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| **Source:** | **3DG** |
| **Status :** | **Draft** |
| **Title:** | **Description of EE13.5 for G-PCC: on Region-wise Quantization Control on Attribute Coding** |
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# Abstract

This document provides a description of PCC Exploration Experiments (EE) 13.5 on Region-wise Quantization control for attribute coding.

# Introduction

The importance and visual quality of each 3D point cloud is valuated differently based on its geometry location from the center Point of Interest as well as the amount of details / data that the 3D point cloud carries. For example, the face region of a human or the proximity for a 360-degree vehicle scan have higher importance and thus required better quality. This can be done by having lower QP value for the attribute information of these selected 3D point cloud compared to the rest.

To realize this functionality, we propose the region-wise QP control which changes the QP based on the geometry position in a slice. It can keep the compression performance compared to a slice base QP Control because the attribute prediction structure will not be changed.

Figure 2‑1 Concept of Region-wise QP control

# Mandates

Mandates for this EE13.5 is to evaluate implementation of Region of Interest (ROI).

To achieve that there are 3 methods as follow:

1. Region-wise Quantization control in single slice implementation for attributes coding [1].
2. Investigate region-wise image quality control by non-normative method through Predicting/Lifting Transform residue setting.
3. Investigate in detail slice base ROI comparing to Region-wise Delta QP control by comparing both method in an equal comparison method

# Participants

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(P=proponent, C=crosss checker)

# Test Model, Anchors and CTC

The latest G-PCC reference software TMC13v7 [2] will be used as the anchor for this EE result gathering and comparison purposes.

## Test Conditions

Subjective quality test will be run on selected 3D Point Cloud content available in common test condition.

Tests will be also performed using the Category 1 and Category 3 common test conditions [3] to check on conformity.

## Process for ROI

### Process of 3D Region Using QP Control

In 3D-Region QP control method, the different attribute QP value is applied to specific region. Figure 3-1 shows the part of process of encoder. At first, slice QP is pre-determined. Next, the region where QP value should be changed and its target QP are determined, then the differential value of QP are calculated.

Before attribute coding, The QP value for each point is determined by using geometry as following,

* If a 3D point cloud is within the box region, then Delta QP value will be added on the slice QP to get the effective QP for that point.
* Otherwise slice QP will be the effective QP.

After that, the attribute value of each point is processed with Lifting / RAHT along with Delta QP value.

Compare to tile and slice based QP tuning, region based QP tuning will not break the continuity of the 3D point cloud referencing. This makes a more efficient predicting algorithm and encoding performance improved. If there are multiple regions, this process is executed for each area.

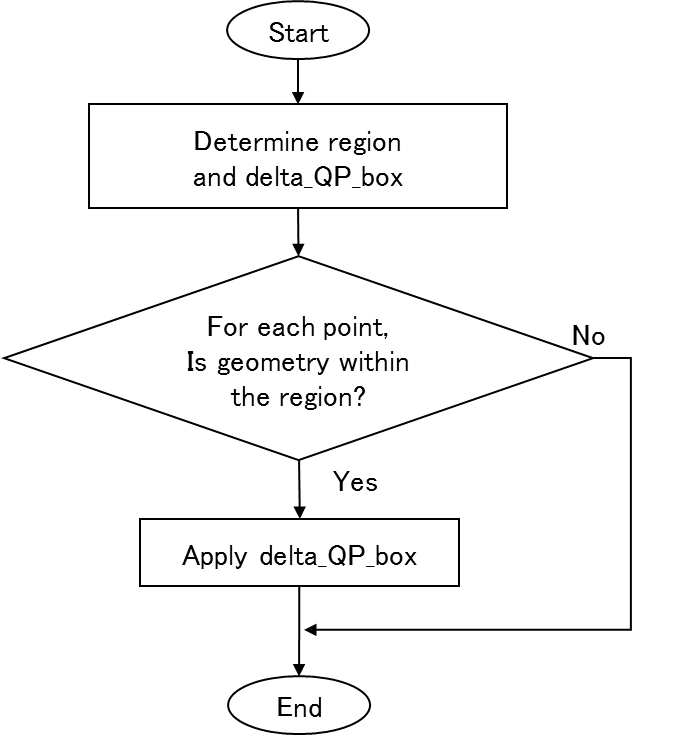


Figure 3‑1　Diagram of proposed method

In the current G-PCC specification, the attributes values are coded with Predicting/Lifting Transform or RAHT to achieve better coding efficiency.

For Predicting/Lifting, the residual attribute value of each 3D point is calculated by using prediction method, then it is quantized with QP value.

For RAHT, the transform function takes two nodes and divides the energy level of the attributes information into high or low frequency. The higher frequency is quantized and coded while the lower frequency is propagated on to the next level. In this proposal, after the QP is assigned to each 3D point based on the geometry position and the box region like Predicting/Lifting case, QP is propagated as following,

* If the node is right side one of RAHT tree, the QP which is assigned to this node will be used to quantize high frequency value after RAHT transform
* Otherwise (the node is left side), the QP which is assigned to this node will be propagated to upper layer node with low frequency value after RAHT transform

### Process of 3D Region Using Residue Control

Residue control for predicting/lifting transform to achieve ROI can be evaluated. Slice Delta QP if first set to a lower QP value to obtain high quality image. Residue value out of ROI will be set to value 0 or clip to a predefined range depending on Delta QP Box value. There is no change for Point cloud within ROI.

### Process of 3D Region Using Slice Partition

In this method, ROI is prepared and encoded into separate slice with corresponding Delta Slice QP equivalent to Delta Box QP. Number of slice will be reflected to be almost the same as number of box in ROI.

# Timeline

2019/07/12 MPEG #127 meeting ends

2019/08/12 Expected date for release of cross-verified G-PCCv7.0 software and anchors

2019/09/18 Distribution of EE SW and results for verification

2019/09/25 EE verification feedback from cross-checkers to the proponents

2019/10/02 MPEG 127 document upload deadline

# References

1. G-PCC Region-wise Quantization Control in Attribute Coding, ISO/IEC JTC 1/SC29 WG11 Doc. m49626, Gothenburg, SE, July 2019.
2. G-PCC Test Model v7, ISO/IEC JTC1/SC29/WG11 Doc. w18664, Gothenburg, SE, July 2019.
3. G-PCC performance evaluation and anchor results, ISO/IEC JTC1/SC29 WG11 Doc. w18665, Gothenburg, SE, July 2019.