m49626:

[G-PCC] Region-wise Quantization Control in Attribute Coding

ISO/IEC JTC1/SC29/WG11

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Panasonic

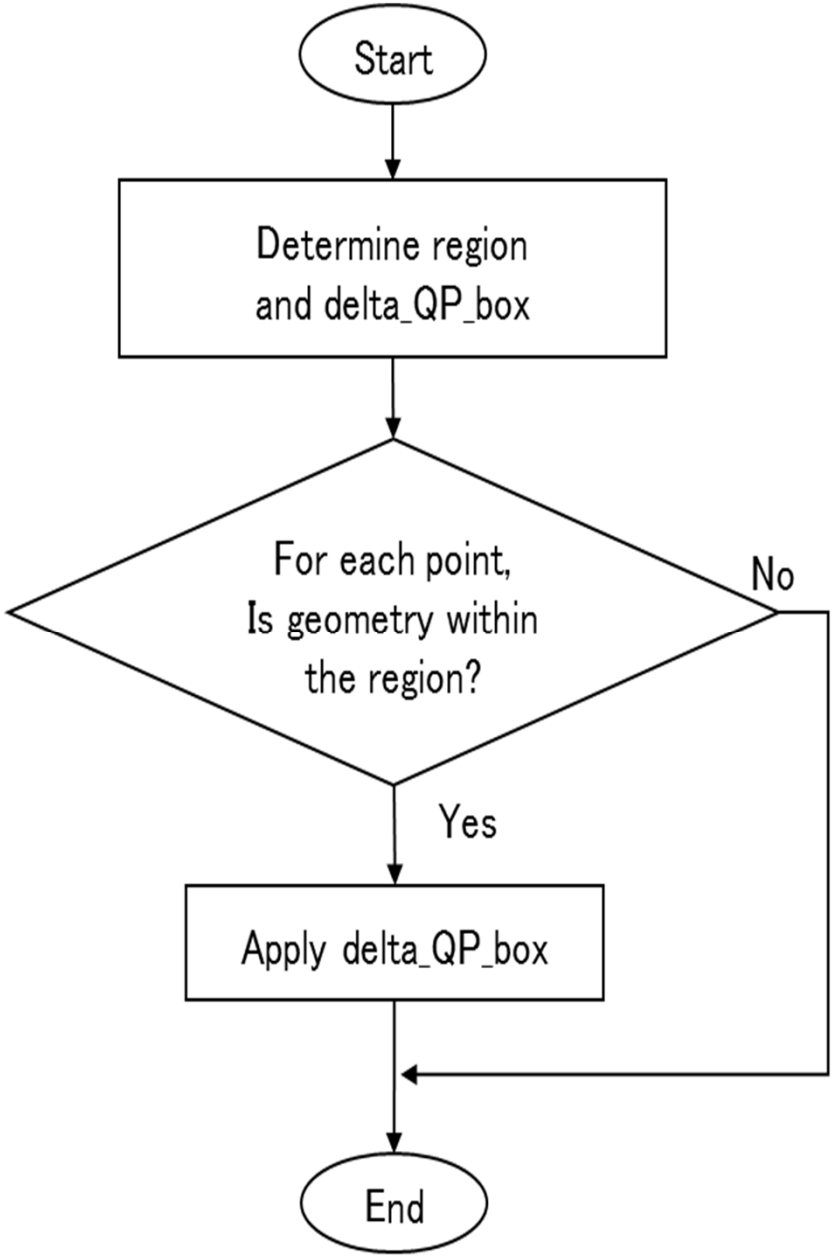
3D Region QP Control Overview

- Depending on the region in the point cloud, the requirement of visual quality may be different.
- We propose a method to change QP of attribute by specifying the region using only single slice.
- It can keep the compression performance compared to a slice base QP Control
  - because the geometry and attribute structure will not be changed.

Process of 3D Region QP Control

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

1. 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.
2. Otherwise slice QP will be the effective QP.



QP Determination process

After the QP is assigned to each 3D point based on the geometry position and the box region, QP is propagated as following,

Predicting / Lifting

- The residual attribute value of each 3D point is calculated by using prediction method, then it is quantized with QP value.

RAHT

- 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

Proposed Syntax and Semantics

attribute_slice_header( ) {	Descriptor
ash_attr_parameter_set_id	ue(v)
ash_attr_sps_attr_idx	ue(v)
ash_attr_geom_slice_id	ue(v)
ash_attr_delta_QP_box_present_flag	u(1)
if(ash_attr_delta_QP_box_present_flag) {	
number _of_region	se(v)
for(idx = 0; idx < number_of_region; idx++) {	
ash_attr_box_origin_x[idx]	se(v)
ash_attr_box_origin_y[idx]	se(v)
ash_attr_box_origin_z[idx]	se(v)
ash_attr_box_length[idx]	se(v)
ash_attr_box_width[idx]	se(v)
ash_attr_box_depth[idx]	se(v)
ash_attr_box_delta_QP[idx]	se(v)
}	
}	
byte_alignment( )	
}	

ash_attr_delta_QP_box_present flag indicated the present or absent of delta QP box parameter in the syntax. If present flag is set to 1 below parameters are present.

