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# SWITCHED HALF-PEL INTERPOLATION FILTER

## JVET-N0309

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# BASIC IDEA

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- Allow switching of the luma half-pel interpolation filter at CU level
- Either 1 or 2 additional alternative half-pel filters are supported
- Limit the signalling overhead by:
  - Introduction of a new half-pel AMVR mode
  - Allow alternative filters only in case of half-pel MV resolution

# 1. Adaptive Motion Vector Resolution (AMVR) with HPEL

- Straightforward AMVR mode extension to HPEL:

amvr mode	bin string	ctx	
		0	1
0 (QPEL)	0	0,1,2*	
1 (FPEL)	10	0,1,2*	3
2 (4PEL)	11	0,1,2*	3

VTM-4.0

amvr mode	bin string	ctx		
		0	1	2
0 (QPEL)	0	0,1,2*		
1 (HPEL)	10	0,1,2*	3	
2 (FPEL)	110	0,1,2*	3	4
3 (4PEL)	111	0,1,2*	3	4

NEW

# 1. Adaptive Motion Vector Resolution (AMVR) with HPEL

## ■ VTM-4.0 Random Access

	Y	U	V	EncT	DecT
Class A1	-0.03%	-0.06%	0.08%	105%	100%
Class A2	-0.16%	-0.22%	-0.09%	105%	99%
Class B	-0.02%	-0.04%	-0.04%	106%	98%
Class C	-0.08%	-0.05%	-0.16%	106%	102%
Class E					
<b>Overall</b>	-0.07%	-0.08%	-0.06%	106%	100%
Class D	-0.14%	-0.04%	-0.16%	106%	101%
Class F	-0.03%	-0.04%	-0.09%	104%	101%

# 1. Adaptive Motion Vector Resolution (AMVR) with HPEL

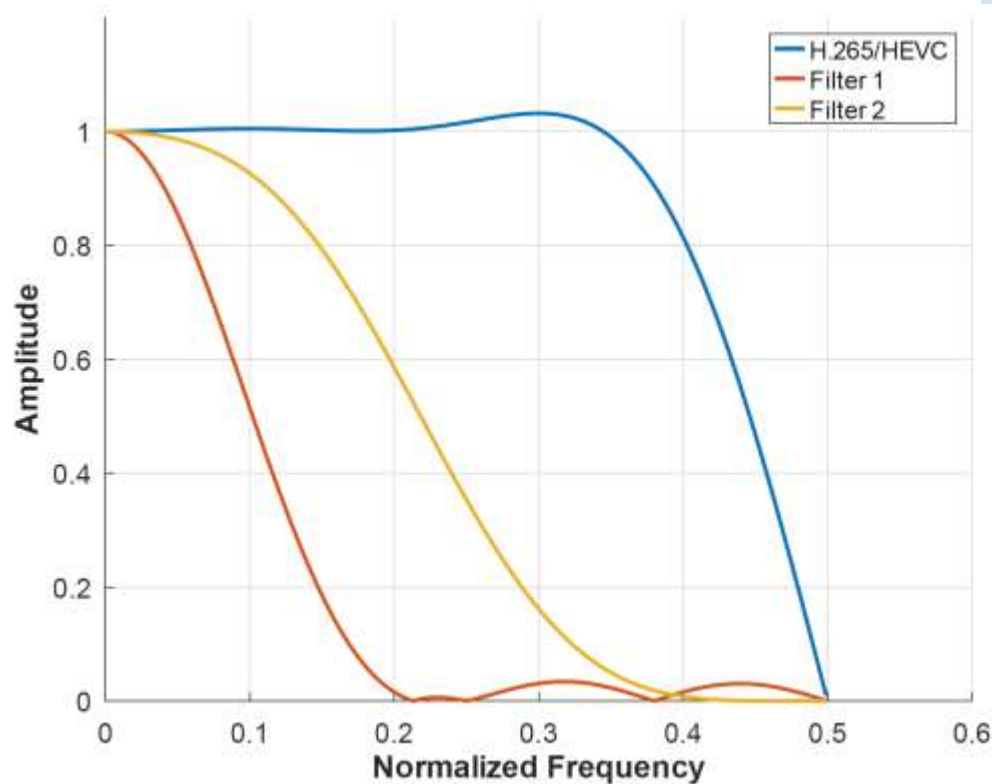
## ■ VTM-4.0 Low delay B

	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!
Class C	-0.10%	0.12%	-0.14%	109%	94%
Class E	-0.04%	0.43%	0.18%	109%	99%
<b>Overall</b>	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!
Class D	-0.08%	-0.18%	-0.42%	111%	101%
Class F	-0.18%	-0.45%	0.08%	108%	97%

