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Editorial: Volumetric video processing

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Editorial on the Research Topic
Editorial: Volumetric video processing

The rapid development of volumetric video processing is reshaping the landscape of immersive technologies. With applications in extended reality (XR), video conferencing, medical visualization, and interactive digital media, volumetric video (represented by colored point clouds or textured 3D meshes) provide a more natural and dynamic representation of real-world objects and scenes. However, significant challenges remain in compression optimization, quality assessment, real-time rendering, and user experience. Recent research efforts have focused on enhancing the efficiency, adaptability, and fidelity of these technologies to support the growing demand for high-quality immersive content.

This editorial presents four contributions that explore different facets of volumetric video processing, ranging from quality assessment methodologies to compression optimization techniques and practical implementations in immersive communication.

Remde et al., in the article titled "Sparse camera volumetric video applications: a comparison of visual fidelity, user experience, and adaptability," provide a comparative analysis of three volumetric video capture applications: Depthkit Studio, LiveScan3D, and VolumetricCapture. The study benchmarks these applications based on spatial calibration accuracy, artifact occurrence, and user perception, highlighting trade-offs between ease of use, visual fidelity, and computational requirements. Depthkit Studio emerges as the preferred choice for high-quality captures, while LiveScan3D is recommended for research and experimentation due to its open-source nature. VolumetricCapture is found to be well-suited for scenarios requiring large-scale multi-sensor configurations. The study provides valuable insights for researchers and developers looking to adopt volumetric video technologies for various applications.

Yuan et al., in "Optimized quantization parameter selection for video-based point cloud compression," aim to tackle the challenge of rate-distortion optimization in video-based point cloud compression (V-PCC). This study challenges the default V-PCC approach of applying a uniform quantization parameter (QP) across all frames and proposes a more flexible QP selection framework. By leveraging a differential evolution (DE) algorithm, the proposed QP selection method demonstrates significant improvements in rate-distortion performance, achieving up to 43% bitrate savings without compromising visual quality. The findings suggest that more adaptive QP selection strategies can substantially enhance the

efficiency of point cloud compression, making real-time transmission and storage of volumetric content more viable for practical applications.

Tious et al., in the article titled "New challenges in point cloud visual quality assessment: a systematic review" provide a comprehensive review of subjective and objective methodologies for point cloud quality assessment (PCQA). The study highlights the limitations of existing evaluation frameworks, particularly in their ability to account for real-world viewing conditions and user perception. The authors identify key research gaps, such as the lack of standardization in subjective testing conditions and the need for perceptually optimized learning-based metrics. The authors' discussions underscore the importance of developing new perceptual metrics and benchmarking protocols that can better capture the nuances of visual quality in dynamic and immersive environments.

Gunkel et al., in "From 2D to 3D video conferencing: modular RGB-D capture and reconstruction for interactive natural user representations in immersive extended reality (XR) communication," explore the transition from conventional video conferencing to more immersive 3D communication using RGB-D sensors. Their proposed modular capture framework integrates real-time depth sensing, image enhancement, and rendering techniques to create photorealistic 3D representations of users. The system is evaluated in both technical benchmarks and user studies, demonstrating improved social presence and interaction fidelity. The performance, technical suitability, and the ease of integration of 3D user representations were validated in a user evaluation, showing the effectiveness of the proposed pipeline.

The four papers included in this Research Topic illustrate the breadth of research and innovation in volumetric video processing. From improving quality assessment methodologies and optimizing compression to developing practical capture and rendering systems, these studies contribute significantly to advancing the state of the art. As immersive technologies continue to evolve, addressing the remaining challenges in real-time processing, standardization, and user experience will be crucial for widespread adoption. We hope that these contributions will inspire further research and innovation in the field, paving the way for more sophisticated and accessible volumetric video applications in the future.

We extend our gratitude to the authors for their contributions and to the reviewers for their valuable insights in ensuring the scientific rigor of these papers. We are confident that this Research Topic will serve as a valuable resource for researchers and practitioners in the field of volumetric video processing.

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