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**CODING OF MOVING PICTURES AND AUDIO**

**ISO/IEC JTC1/SC29/WG11 m49591**

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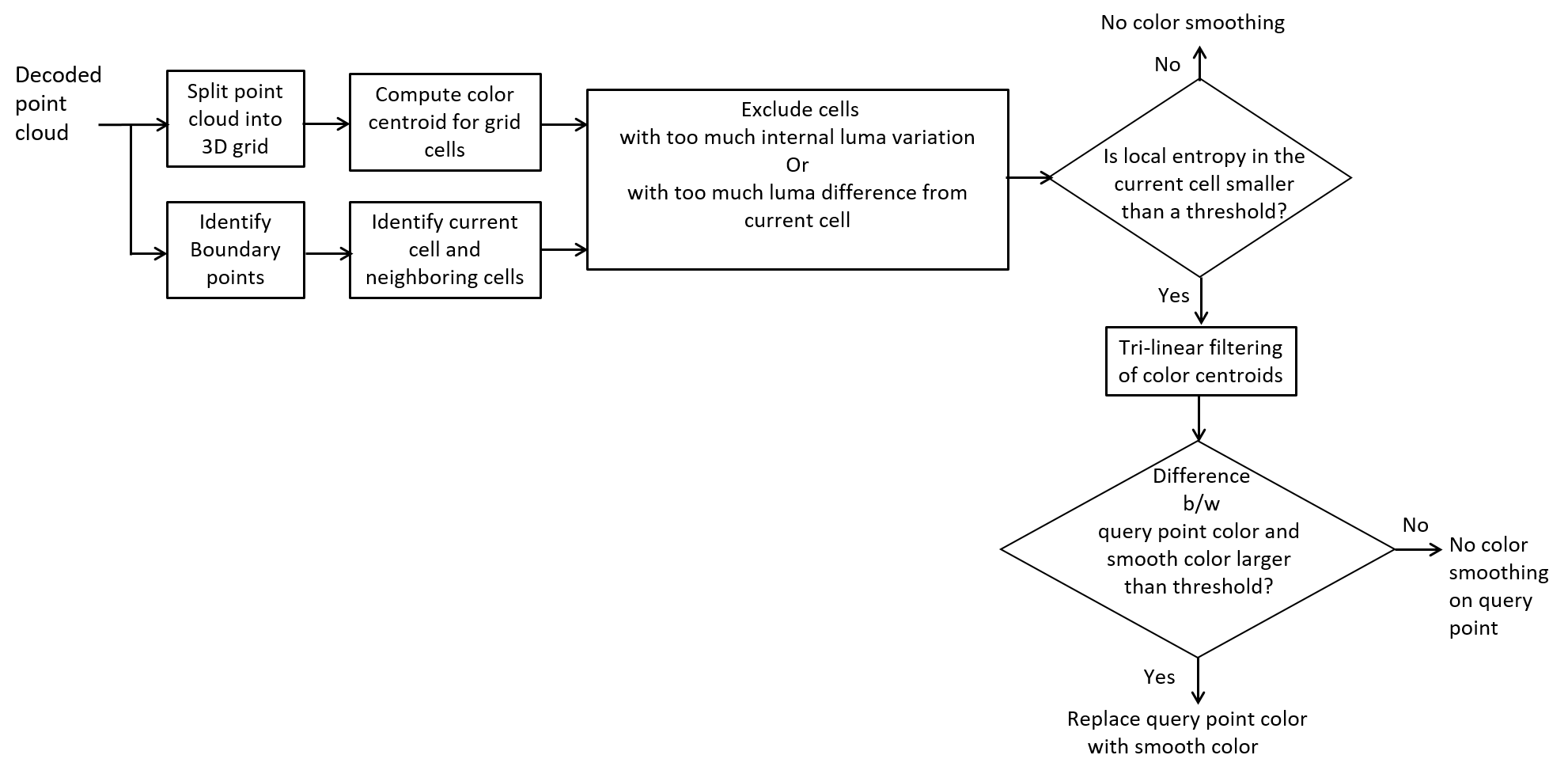
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| --- | --- |
| **Source** | **Samsung Electronics** |
| **Status** | **Input contribution** |
| **Title** | **[V-PCC][New Proposal] Simplified low complexity color smoothing** |
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# Introduction

