Title	**[MIV] Chroma dynamic range modification**
Source	**PUT, ETRI**
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Abstract

The document presents a proposal of scaling both chroma components of attribute atlases. The idea is similar to changing the dynamic range of the depth maps. The proposal increases the dynamic range of chroma, allowing for a better representation of colors in synthesized viewports. The recommendation is to adopt the proposed syntax and include the proposed modification in TMIV16.

1 Proposal

The idea of patch geometry offset modification is similar to changing the values of color components of the patch to move the average value to the neutral color. Here, we propose to perform a similar process also for the geometry of patches.
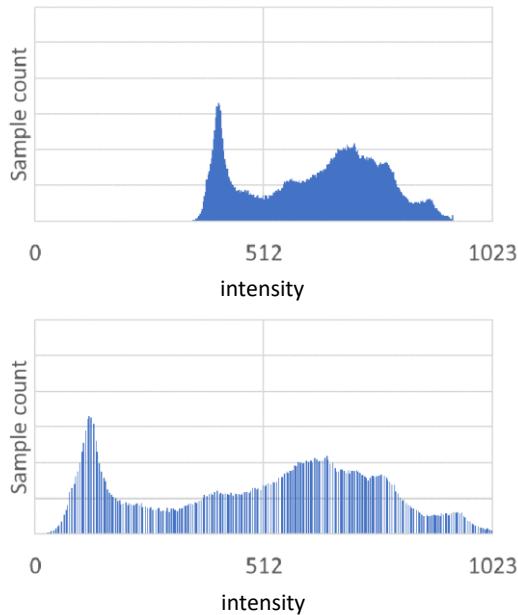

Fig. 1. Idea of the proposed modification of chroma dynamic range. From top: original histogram of a chroma component of a view and histogram of the view after modification of the chroma dynamic range.
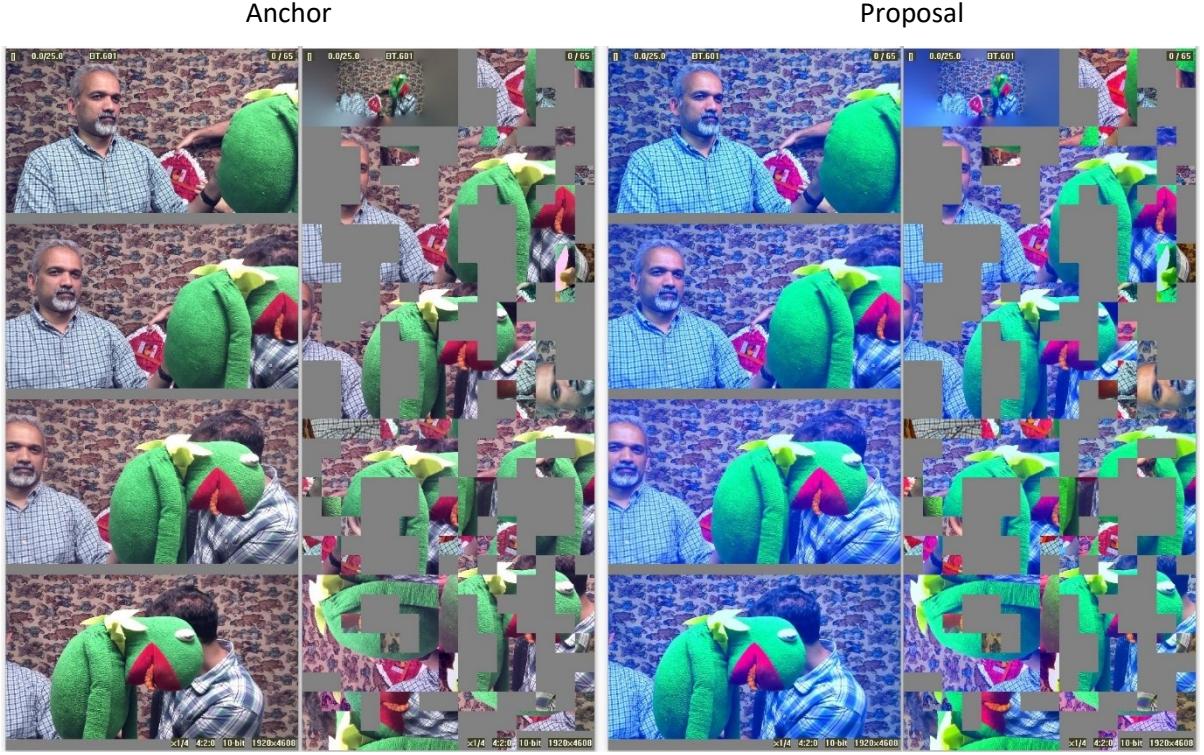
Anchor	Proposal

