PAVE

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Figure 1: Rendered Conditional Images

ABSTRACT

In this work we offer an approachable platform for visualization tasks by employing a neural network for real time rendering and accurate light transport simulation within the framework of Python made compatible for distributed systems and high performance computing (HPC). The provided model is a coalescence of VTK-m, a visualization tookit fit for massively threaded architectures, PyTorch, an increasingly popular language within machine learning due to robust libraries for neural networks, and Adios, an adaptable unified IO framework for data managment at scale. The resulting work accomplishes this combination by utilizing VTK-m to construct a path trace renderer able to fluidly and efficiently communicate to a conditional Generative Advisarial Network (cGAN) by means of Adios during training cullminating in a generative model which serves as a filter for rendered images and visual simulations capable of approximating indirect illumination and soft shadows at real-time rates while maintaining quality comparable to offline approaches.

CCS CONCEPTS

• **Theory of computation** → **Parallel computing models**; **Distributed computing models**; **Structured prediction**; **Adversarial learning**; **Data structures and algorithms for data management**; *Probabilistic computation*; *Database query languages (principles)*; • **Applied computing** → **Computer-aided design**.

KEYWORDS

VTKm, neural networks, generative adversarial network, Adios, PyTorch, path tracing

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1 APPLICABLE "AREA OF INTERESTS" TARGETS

(1) In situ data management and infrastructures Current Systems: production quality, research prototypes , Opportunities ,Gaps
Current Systems: integration of VTKm, Adios2 and Python (PyTorch). Prototype being a conditional generative adversarial network (cGAN) designed to use a VTKm based pathtracer applied but not limited to learning global illumination and light behavior in rendering tasks. Opportunities: Introducing a framework allowing researchers easy access to python on HPC systems as well as machine learning aided technique to treat and study experimental data used in scientific simulations as learnable probability distributions with derived conditional dependencies of interest.
(2) System resources, hardware, and emerging architectures. Enabling Hardware, Hardware and architectures that provide opportunities for In situ processing, such as burst buffers, staging computations on I/O nodes, sharing cores within a node for both simulation and in situ processing
Enabling Hardware: By constructing an architecture allowing for Python to interface with VTKm data management controlled by Adios2 the proposed software

allows for a well distributed simulation task among cores.
(3) Methods and algorithms: Analysis: feature detection, statistical methods, temporal methods, geometric and topological methods Visualization: information visualization, scientific visualization, time-varying methods
(4) Case Studies and Data Sources In situ methods/systems applied to data from simulations and/or experiments/observations
(5) Simulation and Workflows: Integration:data modeling, software-engineering, Workflows for supporting complex in situ processing pipelines
(6) Requirements, Usability: Reproducibility, provenance and metadata

2 INTRODUCTION

3 RELATED WORK

Tomas and Forbes Deep Illumination: [2] VTKm [1]

4 MOTIVATION AND CONTRIBUTION

5 IMPLEMENTATION DESIGN

6 EXPERIMENTS

6.1 Cornell Box

6.2 Streamline Simulation

7 RESULTS

8 CONCLUSIONS

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REFERENCES

[1] Kenneth Moreland, Christopher Sewell, William Usher, Li-ta Lo, Jeremy Meredith, David Pugmire, James Kress, Hendrik Schroots, Kwan-Liu Ma, Hank Childs, et al. 2016. Vtk-m: Accelerating the visualization toolkit for massively threaded architectures. *IEEE computer graphics and applications* 36, 3 (2016), 48–58.
[2] Manu Mathew Thomas and Angus G Forbes. 2017. Deep Illumination: Approximating Dynamic Global Illumination with Generative Adversarial Network. *arXiv preprint arXiv:1710.09834* (2017).

A APPENDIX