Explanation of Additional Contributions in the ACM TOMM Submission

Dear Editor,

We are pleased to submit our manuscript titled ”BOLA360: Near-optimal View and Bitrate Adaptation for 360-degree Video Streaming” for consideration in ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM). This work builds upon our previous publication in the 2024 ACM Multimedia Systems (MMSys) Conference. However, due to the page limitations at MMSys, several key contributions could not be included in the camera-ready version.

The submitted TOMM version represents a comprehensive and significantly extended version of the paper, containing over 25% new material. Below, we highlight additional contributions and other changes included in this submission:

1. **Entirely New Section and Algorithm – Optimal Offline Algorithm:**

We have introduced an entirely new section (Section 4) that presents an optimal offline algorithm for the online bitrate control problem. Calculating the QoE of optimal offline algorithm is crucial for understanding the performance of online algorithms, as it allows us to quantify the gap between their QoE and the maximum achievable QoE. This section provides a thorough explanation of the optimal offline algorithm, along with proofs of its correctness, which were not part of the MMSys version.

1. **Providing Proof of Theorem 5.2 (Main Theorem of the Paper):**

In the MMSys version, only a sketch of the proof for Theorem 5.2, which asserts the optimality of BOLA360, was included. In the TOMM version, we have provided a complete and rigorous proof for this theorem. While the sketch offered a high-level overview, the complete proof adds significant value and is a crucial part of the contribution in this work.

1. **New Evaluation Metric – Wasted Bandwidth:**

Wasted bandwidth is a key metric for assessing the efficiency of online ABR algorithms, particularly in the context of 360-degree video streaming. It measures how effectively the available bandwidth is utilized. Due to space constraints, we omitted the comparison of wasted bandwidth between BOLA360 and other ABR algorithms in the MMSys version. In the TOMM version, we used wasted bandwidth as an additional evaluation metric to compare BOLA360 with other ABR algorithms. This is a significant extension, and Figures 11 and 12, which present the wasted bandwidth results, are entirely new to this submission.

1. **Updated Evaluation Metric – Normalized Quality of Experience (QoE):**

We have added a new QoE metric that is obtained by normalizing it against the optimal offline algorithm. We believe that this metric makes the QoE comparisons more understandable and meaningful for readers. The new QoE metric is presented in Figures 7, 9, and 13.

1. **Enhanced Reproducibility – Experimental Setup Details:**

The new version includes comprehensive details of the experimental setup, which were not fully presented in the MMSys paper. This includes additional information on the video sequences and head position probability distributions used in our evaluation, detailed in Tables 2, 3, and 4.

1. **Clarification of the Paper Presentation:**

The presentation of several sections have been improved for better clarity and more detailed explanations. Notable extensions include Section 6.5, the final two paragraphs of Section 7, the full proof of Theorem 5.1 in Section 5.2, and minor revisions to the Introduction for better readability.

1. **Expanded Related Work Section:**

‘Due to page constraints, we could not provide a comprehensive review of the related work in the MMSys paper. In this version, we have expanded the related work section to include the most recent advances in online 360-degree video streaming.

These enhancements make the current version more complete and technically robust, meeting the journal’s requirement for 25% new material. We believe these additions significantly contribute to the research community and improve the overall quality of the manuscript.

Thank you for considering our paper for publication in ACM TOMM.

Sincerely,  
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