2 Results

A65

Mandatory content - Proposal vs. Low/High-bitrate Anchors						Max delta Y-PSNR [dB]			Max delta IV-PSNR [dB]		
Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR	MIV Main	m63397	Difference [%]	MIV Main	m63397	Difference [%]
Chess	B02	10.8%	-46.6%	-0.1%	0.6%	17.50	17.43	-0.4%	22.18	22.02	-0.7%
Guitarist	B03	14.2%	-25.5%	-0.0%	0.2%	24.97	25.11	0.6%	23.50	23.58	0.3%
Cadillac	J02	12.2%	-15.1%	-0.5%	0.4%	6.73	6.70	-0.3%	6.50	6.44	-0.8%
Fan	J04	5.3%	-10.9%	-0.6%	1.1%	5.37	5.40	0.5%	4.98	5.00	0.5%
Group	W01	9.6%	-17.4%	-0.3%	0.9%	13.69	13.73	0.2%	14.46	14.48	0.1%
Painter	D01	9.3%	-21.4%	-0.6%	0.6%	6.56	6.59	0.4%	5.01	4.98	-0.7%
Frog	E01	4.1%	-15.9%	-0.2%	1.0%	9.72	9.72	0.0%	6.15	6.15	0.0%
CBABasketball	L02	6.0%	-11.0%	-0.1%	0.3%	16.52	16.51	-0.1%	14.00	14.00	0.0%
Average		8.9%	-20.5%	-0.3%	0.6%	12.63	12.65	0.1%	12.10	12.08	-0.2%

The proposal increases the bitrate (negligible increase for RP4, significant increase for RP1, see example of RD-curves below) and increases objective quality for chroma components (included in IV-PSNR). WS-PSNR BD-rate includes only the luma component, which is not affected.

