上海工程技术大学
Shanghai University of Engineering Science

Point AE-DCGAN: A deep learning model for 3D point cloud lossy geometry compression

Jiacheng Xu∗, Zhijun Fang∗, Yongbin Gao∗, Siwei Ma†, Yaochu Jin⋆, Heng Zhou∗ and Anjie Wang†

∗Shanghai University of Engineering Science, Shanghai, P.R. China

†Peking University, Beijing, P.R. China

⋆University of Surrey, Surrey, UK

Corresponding Author : Zhijun Fang (email: jzfang@sues.edu.cn)

Introduction

3D Point Cloud Data

Point cloud data always takes up a lot of storage space.

For example in the MVUB[1], a point cloud with 0.3 million points per 3D frame at 30 fps, point cloud raw video needs around 200MB of storage space per second.

[1] C. Loop, Q. Cai, S. Orts Escolano, and P.A. Chou, "Microsoft Voxelized Upper Bodies – A Voxelized Point Cloud Dataset," *ISO/IEC JTC1/SC29 Joint WG11/WG1 (MPEG/JPEG) input document m38673/M72012,* Geneva, May 2016.

Related Work

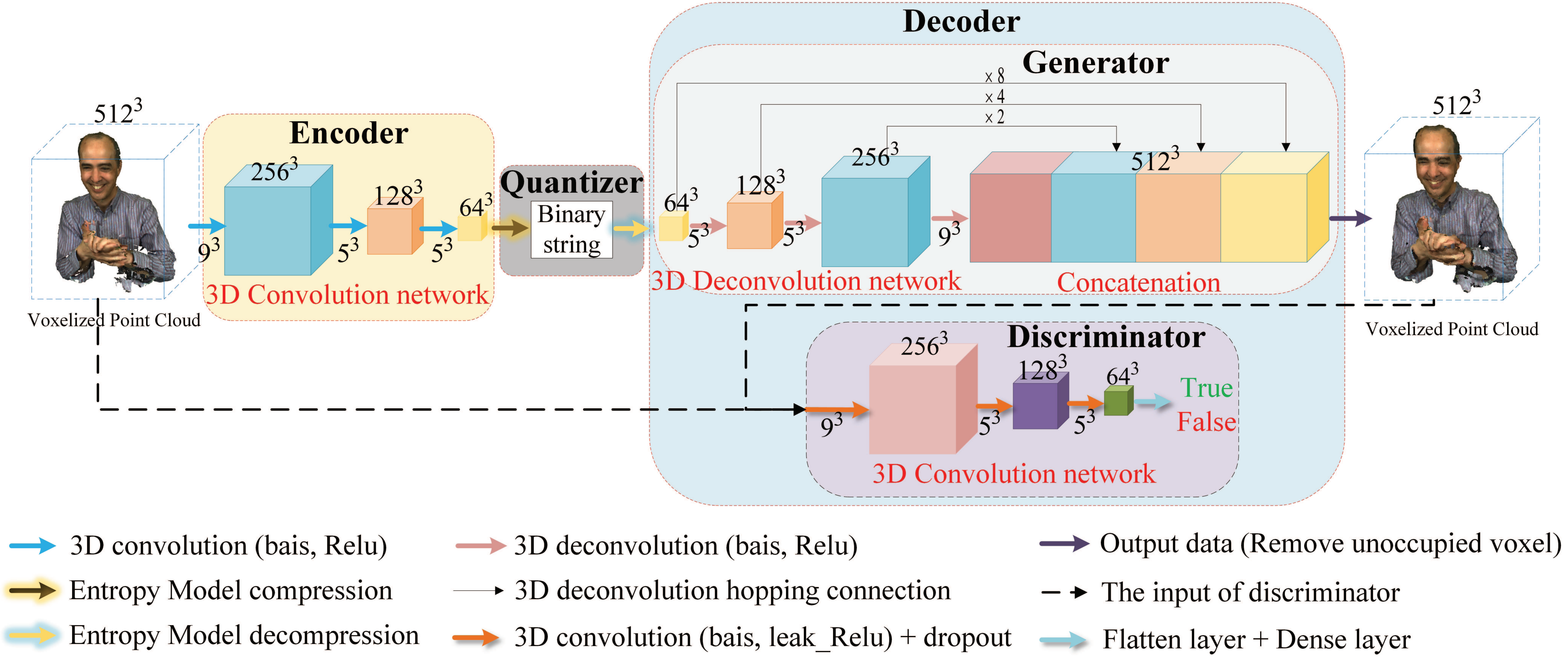
Lossy Geometry Compression

- The hand-crafted point cloud lossy geometry compression
  - MPEG G-PCC standard[2]
    - In case of low and medium bit rates, method are prone to producing block effects and many points will be lost after decoded.
- The deep learning-based point cloud lossy gemotry compression
  - Autoencoder-based approach
    - Quach et al. proposed method[3] tackle the block effects problem, but construct point cloud still has a large area of points missing nowadays.

[2] K. Mammou, P. A. Chou, D. Flynn, M. Krivoku´ca, and O. Nakagami, “G-PCC codec description v2,” ISO/IEC JTC1/SC29/WG11 N18189, 2019.
[3] M. Quach, G. Valenzise, and F. Dufaux, “Learning convolutional transforms for lossy point cloud geometry compression,” in 2019 IEEE International Conference on Image Processing (ICIP). IEEE, 2019, pp. 4320–4324.

