



Octree-Retention Fusion: A High-Performance Context Model for Point Cloud Geometry Compression

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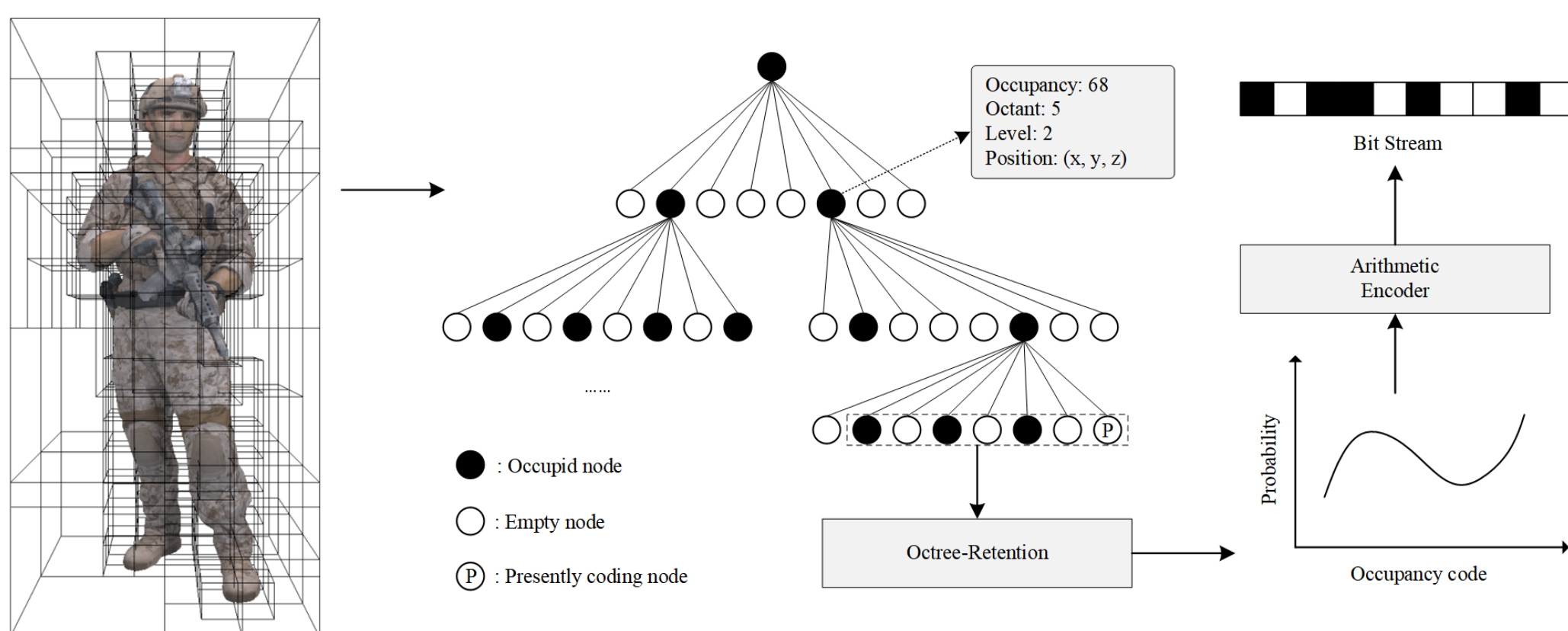


Introduction

Point clouds are a critical data structure for capturing the physical form of the real world, used extensively in fields such as virtual reality, autonomous driving, and cultural heritage preservation. Despite their utility, the vast data volume of point clouds poses significant challenges for storage and transmission.

This research introduces a novel model, the Octree-Retention model, which uses Retentive Networks (RetNet) to achieve efficient point cloud compression.

Method



1. Octree Construction:

- An octree partitions the point cloud data into hierarchical segments.
- Each node represents a sub-cube, which is recursively subdivided based on the presence of point cloud data.

