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**CODING OF MOVING PICTURES AND AUDIO**

**ISO/IEC JTC1/SC29/WG11 MPEG2016/M50855**

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| **Source** | **InterDigital** |
| **Status** | **Input document** |
| **Title** | **Duplicate points attribute average** |
| **Author** | Pierre Andrivon, Julien Ricard, Yannick Olivier, Céline Guede |

# Introduction

Version d40 of the V-PCC draft specification includes a "duplicate points pruning" stage (indicated by asps\_remove\_duplicate\_point\_enabled\_flag syntax element). Basically, at the geometry reconstruction stage, a collocated point in two (or more) maps of geometry may have the same (depth) value. The duplicated geometry value is not reconstructed in the reconstructed Point Cloud geometry when the flag is enabled. Besides, in this case of duplicate removal, the attribute value corresponding to the non-discarded geometry point is allocated to the reconstructed Point Cloud attribute (see Figure 1).

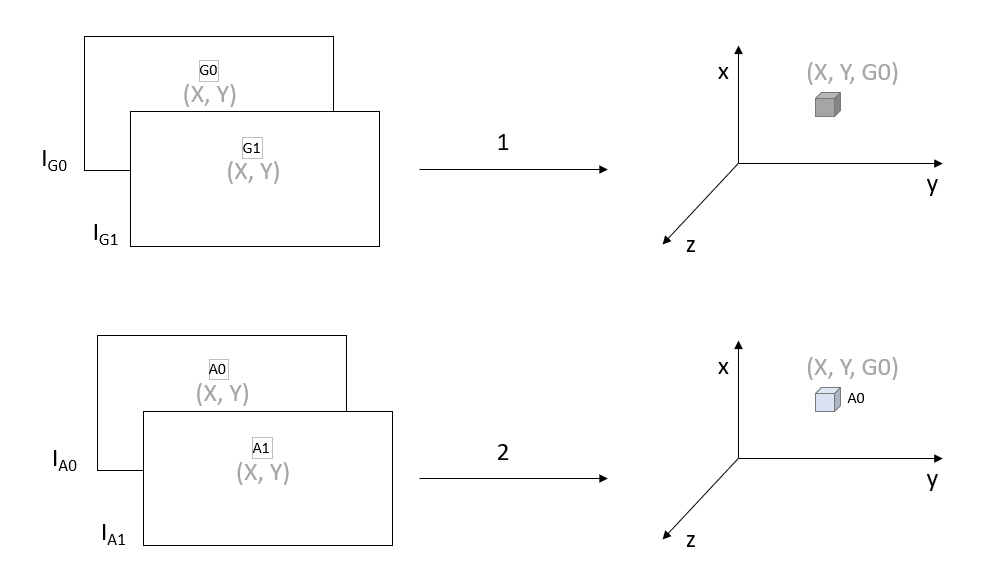


Figure 1: "Remove duplicate" process illustration

Step 1 - Geometry duplicate point removal

Step 2 - Allocation of the attribute value corresponding to the non-discarded point

Thus, attribute information of the discarded point present in the original point cloud is removed from the reconstruted point cloud. It is proposed to preserve this information.

# Proposal

It is proposed to average attribute values of corresponding removed and non-removed geometry map points.

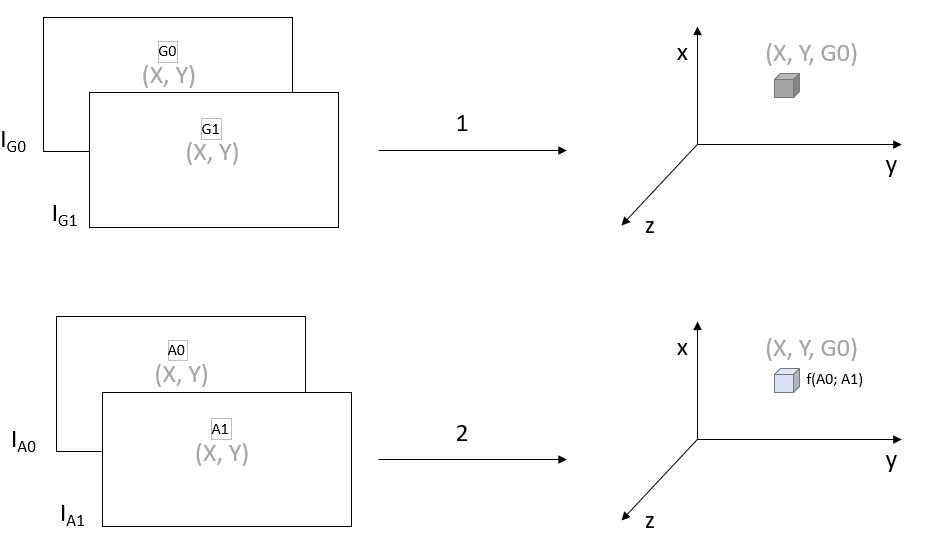


Figure 2: Proposed "remove duplicate" process illustration

Step 1 - Geometry duplicate point removal

Step 2 - Attributes values averaging of duplicated points (f(a,b) is a mean))