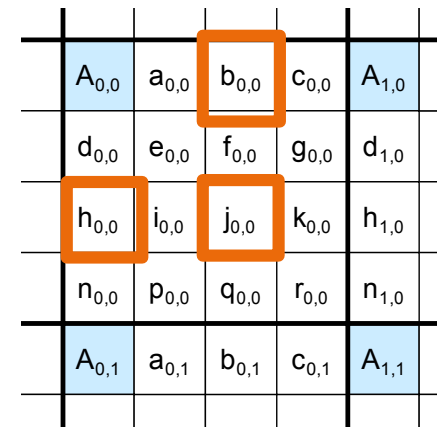
## 2. Switchable Luma Interpolation Filters for HPEL MVs

### 8-Tap Filter Set

- Two alternative filters can be applied to HPEL positions:



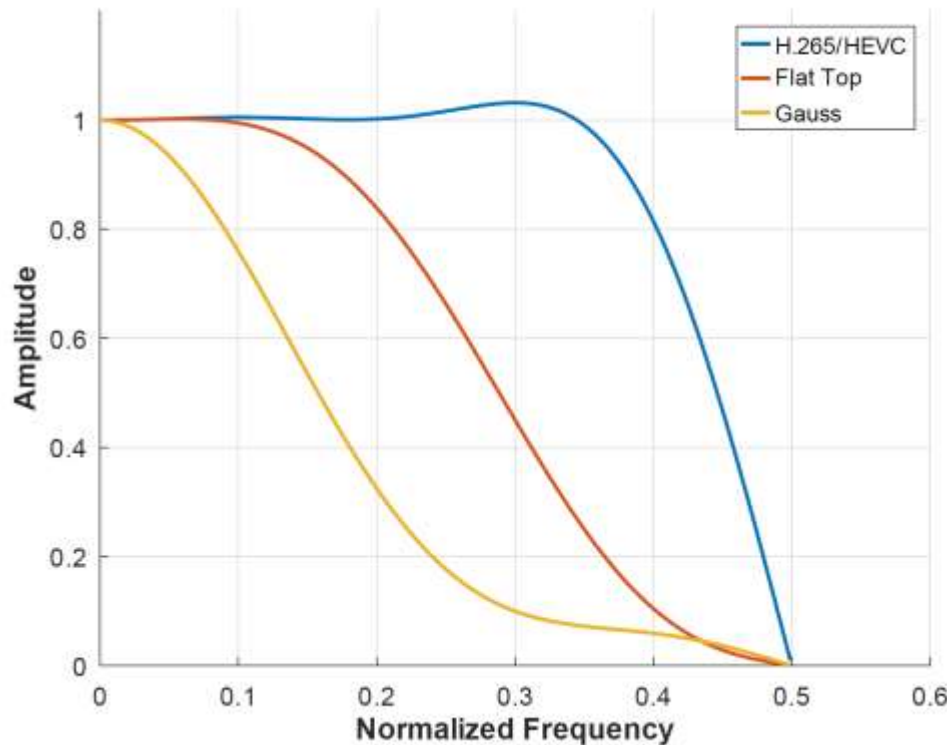
Filter	Coefficients $h[i]$
HEVC	$[-1 \quad 4 \quad -11 \quad 40 \quad 40 \quad -11 \quad 4 \quad -1]$
Filter 1	$[3 \quad 6 \quad 10 \quad 13 \quad 13 \quad 10 \quad 6 \quad 3]$
Filter 2	$[-1 \quad -1 \quad 9 \quad 25 \quad 25 \quad 9 \quad -1 \quad -1]$