Contribution m46277 [1] on low complexity color smoothing was adopted in 126th MPEG meeting in March 2019. The adopted technique uses local entropy to make a decision whether color smoothing is needed in each cell. Local entropy is calculated using the logarithm of the probability of the luma values in each cell which requires floating-point precision. This contribution introduces a simplified low complexity color smoothing method wherein local entropy is removed from the color smoothing process. The proposed method provides the same objective scores and subjective quality.

# Proposal

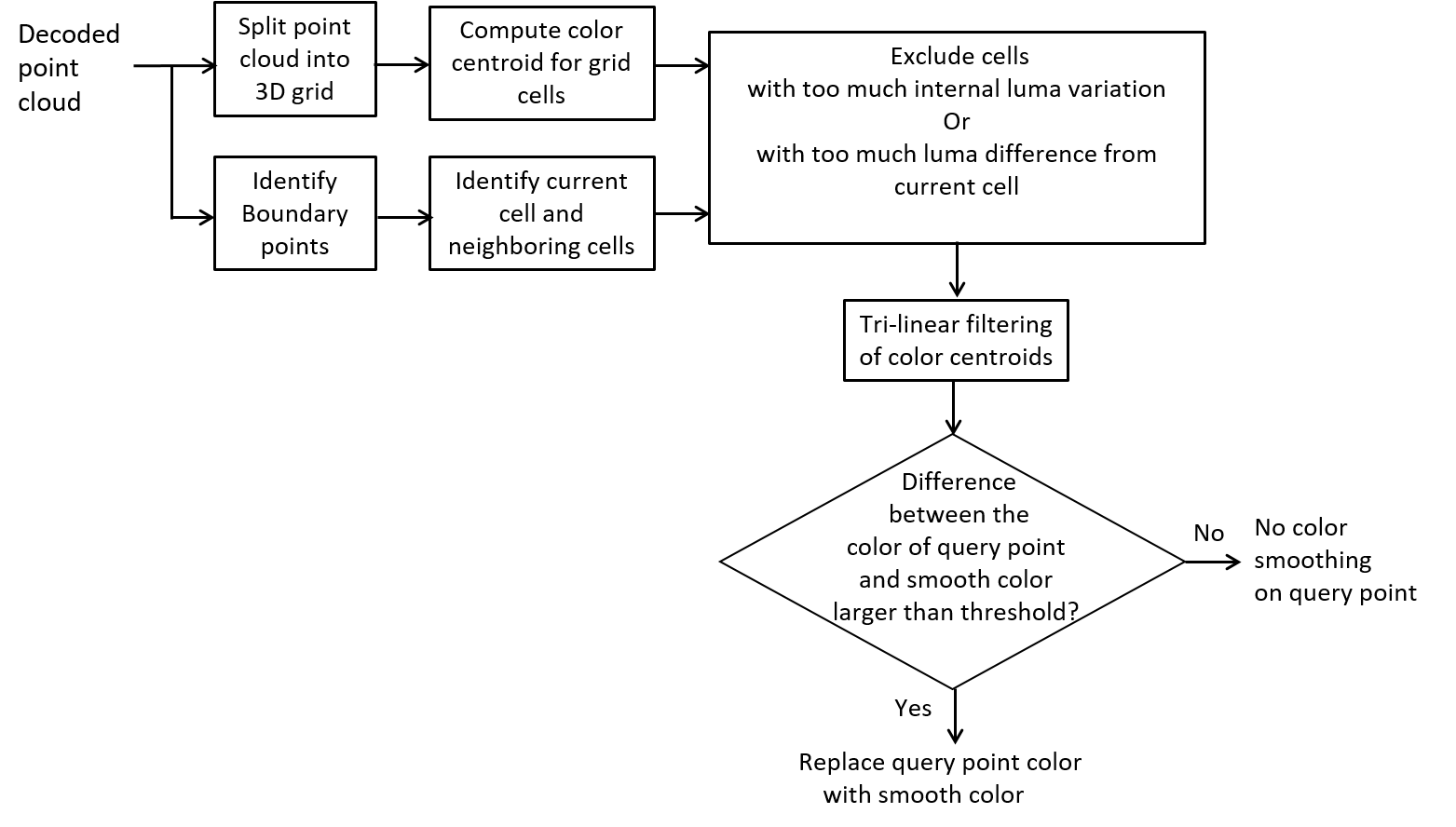
In the color smoothing method reported in m46277, input point cloud is split into a 3D grid. Local entropy of the luma of points in each cell is calculated to make a decision if color smoothing is performed in a cell. The process flow for the adopted method m46277 is shown in figure 1.