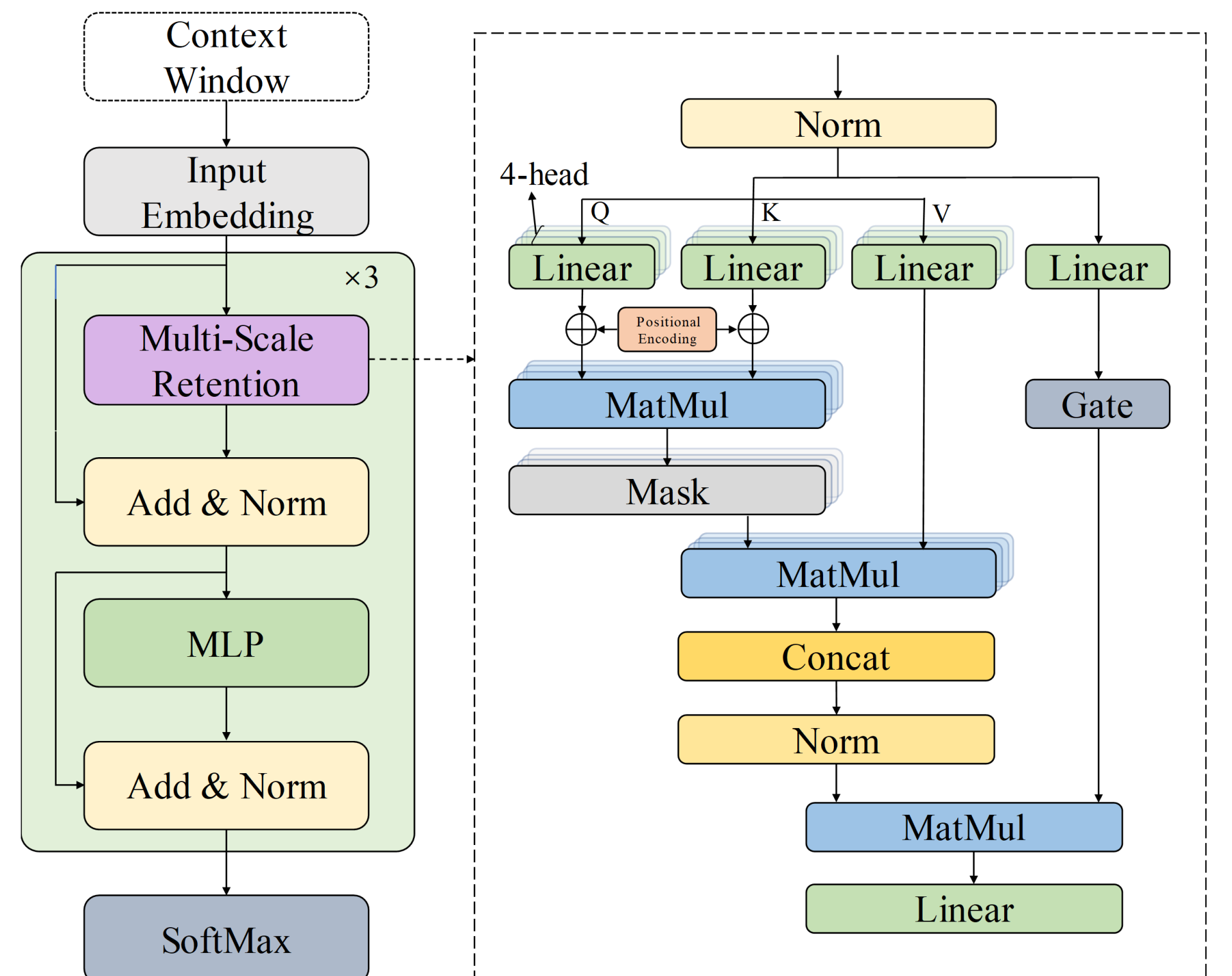
2. Context Feature Extraction:

- Contextual features from sibling and ancestor nodes are extracted and used to create input sequence features for the model.