Proposed Architecture

Point AE-DCGAN



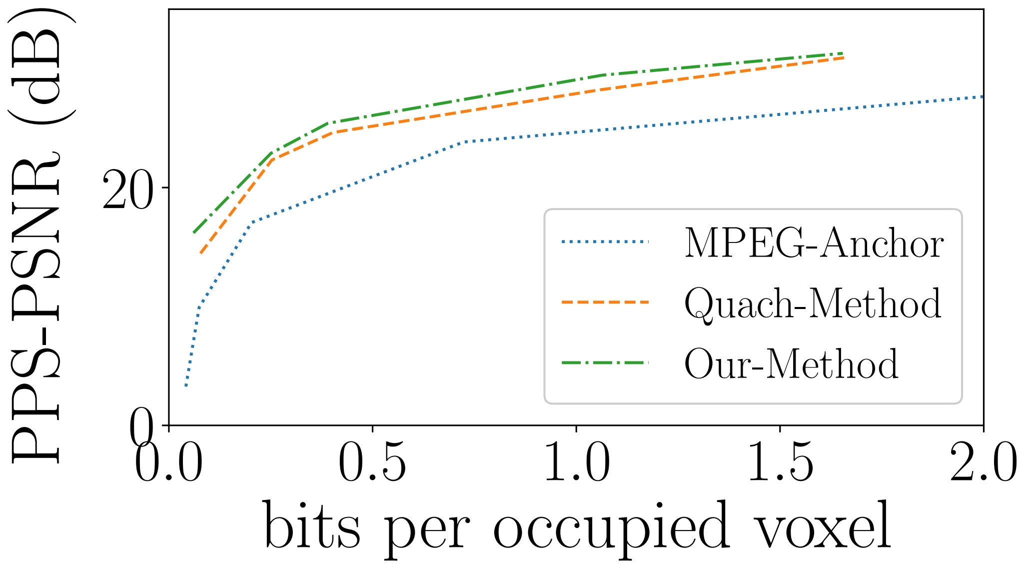
Our Compression System

Experimental

RD Performance on the MVUB dataset

In the table, ”+” indicates an increase and ”-” indicates a decrease.

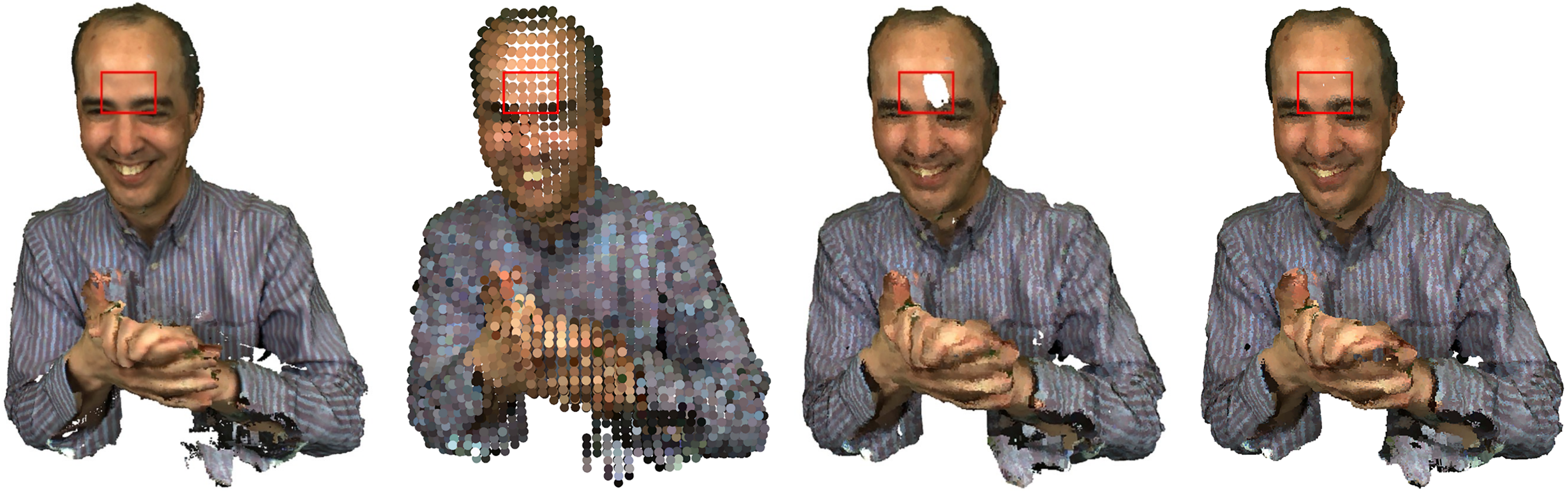
Point cloud		Average
Quach method	BD-BR	-17.30%
	BD-PSNR	1.1325dB
MPEG G-PCC	BD-BR	-60.35%
	BD-PSNR	4.5513dB



RD-Curve Figure on MVUB dataset

Experimental

Visual Quality



(a) Original (b) MPEG G-PCC (c) Quach Method (d) Our Method

3D point cloud data "Phil" as an example

Conclusion

- The proposed method is first GAN-based point cloud compression algorithm
- Our Point AE-DCGAN solves the problem of points missing
- The multi-scale deconvolution connection structure reconstruct the good quality point cloud at lower bit rates.
- This work can be extended to the compression of the dynamic point cloud