Syntax is left unchanged, suggested code and specification modifications are as follows:

Code change is blue highlighed below:

if( !losslessAtt && f == 0 && ( i + 1 < pointCount && pointToPixel[i+1][2] != 1 ) ){

            const auto& frame0 = video.getFrame( shift + 0 );

            const auto& frame1 = video.getFrame( shift + 1 );

            for ( size\_t c = 0; c < 3; ++c ) {

              color[i][c] = (uint8\_t)( ( (float)frame0.getValue( c, x, y ) + (float)frame1.getValue( c, x, y ) + 0.5f ) / 2.f ) ;

            }

          } else {

            // PREVIOUS CODE

            const auto& frame =

                video.getFrame( shift + ( ( !params.oneLayerMode\_ && f == IntermediateLayerIndex ) ? 1 : f ) );

            for ( size\_t c = 0; c < 3; ++c ) { color[i][c] = frame.getValue( c, x, y ); }

            //~ PREVIOUS CODE

In clause 9.4.3 of [1] (reconstruction for non-raw intra and inter coded patches when both deinterleaving and PLR are disabled), is added the following alternative condition:

Otherwise, if isDuplicate is equal to 1, the following applies:

* For aIdx = 0 .. ai\_attribute\_count[ atlasIdx ] − 1, attributes are assigned to the newly added point as follows:

attrDim = ai\_attribute\_dimension\_minus1[ atlasIdx ][ aIdx ] + 1  
for( cIdx = 0; cIdx  <  attrDim; cIdx+ + )

RecPcAttr[ PointNb ][ aIdx ][ cIdx ] = (AFrame[ aIdx ][ mapIdx ][ cIdx ][ y ][ x ]

+ AFrame[ aIdx ][ mapIdx - 1][ cIdx ][ y ][ x ] + 0.5)  / 2

where PointNb represents the "PointCnt" number of AFrame[ aIdx ][ mapIdx - 1][ y ][ x ] (i.e. collocated Point at the inferior map level).

# Results

Results demonstrates consistent gains of -0.2% on TMC2v7 (32 frames).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| C2AI | | | | | C2RA | | | | |
| **Geom. BD‑TotalRate [%]** | | **End-to-End BD‑TotalRate [%]** | | | **Geom. BD‑TotalRate [%]** | | **End-to-End BD‑TotalRate [%]** | | |
| **D1** | **D2** | **Luma** | **Cb** | **Cr** | **D1** | **D2** | **Luma** | **Cb** | **Cr** |
| 0,0% | 0,0% | -0,1% | -0,1% | -0,1% | 0,0% | 0,0% | -0,2% | -0,1% | -0,1% |
| 0,0% | 0,0% | -0,2% | -0,1% | 0,0% | 0,0% | 0,0% | -0,2% | -0,1% | -0,2% |
| 0,0% | 0,0% | -0,1% | -0,3% | -0,3% | 0,0% | 0,0% | -0,3% | -0,1% | -0,1% |
| 0,0% | 0,0% | -0,2% | -0,4% | -0,5% | 0,0% | 0,0% | -0,2% | -0,3% | -0,3% |
| 0,0% | 0,0% | -0,1% | -0,2% | -0,2% | 0,0% | 0,0% | -0,2% | -0,2% | -0,2% |
| 0,0% | 0,0% | -0,2% | -0,1% | -0,1% | 0,0% | 0,0% | -0,2% | -0,1% | -0,1% |
| 0,0% | 0,0% | -0,2% | -0,1% | -0,1% | 0,0% | 0,0% | -0,1% | -0,1% | -0,1% |
| 0,0% | 0,0% | -0,2% | -0,2% | -0,2% | 0,0% | 0,0% | -0,2% | -0,1% | -0,2% |
| 0,0% | 0,0% | -0,1% | -0,2% | -0,2% | 0,0% | 0,0% | -0,2% | -0,2% | -0,2% |
| 0,0% | 0,0% | -0,2% | -0,1% | -0,1% | 0,0% | 0,0% | -0,2% | -0,1% | -0,1% |
| 0,0% | 0,0% | -0,2% | -0,2% | -0,2% | 0,0% | 0,0% | -0,2% | -0,1% | -0,2% |

# References

[1] Draft V-PCC specification, CD stage, revision d40