m56809
[G-PCC] EE13.47 report on spherical coordinate geometry

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Spherical In/Out for Predictive Geometry Coding

Original proposal: m55361

G-PCCv1 spec.
- only cartesian coordinates (x, y, z) is supported as input/output
- two coding mode (anguler on /off)

1. Angular mode: OFF (I/O: cartesian, Coding: cartesian)

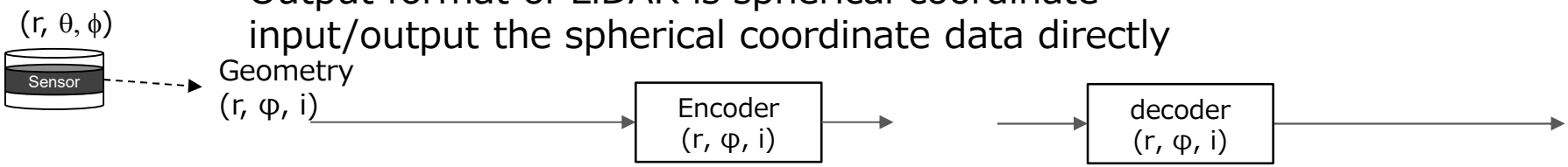
2. Angular mode: ON (I/O: cartesian, Coding: spherical)

3. Proposed Angular mode (I/O: spherical, Coding: spherical)

Use case

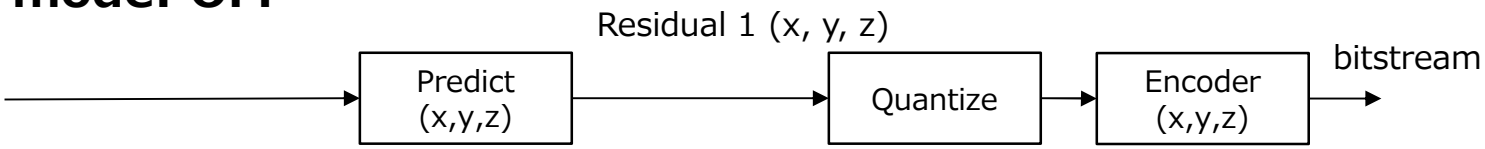
Output format of LiDAR is spherical coordinate

input/output the spherical coordinate data directly



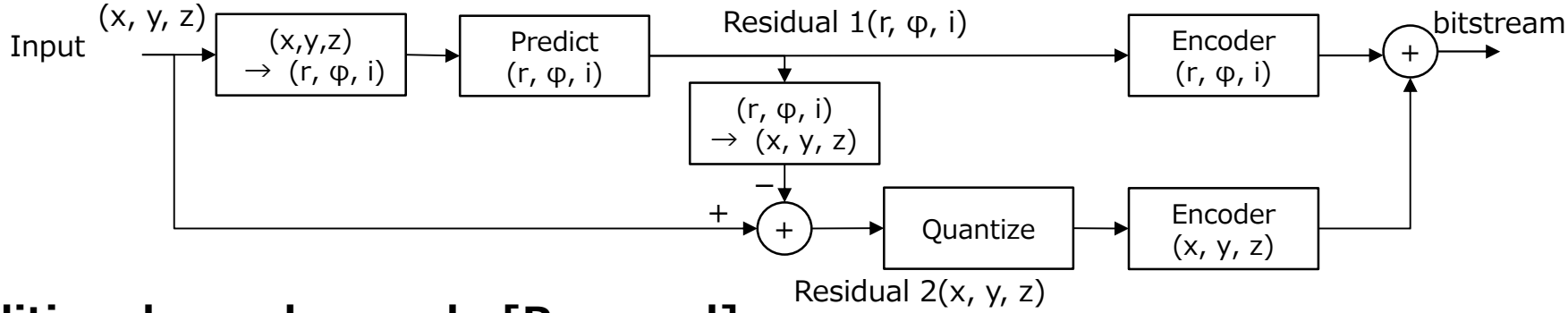
Encoder

Angular mode: OFF



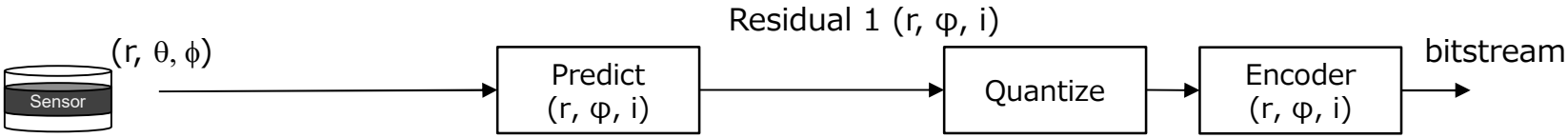
Angular mode: ON

Residual1: predicting residual (Spherical)
Residual2: coordinate conversion error (Cartesian)



