Collaborative View Synthesis for Interactive Multi-view Video Streaming

Fei Chen, Jiangchuan Liu, Yuan Zhao, Edith Cheuk-Han Ngai
Outline

• Background
• System Description
• View Synthesis Collaboration Strategy
• View Synthesis Algorithm
• Evaluation
• Conclusion
Background
Background

Character

Multiview video enables users to enjoy the video from different viewpoints.

Requirements for multiview streaming

• **Rendering Quality:** to reduce disparity of interview and smooth the view sweeping process.

• **Efficiency:** to guarantee the availability of interactive application

• **Bandwidth Scalability:** adaptive to available bandwidth of users
System Description

Methods
- Multi view video coding
- Scalable video coding
- View Synthesis

Collaboration Strategy

Multiview Streaming Structure
View Synthesis Collaboration

Middle synthesis

Shift synthesis

Different strategies to generate visual views
View Synthesis Algorithm

- DIBR: Depth image based rendering

(a) Left Reference View (b) Right Reference View (c) Synthesized View (d) Original View
View Synthesis Algorithm

- S-DIBR: Shift depth image based rendering
S-DIBR

• The shift value from the main reference view to the visual view is:

\[ S_0 = \frac{fd_n}{\lambda N}, \quad \text{where } n = 1, 2, \ldots, \frac{N}{2} \]

• The shift value from the visual view to the assistant reference view is:

\[ S_1 = \frac{fd}{\lambda} (1 - \frac{n}{N}), \quad \text{where } n = 1, 2, \ldots, \frac{N}{2} \]

• Therefore we have following relationship:

\[
\begin{cases}
   P_i \subset P_{i+1}, & P = P^A \\
   P_{i+1} \subset P_i, & P = P^M
\end{cases}
\]
View Synthesis Analysis

Different view comparison

(a) PSNR

(b) SSIM
View Synthesis Analysis

(a) PSNR

(b) SSIM

Synthesized with different reference views
Rendering Quality

<table>
<thead>
<tr>
<th>Visual View</th>
<th>W-DIBR</th>
<th>S-DIBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>V(4)</td>
<td>26.5dB/0.73</td>
<td>25.9dB/0.71</td>
</tr>
<tr>
<td>V(4,5)</td>
<td>25.6dB/0.72</td>
<td>25.8dB/0.7</td>
</tr>
<tr>
<td>V(3,4,5)</td>
<td>22dB/0.63</td>
<td>24.7dB/0.68</td>
</tr>
<tr>
<td>V(2,3,4,5,6)</td>
<td>20.2dB/0.62</td>
<td>20dB/0.6</td>
</tr>
</tbody>
</table>

Rendering quality comparison between W-DIBR(warping DIBR) and S-DIBR(shift DIBR)

- Similar rendering quality for 1 visual view
- S-DIBR keeps the performance stable as the number of visual views increases
Efficiency

• The computation latency:

\[ T = N(T_p + T_m + T_t + T_h) = NT_p + \delta \]

• The time cost in pixel projection for S-DIBR:

\[ T_p(S) = \sum_{j=1}^{N} T_{j,p} \]

\[ = 2K[(P_1^M + P_1^A) + (P_2^M + P_2^A)...(P_{N/2}^M + P_{N/2}^A)] \]

\[ = 2KP[\prod_{j=1}^{N/2} \alpha_i^M + \prod_{j=1}^{N/2} \alpha_i^A] \]

• And we have the computation latency reduction:

\[ \varphi = \frac{T(D) - T(S)}{T} = 1 - \sum_{j=1}^{N/2} \left( \prod_{i=1}^{j} \alpha_i^M + \prod_{i=1}^{j} \alpha_i^A \right) \]
Efficiency

- The computation latency reduction aggregates as the number of visual views increases
Bandwidth Scalability

scalable rendering with different bitrates
Conclusion

• A collaborative view synthesis strategy for multiview streaming system

• S-DIBR algorithm with rendering quality, efficiency and bandwidth scalability
Thanks

Q & A