Accelerating path tracing rendering with Multi-GPU in Blender cycles

1st Jiuyi Chen
Shenzhen Institute of Advanced Technology, CAS
University of Chinese Academy of Sciences
Shenzhen, China
chen.jy@siat.ac.cn

2nd Ling chen
Shenzhen Institute of Advanced Technology, CAS
University of Chinese Academy of Sciences
Shenzhen, China
xjy109200@siat.ac.c

3rd Zhibin Yu
Shenzhen Institute of Advanced Technology, CAS
Shenzhen, China
zb.yu@siat.ac.cn

***Abstract*— Metaverse is one of the current hottest research fields, which not only requires rendering techniques such as path tracing but also rendering engines such as Blender. However, rendering scenes by path tracing is a complex and computationally intensive process, especially for large scenes, causing catastrophically slow rendering using only a single GPU.**

To improve rendering performance, we use multiple GPUs to achieve parallel rendering in Blender Cycles for path tracing. First, we distribute the workload based on pixel blocks. Each GPU renders one of the image fragments to finally combine the rendering results into a complete image. Second, we propose a Dynamic Workload Adjustment Algorithm (DWAA) to solve the workload imbalance problem. DWAA takes advantage of the fact that path tracing requires multiple samples, so it increases or decreases the work area of each GPU for the next ray sample according to the rendering time of each GPU's last path-tracing sample, which can reduce GPU idle time and improve overall rendering performance.

To evaluate the Multi-GPUs rendering approach and DWAA, we use two different scale scenes-Babershop and Junkshop, and test them with different GPU clusters consisting of 2, 3, and 4 NVIDIA A100 GPUs respectively. The results show that compared to a single GPU, 2 GPUs can accelerate up to 1.98x, 3 GPUs up to 2.94x, and 4 GPUs up to 3.9x, which has high scalability and the parallelism is close to linear increase.

***Keyword*— Blender Cycles, Multi-GPU, Path-Tracing, Performance Optimization, Rendering.**

Jiuyi Chen received the bachelor's degree from the automation department, Huazhong University of Science and Technology, Wuhan, China, in 2020. Currently, he is a Graduate Student at the Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences. His current research focuses on GPU rendering optimization techniques and parallel computing.

Chen Ling received her bachelor's degree in Electronic Information from Xinyu University in 2017. She is currently a graduate student in the Computer Science Department at Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences. Her current research focuses on vulkan microarchitecture-independent benchmark build.

Zhibin Yu received his PhD degree in computer science from Huazhong University of Science and Technology (HUST) in 2008. He visited the Laboratory of Computer Architecture (LCA) of ECE of the University of Texas at Austin for one year and he worked in Ghent University as a postdoctoral researcher for half of a year. Now he is a Professor in Shenzhen Institute of Advanced Technology(SIAT). His research interests are micro-architecture simulation, computer architecture, workload characterization and generation, performance evaluation, multi-core architecture, GPGPU architecture, virtualization technologies, big data processing and so forth.
Prof. Yu won the outstanding technical talent program of Chinese Academy of Sciences (CAS) in 2014 and the 'peacock talent' program of Shenzhen City in 2013. He is a member of IEEE and ACM. He serves for ISCA 2013, 2015, 2020, MICRO 2014, HPCA 2015, 2018, PACT 2016, and ICS2018, 2019.