Additional angular mode [Proposal]

no residual 2, quantize residual1



Point1: can input spherical coordinate data directly
Point2: can quantize the residual even when no residual 2(conversion error)
Point3: no additional process (select the existing function by 1bit flag)

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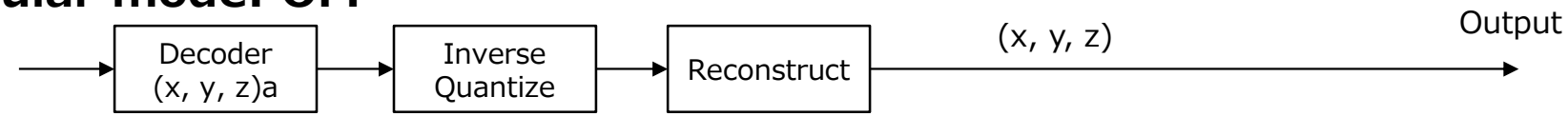
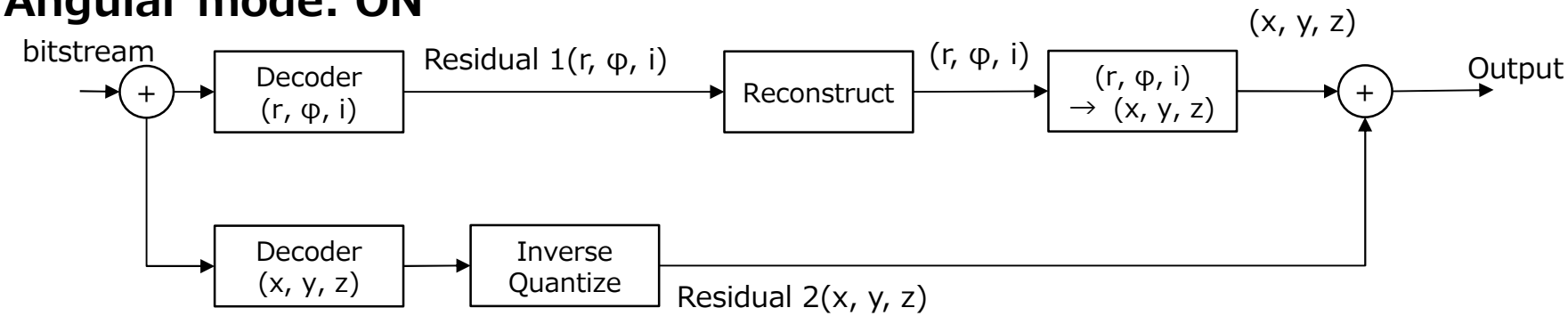
Decoder

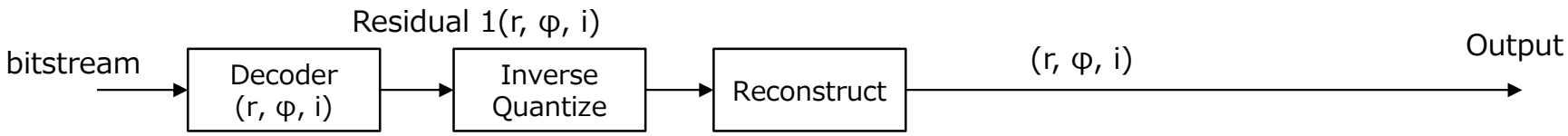
Angular mode: OFF



Angular mode: ON



Additional angular mode [Proposal]



Point: no additional process
(select the existing function by 1bit flag)

