

JVET-AH0096

EE1-1.4: Content-adaptive loop filter

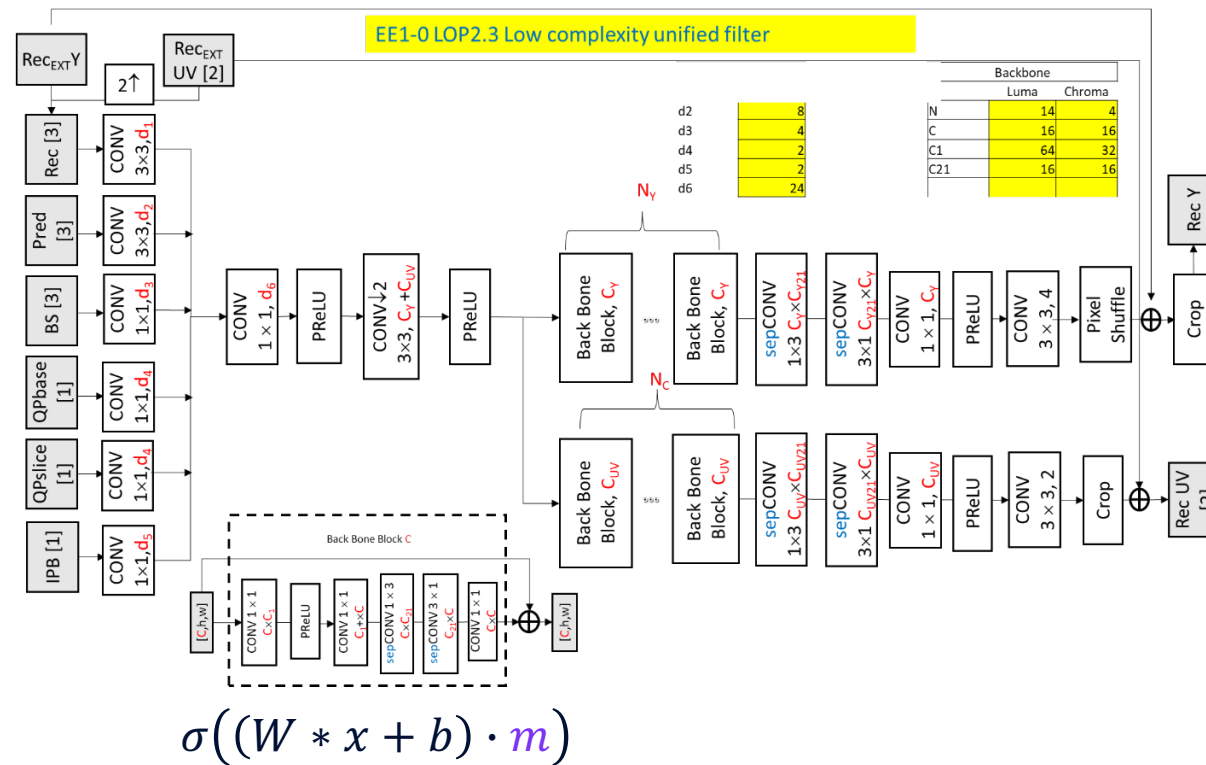
M. Santamaria, R. Yang, F. Cricri, M. M. Hannuksela, D. Bugdayci
Sansli, A. Hallapuro, H. R. Tavakoli, J. Lainema, H. Zhang

Highlights

- RA segment-wise content adaptation of LOP2 filter, via overfitting to input test content
- NN weight-update
 - Compressed with MPEG NNR/NNC
 - Carried within a Neural Network Filter Update (NNFU) Adaptive Parameter Set (APS)
 - One per RA segment
 - Signalled within first B-frame of the segment
- Results over NNVC-8.0 (LOP2 and NN-intra ON): -1.2% (Y); -2.2% (Cb); -2.6% (Cr)
- Results over VTM (NNVC-8.0 with NN tools OFF): -8.0% (Y); -15.0% (Cb); -14.4% (Cr)

Overfitting of LOP2 filter

- Content-adaptation is achieved by means of NN overfitting on test content per each RA segment
- Only a subset of parameters (multipliers) are over-fitted, located on the backbone only



