - TI)^b(1 - TO)^c \]
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Validation of 3VQM

<table>
<thead>
<tr>
<th></th>
<th>RMSE</th>
<th>CC</th>
<th>ROCC</th>
<th>MAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average PSNR</td>
<td>0.95</td>
<td>0.73</td>
<td>0.72</td>
<td>0.82</td>
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<tr>
<td>Weighted Average PSNR</td>
<td>0.94</td>
<td>0.76</td>
<td>0.78</td>
<td>0.79</td>
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<tr>
<td>Average SSIM</td>
<td>0.81</td>
<td>0.60</td>
<td>0.54</td>
<td>0.62</td>
</tr>
<tr>
<td>3VQM</td>
<td>0.62</td>
<td>0.89</td>
<td>0.79</td>
<td>0.52</td>
</tr>
</tbody>
</table>

**RMSE:** Root Mean Squared Error  
**CC:** Pearson Linear Correlation Coefficient  
**ROCC:** Spearman Rank Order Correlation Coefficient  
**MAE:** Mean Absolute Error  

Low RMSE: Accuracy  
High CC: Coherency  
High ROCC: Coherency  
Low MAE: Accuracy
Validation of 3VQM

<table>
<thead>
<tr>
<th>OR: Outlier Ratio</th>
<th>Low OR: Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average PSNR</td>
<td>0.19</td>
</tr>
<tr>
<td>Weighted Average PSNR</td>
<td>0.19</td>
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<tr>
<td>Average SSIM</td>
<td>0.13</td>
</tr>
<tr>
<td>3 VQM</td>
<td>0.00</td>
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</tbody>
</table>
Outline

1. A 3D Video Quality Measure (3VQM)
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3. Performance Evaluation of 3VQM
## Performance Evaluation of 3VQM

### Blur
Gaussian Blur Kernel

<table>
<thead>
<tr>
<th>Kernel Size / Standard deviation</th>
<th>$\sigma_1$</th>
<th>$\sigma_2$</th>
<th>$\sigma_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>7x7</td>
<td>2</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>19x19</td>
<td>10</td>
<td>20</td>
<td>80</td>
</tr>
</tbody>
</table>

### Compression
Type: H.264, Coding method: Entropy

| Quantization Parameter (QP)     | 28 | 40 | 50 |

### Transmission
Model: Gilbert Elliot

| Packet Loss Rate | 2 % | 5 % | 10 % |
Performance Evaluation of 3VQM

Blurred Images

Depth

PSNR

Blur levels

Balloons
Champagne
Kendo
Lovebird
Pantomime

Color

PSNR

Blur levels

Balloons
Champagne
Kendo
Lovebird
Pantomime

3VQM

Blur levels

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Performance Evaluation of 3VQM

Comprehension

**PSNR**

- Depth
- Color

**3VQM**

- Balloons
- Champagne
- Kendo
- Lovebird
- Pantomime
Performance Evaluation of 3VQM

Transmission

PSNR

Depth

Color

3VQM

D. Temel
To summarize

3VQM is

- Accurate
- Coherent
- Consistent

3VQM is sensitive to

- Compression artifacts in color video
- Transmission artifacts

3VQM is not sensitive to

- Blurring artifacts
- Compression artifacts in depth
Questions

For more information and related work:
http://www.ece.gatech.edu/research/labs/msl/