

INTERNATIONAL ORGANISATION FOR STANDARDISATION
ORGANISATION INTERNATIONALE DE NORMALISATION
ISO/IEC JTC1/SC29/WG11
CODING OF MOVING PICTURES AND AUDIO

ISO/IEC JTC1/SC29/WG11 MPEG/m52526
January 2020, Brussels, Belgium

<i>Source:</i>	Apple Inc.	
<i>Status:</i>	Input document	
<i>Title:</i>	G-PCC: Geometry swizzling dependent syntax elements	
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Abstract

The current G-PCC draft text [1, w18887] includes a `geometry_axis_order` syntax element in the sequence parameter set [2, m51027]. It is used to assign a permutation of the x, y, and z labels to the first, second and third coded axes. Ie, one coded point cloud representation (bitstream) may encode positions as (x,y,z) and another as (z,y,x). While this feature allows coding the coding order to vary, it raises some ambiguities and may complicate the setting of certain parameters. This contribution introduces the concept that some parameters are specified in world coordinates.

Introduction

Figure 1 shows two identical pointclouds with different mappings of world axes (x, y, and z) to the coding axes (here called s, t, and p). The decoded geometry is the same in both cases after remapping back to the world axes. However, in the current draft and TMC13v8 implementation, syntax variables with per-axis components are not remapped. As such, the SPS bounding box metadata, for example is different for the two point clouds (left vs right).

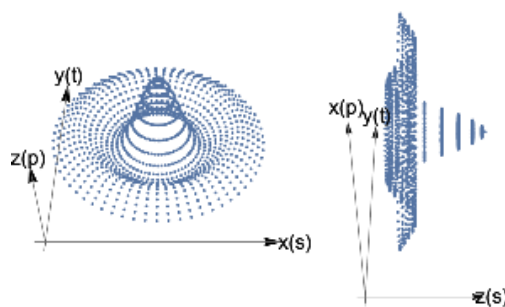


Figure 1 – Illustration of different axes mappings for an identical point cloud

This is observed as part of CE13.26, where, in order to permute the coding axes, it is also necessary to permute the `seq_lod_bias` values to match the coded axes.

A simple solution would dictate that the bounding box too should be permuted according to the `geometry_axis_order`. However, doing so makes using such metadata more difficult, since all users of it must understand how to permute the data.

Proposal

To resolve any ambiguity, we define two axes systems. The world axes, (x, y, z) and the internal coding axes (s, t, p). The `geometry_axis_order` therefore permutes (s, t, p) to (x, y, z), effectively labelling the coded axes. Each axes dependent syntax element is updated to be specified in terms of either the world axes or the coding axes according to Table 1.

Table 1 – Proposed mapping

Syntax element	v8 system	Proposed	Used by decoding process	Rationale
<code>sps_bounding_box_{x,y,z}</code>	coded (s,t,p)	world (x,y,z)	y	External metadata
<code>sps_bounding_box_{w,h,d}</code>	coded (s,t,p)	world (x,y,z)	n	External metadata
<code>tile_bounding_box_{x,y,z}</code>	coded (s,t,p)	world (x,y,z)	n	External metadata
<code>tile_bounding_box_{w,h,d}</code>	coded (s,t,p)	world (x,y,z)	n	External metadata
<code>geom_planar_mode[0..2]</code>	coded (s,t,p)	?	y	
<code>lifting_neighbour_bias[0..2]</code>	coded (s,t,p)	world (x,y,z)	y	Usability
<code>gsh_box_origin_{x,y,z}</code>	coded (s,t,p)	world (x,y,z)	y	External metadata
<code>gsh_log2_max_node_size_{x,y*,z*}</code>	coded (s,t,p)	coded (s,t,p)	y	Internal use
<code>ash_attr_qp_region_box_{x,y,z}</code>	coded (s,t,p)	world (x,y,z)	y	Usability
<code>ash_attr_qp_region_box_{w,h,d}</code>	coded (s,t,p)	world (x,y,z)	y	Usability

Any use of a syntax element by the decoding process that uses world axes must permute the values to coding order according to the `geometry_axis_order`.

In such a system, changing the coding order does not require changing codec specific parameters that relate to real world data.

Open questions

Should `geom_planar_mode` be in xyz or stp? While `gsh_log2_max_node_size_xyz` is primarily for internal use, but may be of interest externally as metadata for estimating if a particular slice intersects a given volume.

Alternatively, should everything be specified using xyz in the high-level syntax and then be mapped internally to stp?

References

- [1] 3DG, “G-PCC Future Enhancements,” ISO/IEC JTC1/SC29/WG11, 128th meeting, Geneva, Tech. Rep. w18887, Oct. 2019.
- [2] D. Flynn and K. Mammou, “[G-PCC][New proposal] G-PCC geometry swizzling,” ISO/IEC JTC1/SC29/WG11, 128th meeting, Geneva, Tech. Rep. m51027, Oct. 2019.