number_of_region specify the number of region that have difference QP value

ash_attr_box_origin_x (,y, z) specify the x-axis origin of region QP control box

ash_attr_box_length (,width, depth) specify the end point of the delta_QP_box on x-axis

ash_attr_box_delta_QP specify the difference between the QP value of a specific region and the slice QP

Visual Quality (Lifting)

The quality of the region shown by red frame can be changed

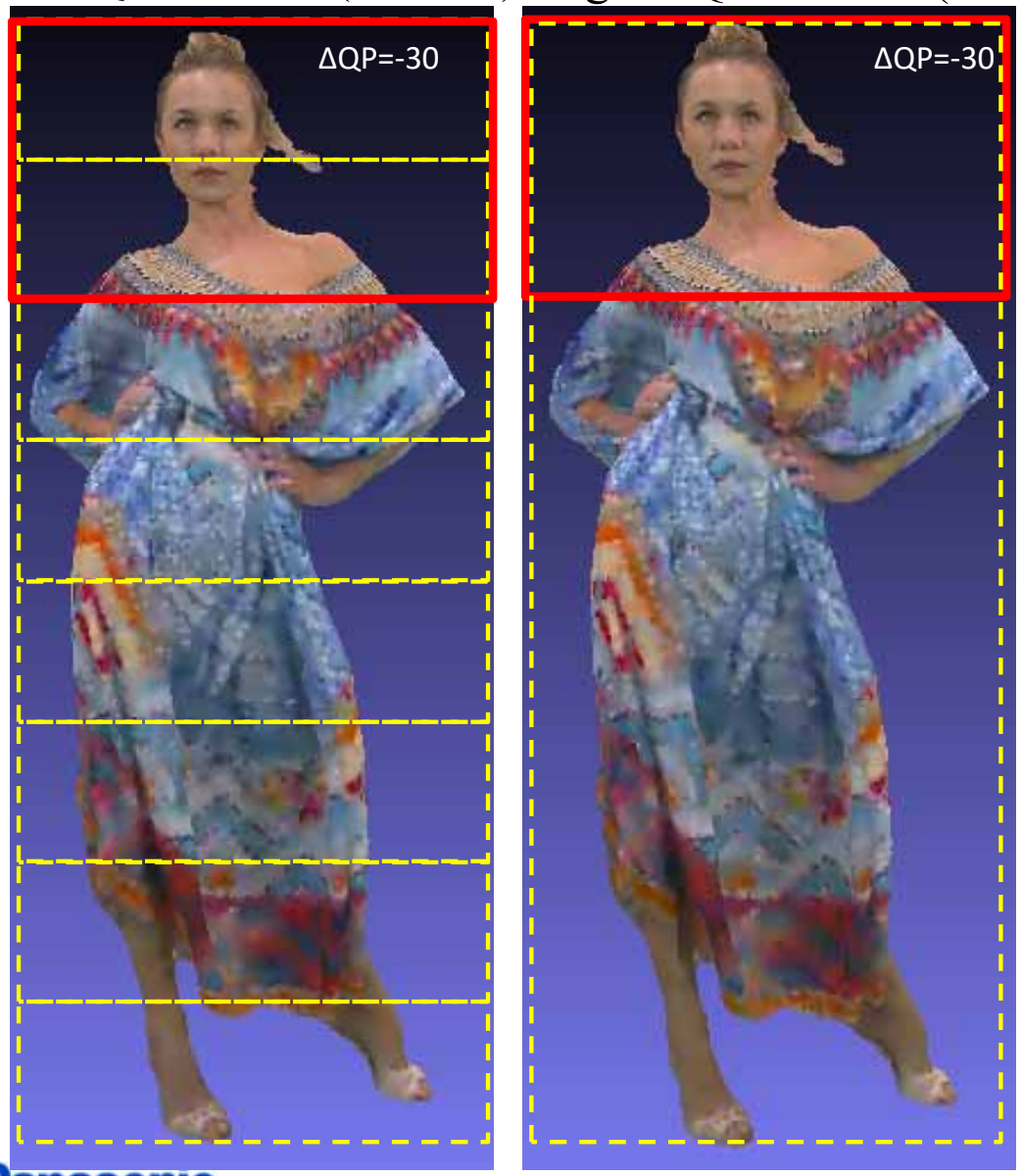
Visual Quality (RAHT)

The quality of the region shown by red frame can be changed

Region-wise QP control vs Slice-wise QP control

Compare to slice QP control, the bitstream size is smaller.

Slice QP Control (8 slices) Region QP Control (1 slice)



Bit Stream Size & PSNR

	Slice-wise	Region-wise
Bitstream size	175179	167789
Luma PSNR	25.927	25.933
Cb PSNR	32.018	32.126
Cr PSNR	30.919	30.958

Lifting, C1(Lossless Geometry, Lossy Attribute, QP=52)

Conclusion

- We proposed to change QP value of attribute by specifying the region with a control box under 1 slice.
  - Add syntax that indicate the number of regions and regions to Attribute Slice Header
- From our simulation result, it show that region-wise QP control can change the QP of target region correctly and can provide the functionality like ROI for G-PCC specification.
- We recommended that this proposal approach be evaluated in next CE activity.