Reference　　　Anchor　　　Proposal
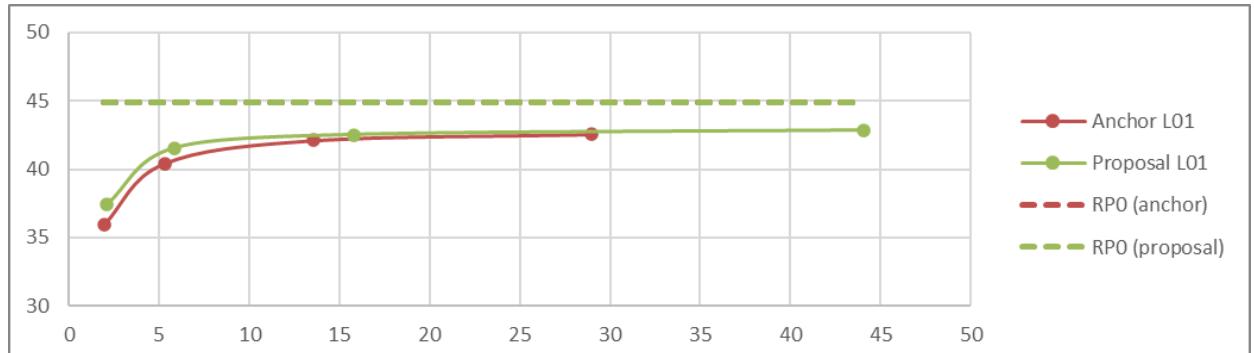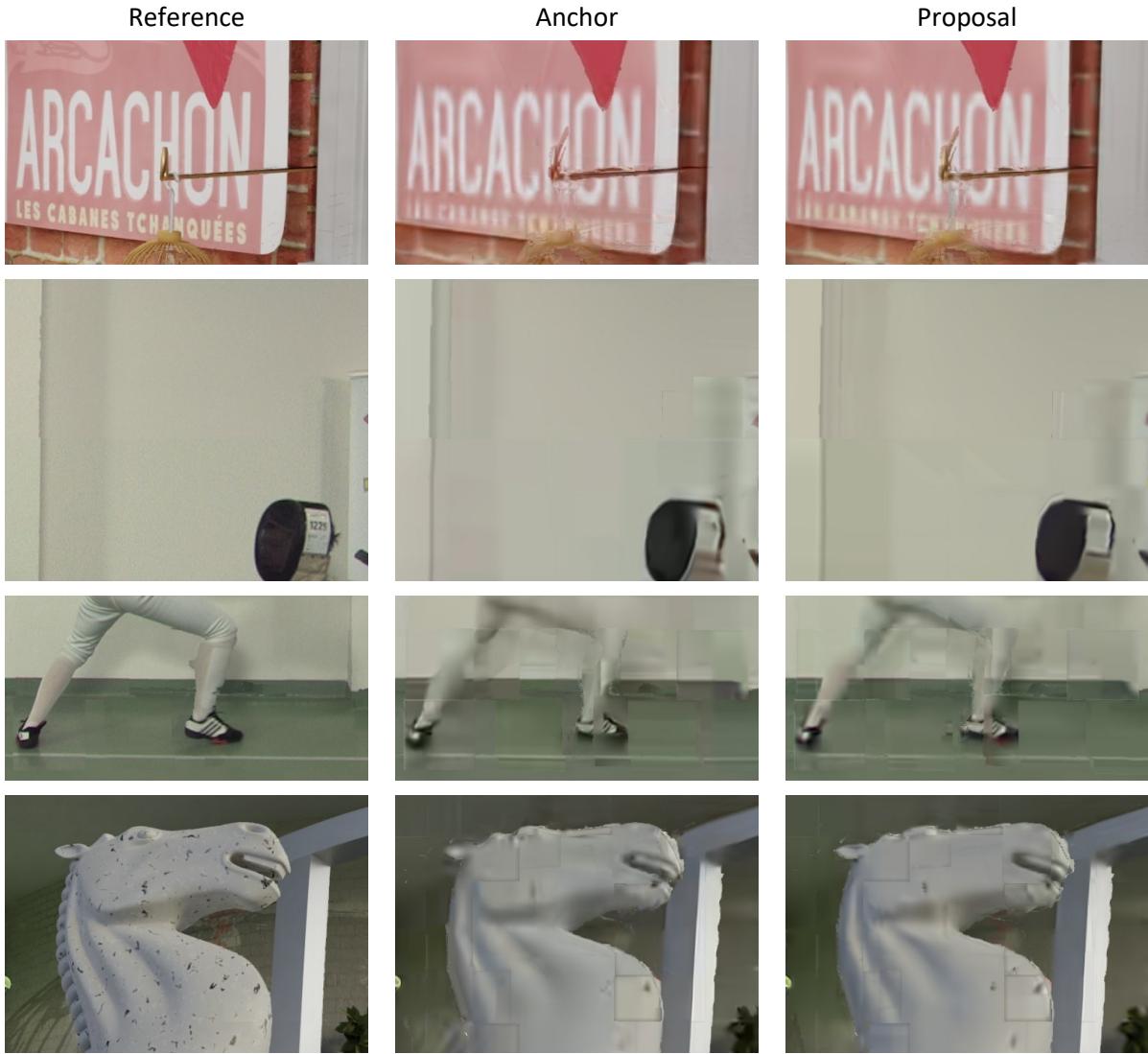
Subjectively, colors within synthesized viewports are more consistent and similar to the original ones.