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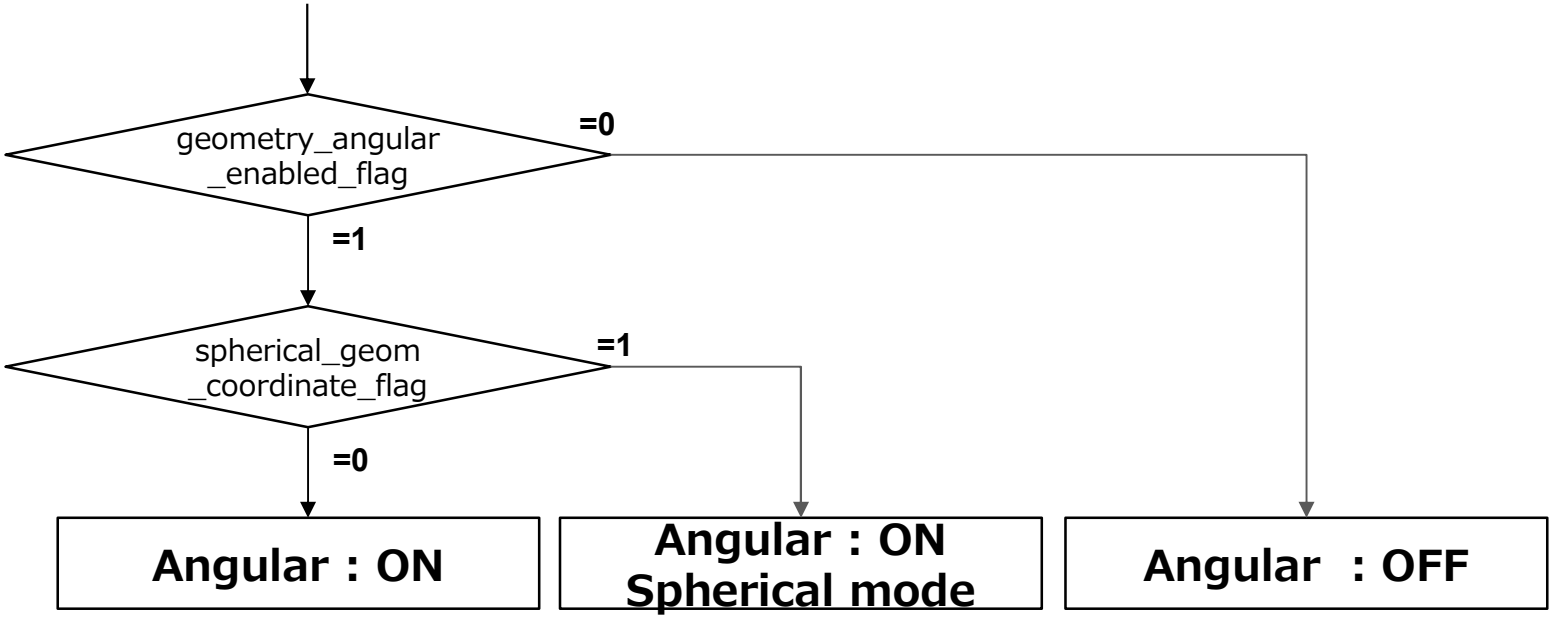
Decode Process



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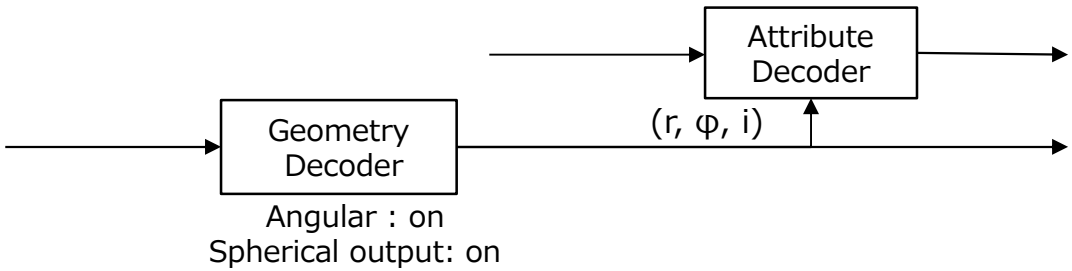
Combination with Spherical Attribute coding

When predgeom angular mode,
the spherical coding mode for attribute can be used.



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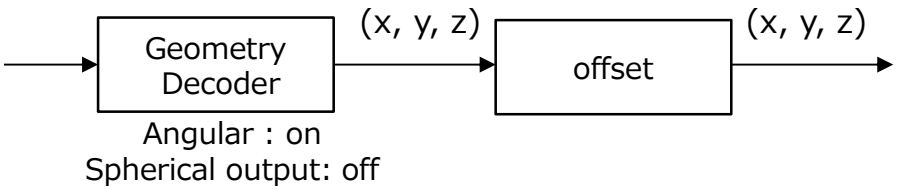
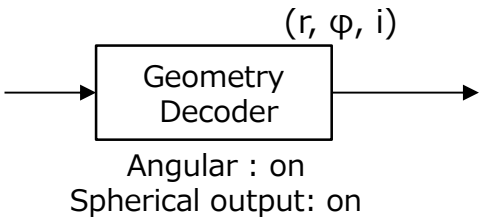
Origin offset

・Cartesian output
position is offset after decoding.
- angular_origin / slice_origin



・Spherical output
offset process can be skipped
syntax can be removed



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Proposed syntax (SPS)

