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| **Title** | **Description of EE4FE 13.47 on spherical coordinate geometry** |
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# Abstract

This document provides a description of G-PCC Exploration Experiment (EE) 13.47 on spherical coordinate geometry for predictive geometry coding.

# Introduction

The goal of EE13.47 is to investigate the predictive geometry angular coding method to encode/decode the spherical coordinate data that was proposed in m55361[1] and m55993[2].

In current G-PCC specification, only cartesian coordinates (x, y, z) is supported as the input/output format of geometry. For example, when use the angular mode on predictive geometry coding, input geometry with cartesian coordinates (x, y, z) is converted to spherical coordinates (r, j, i) and the spherical coordinates data is encoded.

However, the sensor may output in the data format of the spherical coordinate system (ex. Velodyne LiDAR) that include vector of the reflectance per angle of sensor.

In m55361 and m55993, we proposed new predictive geometry angular coding method to encode/decode the spherical coordinate data.

# Proposed Encoder/Decoder

## Encoder

Figure 1 shows a diagram of the encoder for predictive geometry coding.

Currently predictive geometry coding support two coding mode (angular mode on / off) that encode the cartesian coordinate input data. We proposed to add the new method that can encode the spherical coordinate input data with angular mode with no additional process.

This new method:

Point1: can input spherical coordinate data directly.

Point2: can quantize the residual even when no conversion error (residual 2).

Point3: no additional process (select the existing function by 1bit flag).

### Input format: Cartesian coordinate, Angular mode: OFF

When encoding the cartesian coordinate data with the Cartesian coordinate system (angular mode = OFF), prediction, residual generation, quantization, and entropy coding are processed.

### Input format: Cartesian coordinate, Angular mode: ON

When encoding the cartesian coordinate data with the Spherical coordinate system (angular mode = ON), the input data is converted from cartesian coordinate to spherical coordinate. Residual by predicting is encoded with spherical coordinate as Residual 1, and the residual due to coordinate transformation is quantized and encoded as Residual 2.

### Input format: Spherical coordinate, Angular mode: ON [NEW]

When encoding the spherical data with the Spherical coordinate system (angular mode = ON), the input data can be encoded with spherical coordinate system (angular mode = ON) directly.

The process of coordinate conversion and Residual 2 encoding are not necessary compared to encoding with the Cartesian coordinate system. Instead of quantization of Residual 2, Residual 1 is quantized.

Each function to achieve this new encoding method is already included in the conventional encoder, so it can be easily achieved by switching the existing process.

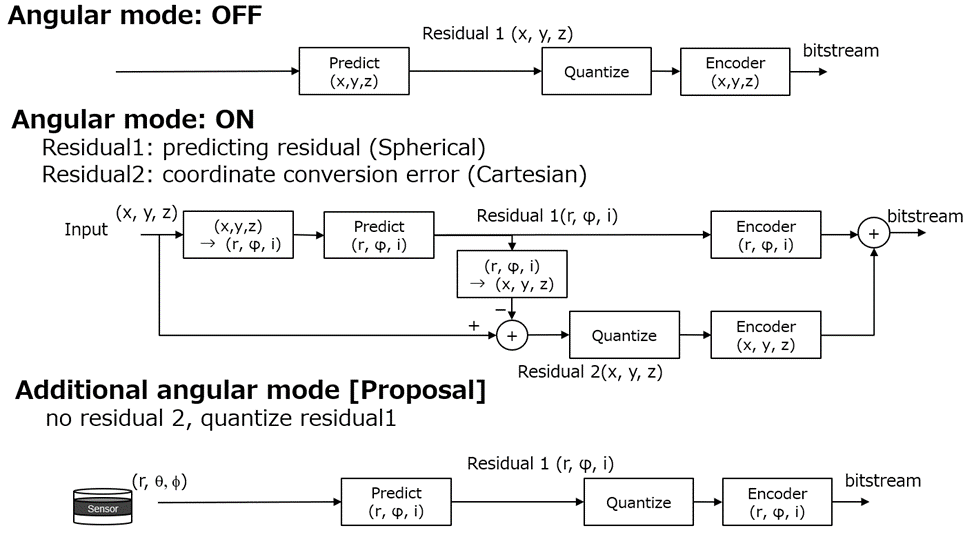


Figure A diagram of the Encoder

## Decoder

Figure 2 shows a diagram of the decoder. The process of the decoder is opposite of the encoder process.

