Dynamic Point Cloud Geometry Compresson via Patch-wise Polynomial Fitting

Yingzhe Xu, Wanjie Zhu, Yiling Xu, Zhi Li
Shanghai Jiao Tong University, China; University of Missouri, Kansas City, USA

Abstract

With the booming requirements of realistic 3D modeling for immersive applications, advanced, yet scalable 3D point cloud dataset has attracted great attention. Firstly, immersive experience using high data volume affirms the importance of efficient compression. Moreover, the depth data is segmented into patches, we generated corresponding depth maps via projection of all the patches by focusing on geometry information. Moreover, we proposed a novel polynomial fitting algorithm based on polynomial fitting of proper patches. The fitting parameters are calculated to generate a padded depth map. After the projecting and padding processes, we perform geometry experiments on four dynamic point cloud sequences. Moreover, we test the performance of the V-PCC (Video-based Point Cloud Compression) model against the proposed algorithm. The results show that the proposed scheme performs better than that of V-PCC with the same level of distortion. To the best of our knowledge, the proposed work is the first one to present a novel polynomial fitting algorithm (PFC) to tackle the point cloud compression.

Introduction

• Point cloud has succeeded in recording and describing three-dimensional objects and scenes, based on the recently-developed 3D media format that assists in recording the point geometry information and attribute information.

• A high precision of the point cloud offers a high data volume, and when point cloud information is transmitted and processed, the data efficiency usually does not perform well.

• Moreover, the irregular and scattered point cloud data increases the complexity of the processing algorithms and takes up a lot of computing space. Therefore, a proper compression algorithm is quite essential in the point cloud applications to overcome these problems.

• A novel point cloud compression algorithm based on polynomial fitting of proper patches is proposed in this paper.

• For attribute compression, the geometric algorithm used to predict the distance between the real depth values and the estimated depth values is introduced. Moreover, we tested the algorithm on several point cloud sequences and obtained a correlation of the cosine values associated with the nearby points in the 3D space.

• For geometry compression, the cosine structure can be utilized to separate the point cloud and then vector encode the corresponding local value information of the geometry information. Moreover, a binary tree structure can be used to encode the extracted point cloud of the geometry information. The results show that we can achieve better compression performance in the geometry information.

• Generally, these point cloud segments are quite regular and we can use polynomial fitting to extract the polynomial parameters using its low encoding complexity.

• In addition, we chose a frame of the database "loot_vox10" as a test sample. From the results of our proposed scheme, we can achieve a better compression performance on the geometry information in the yellow circle. And for some positions, some distortion arose in the red circle. The result shows that we can encode and code attribute even better in some locations.

Results

• The projection process aims at mapping the extracted patches onto a 2D grid for video coding. Via projection, the point cloud object is transformed into depth maps. However, the depth values are already obtained through a spatial coordinate projection of the point cloud. As the depth values are high, these are not convenient for video compression.

• We perform geometry experiments on four dynamic point cloud sequences. Moreover, we test the compression performance for 32 terms of dynamic point clouds in each point cloud sequence. We compare the compression effect of the V-PCC test model and the proposed model. These values are proposed to generate residual video sequences. Moreover, we reconstructed the original depth value by calculating the difference between the predicted depth value and the corresponding residual value.

Discussion

• We choose a frame of the database "loot_vox10" as an example. From the results of our proposed scheme, we can achieve a better compression performance on the geometry information in the yellow circle. And for some positions, some distortion arose in the red circle. The result shows that we can encode and code attribute even better in some locations.