In MPEG132,
it is recommended to signal **geom_spherical_coordinate_flag** in the SPS

1.1.2.1 **Sequence parameter set syntax**

seq_parameter_set( ) {	**Descriptor**
main_profile_compatibility_flag	u(1)
reserved_profile_compatibility_21bits	u(21)
slice_reordering_constraint_flag	u(1)
unique_point_positions_constraint_flag	u(1)
level_idc	u(8)
sps_seq_parameter_set_id	u(4)
frame_ctr_bits	u(5)
slice_tag_bits	u(5)
...	
sps_bypass_stream_enabled_flag	u(1)
sps_entropy_continuation_enabled_flag	u(1)
sps_geom_spherical_coordinate_flag	u(1)
sps_extension_flag	u(1)
if(sps_extension_flag)	
while(more_data_in_byte_stream( ))	
sps_extension_data_flag	u(1)
byte_alignment( )	
}	

sps_geom_spherical_coordinate_flag equal to 1 indicates that the spherical mode is activated. geometry_spherical_enabled_flag equal to 0 indicates that the spherical mode is not activated. When not present, geom_spherical_enabled_flag is inferred to be 0.

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Proposed syntax (GPS)

- Add 1-bit **gps_origin_present_flag**
- not signal origin when **gps_origin_present_flag** is equal to 0.

Geometry parameter set syntax

geometry_parameter_set( ) {	Descriptor
gps_geom_parameter_set_id	u(4)
gps_seq_parameter_set_id	u (4)
gps_gsh_box_log2_scale_present_flag	u(1)
gps_origin_present_flag	u(1)
if(gps_origin_present_flag){	
if(!gps_gsh_box_log2_scale_present_flag)	
gps_gs_box_log2_scale	ue(v)
}	
geom_tree_type	u(1)
if(geom_tree_type == 1)	
duplicate_points_enabled_flag	u(1)
if(geom_tree_type == 0) {	
.....	
}	
geometry_angular_enabled_flag	u(1)
if(geometry_angular_enabled_flag){	
if(gps_origin_present_flag){	
geom_slice_angular_origin_present_flag	u(1)
if(!geom_slice_angular_origin_present_flag) {	
geom_angular_origin_bits_minus1	ue(v)
for(k = 0; k < 3; k++)	
geom_angular_origin_xyz[k]	s(v)
}	
}	
if(geom_tree_type == 1) {	
geom_angular_azimuth_scale_log2	ue(v)
geom_angular_azimuth_step_minus1	ue(v)
geom_angular_radius_scale_log2	ue(v)

gps_origin_present_flag equal to 1 specifies that slice origin and angular origin are present in the GPS or geometry data unit header. **gps_origin_present_flag** equal to 0 specifies that slice origin and angular origin are not present in the GPS and geometry data unit header.

It is a requirement of bitstream conformance that **geom_tree_type** is equal to 1 and **geometry_angular_enabled_flag** is equal to 1 and **gps_origin_present_flag** is equal to 0 when **sps_geom_spherical_coordinate_flag** is equal to 1.

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Proposed syntax (Geometry Data Unit)

- not signal origin when **gps_origin_present_flag** is equal to 0.

Geometry data unit header syntax

geometry_data_unit_header( ) {	Descriptor
gsh_geometry_parameter_set_id	u(4)
gsh_reserved_zero_3bits	u(3)
gsh_slice_id	ue(v)
slice_tag	u(v)
frame_ctr	u(v)
if(!entropy_continuation_enabled_flag) {	
gsh_entropy_continuation_flag	u(1)
if(gsh_entropy_continuation_flag)	
gsh_prev_slice_id	ue(v)
}	
if(gps_origin_present_flag){	
if(gps_gsh_box_log2_scale_present_flag)	
gsh_box_log2_scale	ue(v)
gsh_box_origin_bits_minus1	ue(v)
for(k = 0; k < 3; k++)	
gsh_box_origin_xyz[k]	u(v)
if(geom_slice_angular_origin_present_flag) {	
gsh_angular_origin_bits_minus1	ue(v)
for(k =0; k < 3; k++)	
gsh_angular_origin_xyz[k]	u(v)
}	
}	
...	
byte_alignment( )	

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Conclusion

We proposed the coding mode
for spherical coordinate input/output data on predictive angular mode.

- Add new coding mode for predictive angular mode
- Add 1bit flag in SPS to select the existing process
  - No additional process
- Skip the offset process after decoding
- Remove the offset syntax from GPS and data unit

→ can input/output spherical coordinate data directly
(no conversion error)
→ can in-tree quantization (residual 1)

We recommend to add this method to Amendment.

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