The solution was tested on all CTC content:

Class A						Max delta Y-PSNR [dB]			Max delta IV-PSNR [dB]		
Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR	MIV Main	m63397	Difference [%]	MIV Main	m63397	Difference [%]
ClassroomVideo	A01	10.2%	-25.8%	-0.1%	1.0%	12.61	12.62	0.0%	9.51	9.47	-0.4%
Average		**10.2%**	**-25.8%**	**-0.1%**	**1.0%**	**12.61**	**12.62**	**0.0%**	**9.51**	**9.47**	**-0.4%**

Class B						Max delta Y-PSNR [dB]			Max delta IV-PSNR [dB]		
Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR	MIV Main	m63397	Difference [%]	MIV Main	m63397	Difference [%]
Museum	B01	14.0%	-5.0%	-0.7%	0.3%	21.53	21.54	0.0%	20.89	20.86	-0.1%
Chess	B02	10.8%	-46.6%	-0.1%	0.6%	17.50	17.43	-0.4%	22.18	22.02	-0.7%
Guitarist	B03	14.2%	-25.5%	-0.0%	0.2%	24.97	25.11	0.6%	23.50	23.58	0.3%
Average		**14.2%**	**-25.5%**	**-0.0%**	**0.2%**	**24.97**	**25.11**	**0.6%**	**23.50**	**23.58**	**0.3%**

Class C

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Hijack	C01	7.4%	-21.3%	-0.2%	0.5%
Cyberpunk	C02	3.0%	-8.7%	-0.0%	0.2%
Average		**3.0%**	**-8.7%**	**-0.0%**	**0.2%**

Max delta Y-PSNR [dB]

MIV Main	m63397	Difference [%]
14.60	14.52	-0.6%
13.10	13.10	0.0%
13.10	**13.10**	**0.0%**

Max delta IV-PSNR [dB]

MIV Main	m63397	Difference [%]
15.33	15.22	-0.7%
13.46	13.46	-0.1%
13.46	**13.46**	**-0.1%**

Class J

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Kitchen	J01	11.9%	-22.1%	-0.2%	0.5%
Cadillac	J02	12.2%	-15.1%	-0.5%	0.4%
Mirror	J03	11.9%	-13.4%	-0.8%	0.9%
Fan	J04	5.3%	-10.9%	-0.6%	1.1%
Average		**5.3%**	**-10.9%**	**-0.6%**	**1.1%**

Max delta Y-PSNR [dB]

MIV Main	m63397	Difference [%]
7.83	7.82	-0.1%
6.73	6.70	-0.3%
10.81	10.80	-0.1%
5.37	5.40	0.5%
5.37	**5.40**	**0.5%**

Max delta IV-PSNR [dB]

MIV Main	m63397	Difference [%]
7.72	7.68	-0.4%
6.50	6.44	-0.8%
11.31	11.29	-0.2%
4.98	5.00	0.5%
4.98	**5.00**	**0.5%**

Class W

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Group	W01	9.6%	-17.4%	-0.3%	0.9%
Dancing	W02	5.6%	-27.0%	-0.1%	0.8%
Average		**5.6%**	**-27.0%**	**-0.1%**	**0.8%**

Max delta Y-PSNR [dB]

MIV Main	m63397	Difference [%]
13.69	13.73	0.2%
14.95	14.91	-0.3%
14.95	**14.91**	**-0.3%**

Max delta IV-PSNR [dB]

