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Title **Group Tiling in TMIV**

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1 Group Tiling in TMIV

After 3DoF+ call for response, the *Group-Based TMIV* [1] has been proposed to MPEG-Immersive standard meetings by Intel Corporation. The *group-based TMIV* method preprocesses view group information separately and merges the metadata of these view groups that leads the subjective video quality improvement. Currently, Intel has been proposed *Object-based TMIV* [2,3] to provide personalized 6DoF user experience like priority objects rendering, objects filtering, and so on.

In this regard, there is a discussion on the *requirements for Immersive Media Access and Delivery* [4] for streaming and accessing MPEG coded data. To constraint resource such as bandwidth, decode resources, supporting spatial random access that depending on user's orientation and region of interest (ROI) is technical challenge. To the better immersive media streaming, complying with the following capabilities is required:

- *4K decoding constraint*
- *fewer decoder instance*
- *Single-layer decoding constraint*

This contribution presents a group tiling method for TMIV which is grouping views into HEVC/VVC tiles. The group tiling method for TMIV use motion-constrained tile set (MCTS) techniques to support spatial random access under constrained decode resources. There are advantages of the group tiling method:

- *Single-pass encoding/rendering with MCTS-encoder and modified TMIV*
- *Saving in pixel rate*
- *Saving bandwidth with selective tile-based streaming*

For example, The user viewport can be classified as groups. In the perspective of viewport-adaptive streaming, The group tilling method can achieve selective streaming like priority rendering. With the MCTS-encoder, only tile information is needed to extract MCTS sub-bitstream. Without significant change in TMIV Syntax, the group tiling method can be adopted.

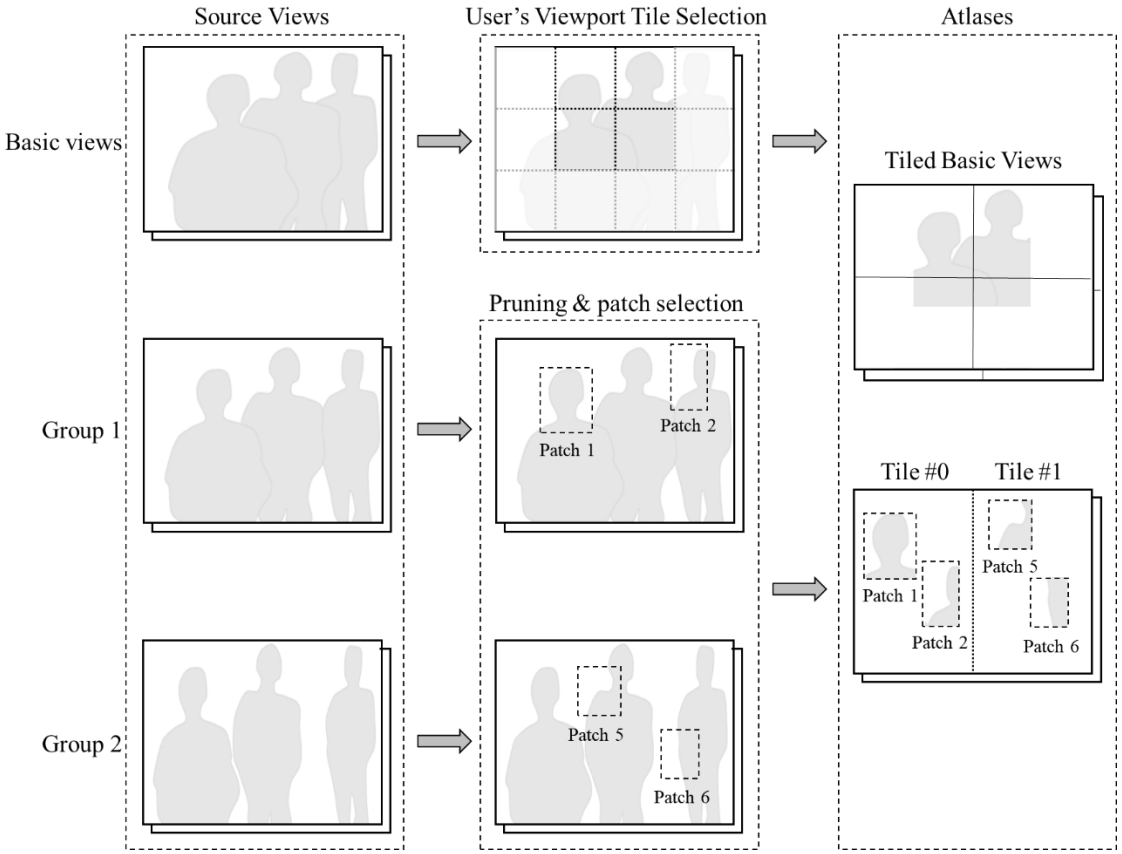

Fig. 1. Conceptual diagram of Tiled basic views and group tiling method with Atlas patch groups packed into Tiles.

The group tiling method enhances the concept of the tile-based approach with (1) Tiled basic views and (2) Atlas patch groups packed into tiles. By extracting only valid tiles and merging, the requirements such as decode resource, bandwidth are reduced.