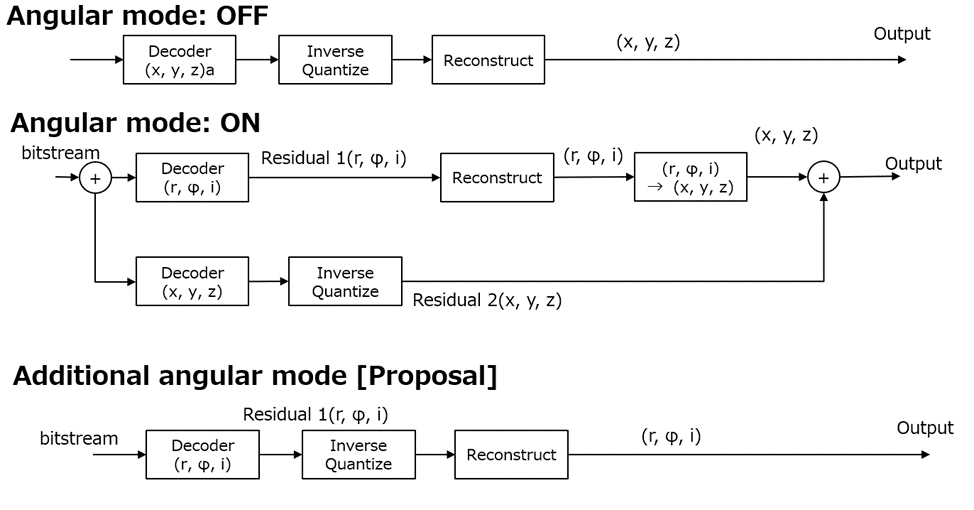


Figure A diagram of the decoder

# geom\_coordinate\_conversion\_flag

Introduces a new flag **geom\_coordinate\_conversion\_flag** in order to switch the coordinate conversion processing is used or not. In combination with **angular\_mode\_enabled\_flag**, it can be switched between 3 modes.

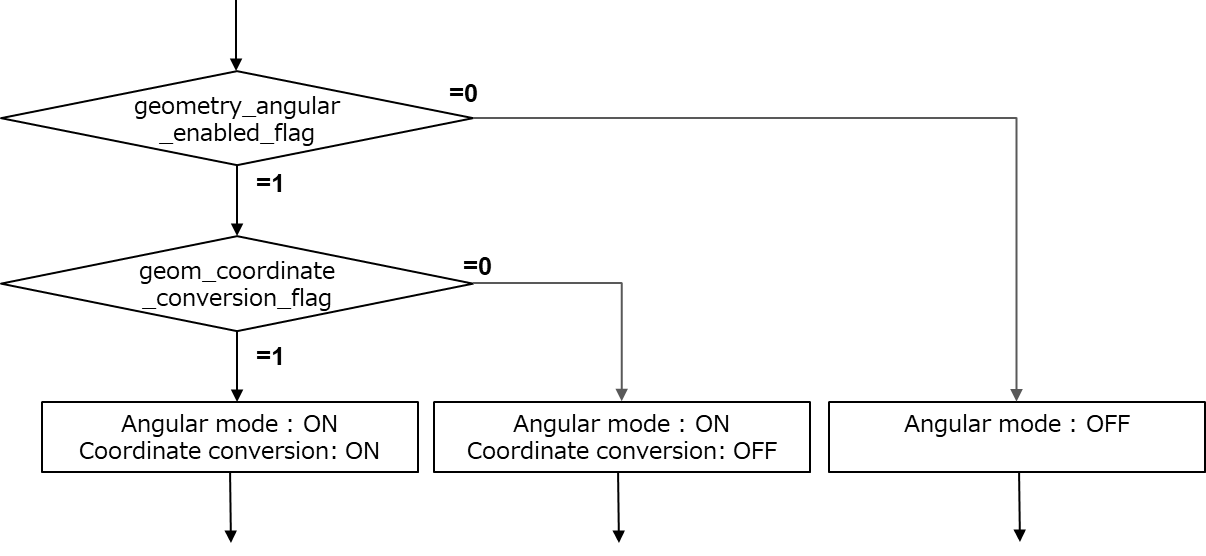


Figure Decoding process

In MPEG132, it is recommended to signal this flag as below.

(1) signal the flag at the sequence parameter set

(2) when signal at the gps level, consider using the extension mechanism.

# Experimental description

We have already tested new process by using cartesian data with no conversion error that we generate and confirmed the performance and functionality of in-tree quantization in previous EE13.47 m55993.

## Mandates

Evaluate Mandates for new EE13.47 is

- Implement new technique and recommended syntax on TMC13v12.1.

- Test with spherical coordinate data input that have no conversion error on angular mode on predictive geometry coding.

## Participants

| **Name** | **Company** | **E-mail address** | **Type** |
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## Information for conducting tests

Proposed method should be evaluated the functionality and the performance in TMC13v12 with predictive geometry coding. The proposed tool shall be implemented on top of TMC13v12.

### Test configurations

Parameters and configurations for TMC13v12 software will be provided by the proponent.

### Evaluation Method

The point cloud test material will be tested under the following conditions of the CTC[3] with predictive geometry coding:

* C2 Lossy Geometry – Lossy Attributes
* CW Lossless Geometry – Lossless Attributes

## EE13.47 Coordinators

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# Timeline:

* **2021-04-05**: Deliver source code and results for cross check
* **2021-04-12**: Report of preliminary cross check results
* **2021-04-19**: Ad-hoc document upload deadline

# References

1. [G-PCC][New] Predictive geometry angular mode using spherical LiDAR data input, ISO/IEC JTC1/SC29/WG7 MPEG2020/m55361 October 2020, Online.
2. EE13.47 report on spherical coordinate geometry, ISO/IEC JTC 1/SC 29/WG 7 m55993, January 2021, Online.
3. Common Test Conditions for G-PCC, ISO/IEC JTC1/SC29 WG7 MDS19642\_WG07\_N00066, January 2020, Online