*Figure 1. Process flow for low complexity color smoothing reported in m46277.*

As seen in Figure 1, the variation in luma values within a cell will be used to characterize the local variation of the point cloud. If the variation in luma values within a cell is greater than a threshold, no color smoothing will be performed in the cell. Since the variation in each cell is already calculated, in the proposed method, the local entropy in each cell will not be calculated. Once local entropy is removed, the value of the threshold for luma variation in cells will be adjusted to make up for the removal of local entropy.

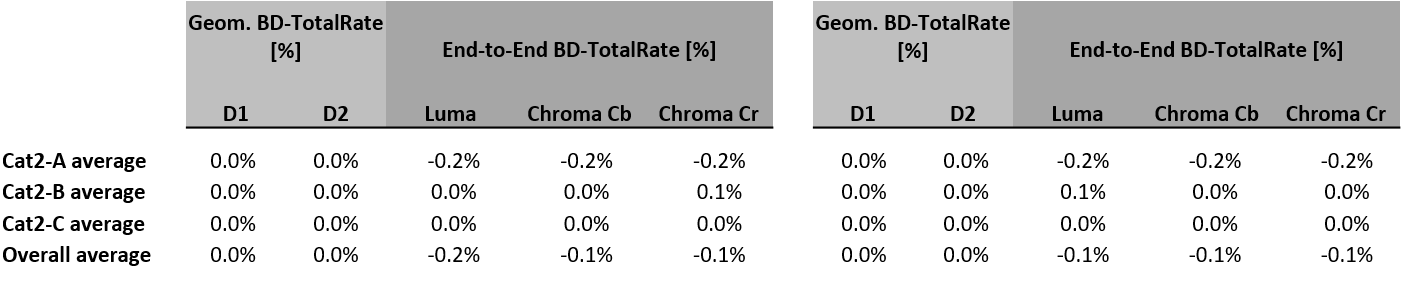
The simplified color smoothing is operates as shown in Figure 2.



*Figure 2. Process flow for the simplified low complexity color smoothing.*

# Results

Table 1 shows the 32-frame objective results for the simplified low-complexity color smoothing compared with the low-complexity color smoothing method reported in m46277.



*Table 1 – RD results of simplified low-complexity color smoothing versus low-complexity color smoothing: All Intra (left), Random Access (right)*

In visual evaluation, the simplified color smoothing method performs the same as the low complexity color smoothing method. Figures 3 and 4 show the screenshots of the reconstructed point clouds for TMC2v6, TMC2v6+low-complexity color smoothing, and TMC2v6+low-complexity color smoothing with no local entropy calculation.



*Figure 3. From left to right: original and reconstructed point cloud for Longdress (encoded at rate 1).*



*Figure 4. From left to right: original and reconstructed point cloud for Loot (encoded at rate 1).*

# Conclusion

Based on the results provided in this document, Samsung requests the simplified low complexity color smoothing method be adopted in the V-PCC test model.

# References

1. [V-PCC] Low complexity color smoothing, ISO/IEC JTC1/SC29 WG11 Doc. m46277, Geneva, Switzerland, March 2019.