A light field capturing system using multiple omnidirectional cameras

Li Qiaoge

School of Integrative and Global Majors, Ph.D. Program in Empowerment Informatics, University of Tsukuba

1. Project Purpose

Using virtual reality technology, we replicate real-world situations with photographs to construct virtual spaces. Commercially available omnidirectional cameras enhance VR applications like virtual tours and remote education. Our proposed method generates implicit neural scene representations using RGB information from multiple panoramas, creating a continuous omnidirectional radiance field. This technique performs well on synthetic datasets and real-world applications. We plan to apply this method to dynamic scenes, integrate it into Unity/Unreal-based scene reconstruction, and simplify data input. However, these applications require significant computing resources.

2. Results

As a dedicated user of MCRP for both 2021 and 2022, I have witnessed remarkable advancements in the field of omnidirectional imaging. In 2021, we developed the innovative omni-nerf system, which was presented at the prestigious IEEEVR 2022 conference [2]. This system achieved a remarkable PSNR of 24.5 at a resolution of 2048x1024. Building on this success, we further enhanced the quality and speed of the system and developed Omnivoxel, which was accepted by GCCE 2022 [3]. Our team also published a journal article based on this system, which was accepted by IIEEJ in 2022, highlighting our work on generative image quality improvement in omnidirectional free-viewpoint images and assessments [1]. These accomplishments showcase the strides we have made in the field of immersive imaging technology, and we are excited to continue contributing to the development of cutting-edge solutions for omnidirectional imaging and virtual reality applications.

3. Roles of the MCRP and its significance

The MCRP is vital in advancing virtual reality technology by replicating real-world situations using photographs and constructing virtual spaces. Its provision of robust computing resources enables processing high-resolution camera data and training large neural rendering models. By harnessing affordable omnidirectional cameras, the MCRP enhances immersion in various VR applications. Its core contribution is generating neural scene representations from multiple panoramas,

creating continuous omnidirectional radiance fields. MCRP aims to expand applicability to dynamic scenes and integrate with platforms like Unity and Unreal. Its significance lies in revolutionizing VR through immersive virtual environments, enabled by powerful computing resources for research and development.

4. Future plan

Our future plans focus on three key objectives: 1) real-time VR reconstruction using omnidirectional cameras for seamless transitions between real-world and virtual environments, 2) editable scenes within the Neural Radiance Field captured by omnidirectional cameras for increased versatility and adaptability, and 3) faster and memory-efficient algorithms for large-scale scene reconstruction to maintain high-quality rendering while minimizing computational overhead. These objectives will advance virtual reality technology, making it more accessible, versatile, and immersive for various applications and industries.

5. Publications and conference presentations

(1) Journal papers

[1] Li Qiaoge, Takeuchi Oto, Kameda Yoshinari, Kim Hansung, Kitahara Itaru "Generative Image Quality Improvement in Omnidirectional Free-Viewpoint Images and Assessments", The Journal of the Institute of Image Electronics Engineers of Japan (IIEEJ Trans. on IEVC Vol. 10 No.1, pp.107-119)

(2) Presentations

[2] Li Qiaoge, Ueda Itsuki, Xie Chun, Shishido Hidehiko, Kitahara Itaru, "Omnidirectional Neural Radiance Field for Immersive Experience", 2022 IEEE Conference on Virtual Reality and 3D User Interfaces (IEEE VR)

[3]Li Qiaoge, Ueda Itsuki, Xie Chun, Shishido Hidehiko, Kitahara Itaru, "OmniVoxel: A Fast and Precise Reconstruction Method of Omnidirectional Neural Radiance Field", 2022 IEEE 11th Global Conference on Consumer Electronics (IEEE GCCE)

(3) Others

Supercomputer	Use	Allocated resources*	
		Initial resources	Additional resources
Cygnus	Yes	3150	
Wisteria/BDEC-01	No		
*in units of node-hour product			