MIV Main	m63397	Difference [%]
14.46	14.48	0.1%
16.06	16.01	-0.3%
16.06	**16.01**	**-0.3%**

Class D

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Painter	D01	9.3%	-21.4%	-0.6%	0.6%
Breakfast	D02	5.4%	-26.2%	-0.1%	0.7%
Barn	D03	8.7%	-31.0%	-0.2%	0.7%
Average		**8.7%**	**-31.0%**	**-0.2%**	**0.7%**

Max delta Y-PSNR [dB]

MIV Main	m63397	Difference [%]
6.56	6.59	0.4%
11.64	11.64	0.0%
13.34	13.33	-0.1%
13.34	**13.33**	**-0.1%**

Max delta IV-PSNR [dB]

MIV Main	m63397	Difference [%]
5.01	4.98	-0.7%
8.32	8.32	0.0%
12.78	12.79	0.0%
12.78	**12.79**	**0.0%**

Class E

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Frog	E01	4.1%	-15.9%	-0.2%	1.0%
Carpark	E02	10.2%	-26.2%	-0.3%	0.9%
Street	E03	14.8%	-46.4%	-0.2%	0.6%
Average		**14.8%**	**-46.4%**	**-0.2%**	**0.6%**

Max delta Y-PSNR [dB]

MIV Main	m63397	Difference [%]
9.72	9.72	0.0%
5.61	5.62	0.2%
5.20	5.20	-0.1%
5.20	**5.20**	**-0.1%**

Max delta IV-PSNR [dB]

MIV Main	m63397	Difference [%]
6.15	6.15	0.0%
5.29	5.29	-0.2%
4.93	4.78	-3.1%
4.93	**4.78**	**-3.1%**

Class L

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Fencing	L01	8.5%	-28.6%	-0.4%	1.0%
CBABasketball	L02	6.0%	-11.0%	-0.1%	0.3%
MartialArts	L03	8.4%	-20.1%	-0.1%	0.2%
Average		**8.4%**	**-20.1%**	**-0.1%**	**0.2%**

Max delta Y-PSNR [dB]

MIV Main	m63397	Difference [%]
21.76	21.75	-0.1%
16.52	16.51	-0.1%
15.74	15.74	0.0%
15.74	**15.74**	**0.0%**

Max delta IV-PSNR [dB]

MIV Main	m63397	Difference [%]
21.34	21.14	-0.9%
14.00	14.00	0.0%
17.17	17.10	-0.4%
17.17	**17.10**	**-0.4%**

3 Syntax & semantics

Syntax and semantics are analogous to the attribute/texture offset already adopted to MIV.

8.3.2.5 Common atlas sequence parameter set MIV extension syntax

	Descriptor
casps_miv_extension( ) {	
casme_depth_low_quality_flag	u(1)

casme_depth_quantization_params_present_flag	u(1)
casme_chroma_scaling_present_flag	u(1)
casme_vui_params_present_flag	u(1)
if(casme_vui_params_present_flag)	
vui_parameters( )	
}	

casme_chroma_scaling_present_flag equal to 1 indicates that the chroma scaling parameters are present in the syntax structure. casme_chroma_scaling_present_flag equal to 0 indicates that the chroma scaling parameters are not present in the syntax structure. When not present, the value of casme_chroma_scaling_present_flag is inferred to be equal to 0.

8.3.2.6 Common atlas frame

8.3.2.6.1 MIV extension syntax

caf_miv_extension( ) {	**Descriptor**
if(nal_unit_type == NAL_CAF_IDR) {	
miv_view_params_list( )	
} else {	
came_update_extrinsics_flag	u(1)
came_update_intrinsics_flag	u(1)
if(casme_depth_quantization_params_present_flag)	
came_update_depth_quantization_flag	u(1)
if(casme_chroma_scaling_present_flag)	
came_update_chroma_scaling_flag	u(1)
if(came_update_extrinsics_flag)	
miv_view_params_update_extrinsics( )	
if(came_update_intrinsics_flag)	
miv_view_params_update_intrinsics( )	
if(came_update_depth_quantization_flag)	
miv_view_params_update_depth_quantization( )	
if(came_update_chroma_scaling_flag)	
miv_view_params_update_chroma_scaling( )	
}	
}	