Weight-update signalling

NNFU APS

adaptation_parameter_set_rbsp() {	Descriptor
aps_params_type	u(3)
aps_adaptation_parameter_set_id	u(5)
aps_chroma_present_flag	u(1)
if(aps_params_type == ALF_APS)	
alf_data()	
else if(aps_params_type == LMCS_APS)	
lmcs_data()	
else if(aps_params_type == SCALING_APS)	
scaling_list_data()	
else if(aps_params_type == NN_UPDATE_APS)	
nn_filter_update_data()	
aps_extension_flag	u(1)
if(aps_extension_flag)	
while(more_rbsp_data())	
aps_extension_data_flag	u(1)
rbps_trailing_bits()	
}	

aps_params_type	Name of aps_params_type	Type of APS parameters
0	ALF_APS	ALF parameters
1	LMCS_APS	LMCS parameters
2	SCALING_APS	Scaling list parameters
3	NN_UPDATE_APS	Neural-network filter update

nn_filter_update_data() {	Descriptor
nnfu_bitstream_size_minus1	u(16)
for(i = 0; i <= nnfu_bitstream_size_minus1; i++)	
nnfu_payload_byte[i]	u(8)
}	

Results

At least one NNFU APS per RA segment

Random access Main10									
	BD-rate Over NNVc-8.0rc3								
	Y-PSNR	U-PSNR	V-PSNR	Y-MSIM	U-MSIM	V-MSIM	EncT	DecT CPU	PSNR Overlap
Class A1	-2,34 %	-1,13 %	-5,17 %	-3,72 %	-1,10 %	-3,90 %	199 %	104 %	100 %
Class A2	-0,68 %	-1,50 %	-1,21 %	0,18 %	-0,94 %	-1,63 %	202 %	98 %	100 %
Class B	-1,41 %	-4,52 %	-3,34 %	0,65 %	-3,92 %	-1,40 %	202 %	108 %	99 %
Class C	-0,40 %	-0,56 %	-0,89 %	0,25 %	-0,71 %	-0,45 %	201 %	101 %	100 %
Class E									
Overall	-1,18 %	-2,18 %	-2,62 %	-0,43 %	-1,90 %	-1,70 %	201 %	103 %	100 %
Class D	-0,02 %	-0,17 %	-0,11 %	-0,01 %	-0,11 %	0,06 %	199 %	100 %	100 %
Class F	-0,35 %	-0,61 %	-0,86 %	0,04 %	-0,78 %	-1,29 %	202 %	130 %	100 %
Class H									

Random access Main10									
	BD-rate Over VTM								
	Y-PSNR	U-PSNR	V-PSNR	Y-MSIM	U-MSIM	V-MSIM	EncT	DecT CPU	PSNR Overlap
Class A1	-10,05 %	-11,16 %	-15,14 %	-11,90 %	-12,06 %	-14,15 %	259 %	6710 %	96 %
Class A2	-7,45 %	-14,09 %	-10,86 %	-6,84 %	-12,72 %	-8,84 %	253 %	5848 %	97 %
Class B	-7,89 %	-17,64 %	-15,53 %	-6,21 %	-16,28 %	-13,33 %	269 %	6567 %	97 %
Class C	-6,96 %	-15,32 %	-15,18 %	-6,88 %	-13,80 %	-13,33 %	263 %	6697 %	98 %
Class E									
Overall	-7,99 %	-15,02 %	-14,42 %	-7,65 %	-14,06 %	-12,60 %	262 %	6478 %	97 %
Class D	-7,18 %	-14,92 %	-15,05 %	-6,51 %	-13,13 %	-13,01 %	259 %	6035 %	98 %
Class F	-4,07 %	-10,02 %	-10,19 %	-4,46 %	-11,29 %	-11,10 %	287 %	3581 %	98 %
Class H									

Summary

- Content-adaptive on top of LOP2 loop-filter is proposed
- Results over NNVC-8.0 (LOP2 and NN-intra ON): -1.2% (Y); -2.2% (Cb); -2.6% (Cr)
- Results over VTM (NNVC-8.0 with NN tools OFF): -8.0% (Y); -15.0% (Cb); -14.4% (Cr)
- Thanks to Ericsson and Qualcomm for crosschecking efforts
- Recommendation: adopt into the next version of NNVC software

NOKIA