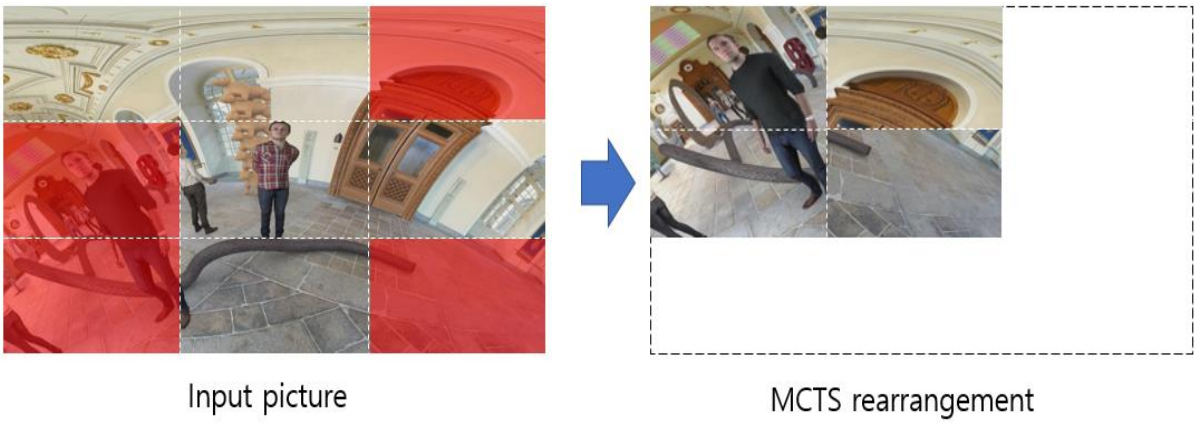

Fig. 2. extraction process of the prposed viewport-adaptivet group tiling method using MCTS techniques. For example, The red is valid tile region (ROI).

Under 4K decoding constraint and fewer decoder capabilities, Current TMIV has a limitation in rendering and streaming. With rearrangement selected tiles in views and decoding, the group tiling method can reduced decode resource significantly.

2 Proposed Syntax and Semantics

The proposed syntax is as shown in Table 1. The *uniform_flag* indicates whether Tiles are divided uniformly or not. The number of Tiles can be more than one. Tile needs its own width and height (multiple of CTU (64 pixels)). Each patch knows the Tile identification (ID) that it belongs.

Table 1. Atlas Parameters List Syntax

atlas_params_list( ) {	
num_atlases_minus1	ue(v)
for (i = 0; i <= num_atlases_minus1; i++) {	
atlas_id[i]	ue(v)
uniform_flag[i]	u(v)
num_tile_columns_minus1[i]	u(v)
num_tile_rows_minus1[i]	u(v)
for (j = 0; j <= num_tiles_minus1; j++) {	
tile_id[i][j]	u(v)
tile_width[i][j]	u(v)
tile_height[i][j]	u(v)
tile_pos_in_atlas_x[i][j]	u(v)
tile_pos_in_atlas_y[i][j]	u(v)
}	
atlas_params(atlas_id[i])	
}	
}	

uniform_flag[i] specifies the tile sizes are uniformly distributed in i-th atlas.
num_tiles_columns_minus1[i] specifies the number of columns in i-th atlas.
num_tiles_rows_minus1[i] specifies the number of rows in i-th atlas.
tile_id[i][j] specifies the tile index of the j-th tile in i-th atlas.
tile_width[i][j] indicates the width of the j-th tile in i-th atlas.
tile_height[i][j] indicates the height of the j-th tile in i-th atlas.
tile_pos_in_atlas_x[i][j] and **tile_pos_in_atlas_y[i][j]** specify the horizontal and vertical coordinates in luma samples, respectively, of the top-left corner of the j-th pixel of the i-th atlas.

3 Conclusion

The view tile selector (VTS) method implementation in TMIV is also proposed [5] to provide detail information for viewport-dependent streaming in TMIV. In the [5], the experiment has been conducted viewport-dependent streaming for pose traces in CTC as proof-of-concept group tiling method. Not only depending on user's orientation, but group tiling method can provide flexible access for media such as priority rendering and viewport-adaptive streaming.

The group tiling method is compatible with MCTS-encoder, so it doesn't require much. Also it can be used for other purposes that comply the *requirements for Immersive Media Access and Delivery* such as personalized 6DoF user experience.

We recommend:

- Adding tile information parameters to atlas parameters list metadata in MIV WD and TMIV software.

References

[1] B. Salahieh, S. Bhatia, J. Boyce, "Group-Based TMIV," ISO/IEC JTC1/SC29/WG11 MPEG/m49406, July 2019, Gothenburg, Sweden.

[2] B. Salahieh, J. Boyce, and F. Yeung, "Object-Based Applications for Immersive Video Coding," ISO/IEC JTC1/SC29/WG11 MPEG/m50949, October 2019, Geneva, Switzerland.

[3] B. Salahieh, J. Boyce, and F. Yeung, "Object-Based Implementation in TMIV," ISO/IEC JTC1/SC29/WG11 MPEG/m52475, January 2020, Brussels, Belgium.

[4] "Requirements for Immersive Media Access and Delivery", July 2019, N18654, Gothenburg, SE.

[5] J.B. Jeong, S. Lee, and E.S. Ryu, "CE1-related: On Viewport Tile Selector Implementation in TMIV for Viewport-dependent Rendering," ISO/IEC JTC1/SC29/WG11 MPEG/m51638, January 2020, Brussels, Belgium.