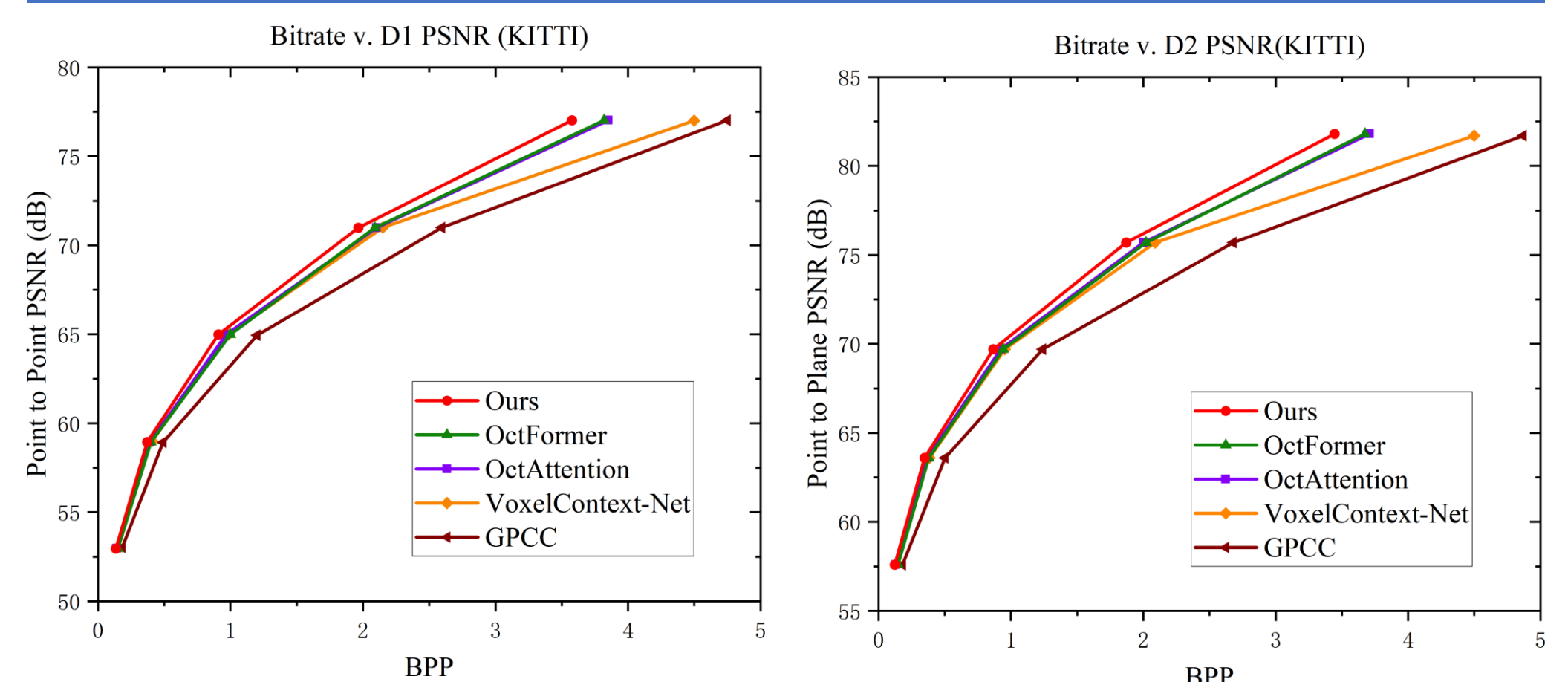
3. Octree-Retention Model:

- Utilizes RetNet in a parallel form with an exponential decay masking mechanism.
- The model efficiently uses prior knowledge of neighboring nodes to predict occupancy probabilities and

compress the point cloud data.



Results



Sequence	GPCC	VoxelDNN	OctAttn	ours	Gain
Loot10	0.94	0.58	0.62	0.53	43.62%
Redandblack10	1.09	0.66	0.73	0.64	41.28%
Boxer10	0.94	0.55	0.59	0.49	47.87%
Thaidancer10	0.99	0.68	0.65	0.55	44.44%
Average	0.99	0.62	0.65	0.55	44.3%

Extensive experiments were conducted on the Semantic KITTI (LIDAR dataset) and MPEG 8i (Object dataset) datasets. Performance was evaluated using point-to-point PSNR(D1 PSNR), point-to-plane PSNR (D2 PSNR), and bits per point (BPP). The Octree-Retention model demonstrated significant improvements over state-of-the-art methods, achieving higher compression rates and lower bitrates while maintaining high fidelity.