came_update_chroma_scaling_flag equal to 1 indicates that the miv_view_params_update_chroma_scaling( ) syntax structure is present in this syntax structure. came_update_chroma_scaling_flag equal to 0 indicates that the miv_view_params_update_chroma_scaling ( ) syntax structure is not present in this syntax structure. When not present, the value of came_update_chroma_scaling_flag is inferred to be equal to 0.

8.3.2.6.2 MIV view parameters list syntax

miv_view_params_list( ) {	**Descriptor**
mvp_num_views_minus1	u(16)
mvp_explicit_view_id_flag	u(1)
if(mvp_explicit_view_id_flag)	
for(v = 0; v <= mvp_num_views_minus1; v++)	

mvp_view_id[v]	u(16)
for(v = 0; v <= mvp_num_views_minus1; v++) {	
camera_extrinsics(v)	
mvp_inpaint_flag[v]	u(1)
}	
mvp_intrinsic_params_equal_flag	u(1)
for(v = 0; v <= mvp_intrinsic_params_equal_flag ? 0 : mvp_num_views_minus1; v++)	
camera_intrinsics(v)	
if(casme_depth_quantization_params_present_flag) {	
mvp_depth_quantization_params_equal_flag	u(1)
for(v = 0; v <= mvp_depth_quantization_equal_flag ? 0 : mvp_num_views_minus1; v++)	
depth_quantization(v)	
}	
mvp_pruning_graph_params_present_flag	u(1)
if (mvp_pruning_graph_params_present_flag)	
for(v = 0; v <= mvp_num_views_minus1; v++)	
pruning_parents(v)	
if (casme_chroma_scaling_present_flag)	
for(v = 0; v <= mvp_num_views_minus1; v++)	
chroma_scaling(v)	
}	

8.3.2.6.X MIV view parameters update chroma scaling syntax

miv_view_params_update_chroma_scaling( ) {	Descriptor
mvpucs_num_view_updates_minus1	u(16)
for(i = 0; i <= mvpucs_num_view_updates_minus1; i++) {	
mvpucs_view_idx[i]	u(16)
chroma_scaling(mvpucs_view_idx[i])	
}	
}	

mvpucs_num_view_updates_minus1 plus 1 specifies the number of chroma_scaling(v) syntax structures that are present within this syntax structure. The value of mvpucs_num_view_updates_minus1 shall be in the range of 0 to mvp_num_views_minus1, inclusive.

mvpucs_view_idx[i] specifies the view index for which updated chroma scaling parameters will be signalled. The value of mvpucs_view_idx[i] shall be in the range of 0 to mvp_num_views_minus1, inclusive.

8.3.2.6.Y Chroma scaling syntax

chroma_scaling(v) {	Descriptor
cs_u_min[v]	u(16)
cs_u_max[v]	u(16)
cs_v_min[v]	u(16)
cs_v_max[v]	u(16)
}	

cs_u_min[v] specifies in scene the minimum value of the first chroma of the view with index equal to v, calculated over entire frame and entire group of pictures.

cs_u_max[v] specifies in scene the maximum value of the first chroma of the view with index equal to v, calculated over entire frame and entire group of pictures.

cs_v_min[v] specifies in scene the minimum value of the second chroma of the view with index equal to v, calculated over entire frame and entire group of pictures.

cs_v_max[v] specifies in scene the maximum value of the second chroma of the view with index equal to v, calculated over entire frame and entire group of pictures.

4 Recommendation

We recommend adopting the proposed syntax and including the proposed modification in TMIV16.

5 Acknowledgement