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<i>Title:</i>	G-PCC: Specification of SPS bounding box and scale factors	
<i>Author(s):</i>	David Flynn Khaled Mammou	<i>davidflynn@apple.com</i> <i>kmammou@apple.com</i>

Abstract

This contribution proposes simplifications to the semantics of the sequence level bounding box and scale factors in order to ensure that non-normative metadata does not necessary to reconstruction.

Introduction

The `sps_source_scale_factor` is a non-normative value that indicates the scale of the coded point cloud compared to some arbitrary source [1].

The G-PCC conformance point is a set of integer points. There is no requirement for a decoder to take any notice of the `sps_source_scale_factor`. This is in much the same way that a JPEG image that has been downsampled to further reduce the file size does not indicate that it must be rescaled to the original size – such information would be provided by an external means. Indeed, in applications where the content is to be rendered into a particular volume, a different scale factor should be determined by the application and used when rendering.

In effect, there are three co-ordinate systems in use in G-PCC:

- The original world co-ordinate system.
- A scaled world co-ordinate system.
- A sequence-local (and slice-local) co-ordinate system.

Issue — SPS bounding box is unscaled

In the current test model, the SPS bounding box origin and size are in the world co-ordinate system. During ply output, points are converted as follows:

$$\text{pos}' = p' \times \text{sps_source_scale_factor}^{-1} + \text{sps_origin}$$

If a decoder wishes to produce output in the scaled world system (ie, the integer points defined by the codec and offset) then it must determine this value using the `sps_source_scale_factor`.

It seems more logical that the SPS bounding box origin and size should be in the scaled world co-ordinate system. Any system that needs to apply local offsets can do so trivially without error. For example, a point

cloud with signed positions must be offset to produce unsigned positions for coding by the octree. Conversion back to signed positions should be immaterial of any scale factor.

Proposal: SPS bounding box should be at the same scale as the conformance output. TMC13 should be updated to reconstruct as follows:

$$\text{pos}' = (p' + \text{sps_source_scale_factor}^{-1}) \times \text{sps_origin}$$

Issue — SPS scale factor is physically meaningless

When presented with a coded point cloud, whether it has been scaled or not, it is currently impossible to understand how the object relates to the physical world. To address this, we suggest changing the semantics of the scale factor to indicate that it indicates the size of a voxel in an SI unit (meters).

To cater for the case where the scale is dimensionless, it is suggested to add a corresponding flag.

```
sequence_parameter_set() {  
    ...  
    sps_source_metre_unit_flag = u(1)  
    sps_source_scale_factor_numerator_minus1 = ue(v)  
    sps_source_scale_factor_denominator_minus1 = ue(v)  
}
```

sps_source_metre_unit_flag equal to 1 indicates that the unit vector in the reconstructed point cloud represents a length equal to:

$$\frac{\text{sps_source_scale_factor_numerator_minus1} + 1}{\text{sps_source_scale_factor_denominator_minus1} + 1} \text{ metres}$$

Issue — Tile inventory has missing dependency

The tile inventory provides the location and dimensions of tiles. The current design seems to provide such dimensions in the world co-ordinate system, relative to the SPS bounding box origin.

Proposal: To ensure consistency, the tile inventory should use the sequence-local co-ordinate system. Otherwise, it presumes scaling to the source.

To understand the tile-inventory in a (scaled) world co-ordinate system, it is necessary to parse the SPS. Yet the tile inventory does not include a reference to the SPS. Alternatively, repeat the SPS origin information in the tile inventory.

Proposal: Add a reference to the SPS. Consider adding SPS origin information to the inventory.

References

- [1] 3DG, “Text of ISO/IEC 23090-9 DIS Geometry-based PCC,” ISO/IEC JTC1/SC29/WG11, 129th meeting, Brussels, Tech. Rep. w19088, Jan. 2020.