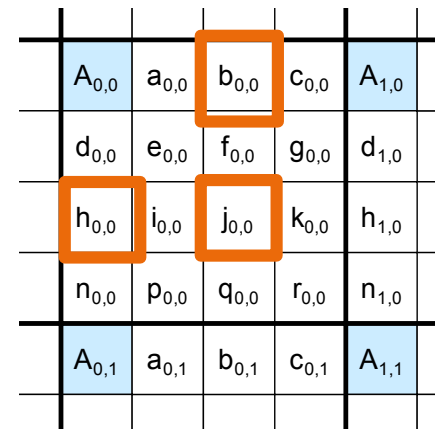
## 2. Switchable Luma Interpolation Filters for HPEL MVs

### 6-Tap Filter Set

- Two alternative filters can be applied to HPEL positions:



Filter	Coefficients $h[i]$
HEVC	$[-1 \quad 4 \quad -11 \quad 40 \quad 40 \quad -11 \quad 4 \quad -1]$
Flat Top	$[-3 \quad 4 \quad 31 \quad 31 \quad 4 \quad -3]$
Gauss	$[3 \quad 9 \quad 20 \quad 20 \quad 9 \quad 3]$



## 2. Switchable Interpolation Filters for HPEL MVs

### ■ Explicit signaling:

- When amvr\_mode = HPEL, HPEL IF signaled with **if\_idx**
- Disabled for affine MVDs

if_idx <b>1 alternative</b>	bin string	ctx	
		0	1
0 (Filter 1)	0	0	
1 (HEVC)	1	0	

### ■ Implicit Signalling: Merge copies if\_idx from neighboring CUs for spatial candidates, including:

- Triangular
- Combined intra/inter
- MMVD

if_idx <b>2 alternatives</b>	bin string	ctx	
		0	1
0 (Filter 1)	0	0	1
1 (Filter 2)	10	0	1
2 (HEVC)	11	0	1



## 2. Switchable Interpolation Filters for HPEL MVs

### ■ Test 1: 1 alternative 6-tap half-pel filter

	Random Access					Low Delay B				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	-0.23%	-0.47%	-0.39%	109%	99%					
Class A2	-0.36%	-1.15%	-0.79%	110%	99%					
Class B	-0.36%	-0.80%	-0.86%	110%	97%	n/a	n/a	n/a		
Class C	-0.24%	-0.30%	-0.57%	110%	101%	-0.20%	-0.20%	-0.27%	116%	98%
Class E						-0.17%	0.66%	-0.65%	115%	101%
<b>Overall</b>	<b>-0.30%</b>	<b>-0.67%</b>	<b>-0.67%</b>	<b>110%</b>	<b>99%</b>	n/a	n/a	n/a		
Class D	-0.20%	-0.38%	-0.51%	110%	99%	-0.17%	0.00%	-0.73%	118%	101%
Class F	-0.09%	-0.07%	-0.18%	106%	99%	-0.25%	-0.22%	0.96%	112%	97%

## 2. Switchable Interpolation Filters for HPEL MVs

### ■ Test 2: 2 alternative 8-tap half-pel filter

	Random Access					Low Delay B				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	-0.32%	-0.46%	-0.28%	113%	97%					
Class A2	-0.39%	-1.23%	-0.81%	115%	99%					
Class B	-0.46%	-0.84%	-1.00%	114%	97%	n/a	n/a	n/a		
Class C	-0.26%	-0.43%	-0.68%	115%	100%	-0.22%	0.06%	-0.27%	123%	98%
Class E						-0.28%	0.15%	-0.25%	117%	99%
<b>Overall</b>	<b>-0.36%</b>	<b>-0.73%</b>	<b>-0.73%</b>	<b>114%</b>	<b>98%</b>	n/a	n/a	n/a		
Class D	-0.23%	-0.44%	-0.43%	115%	99%	-0.15%	0.10%	-1.25%	124%	101%
Class F	-0.10%	-0.09%	-0.13%	109%	100%	-0.17%	0.10%	-0.07%	116%	96%

## 2. Switchable Interpolation Filters for HPEL MVs

### ■ Test 3: 2 alternative 6-tap half-pel filter

	Random Access					Low Delay B				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	-0.30%	-0.68%	-0.40%	113%	98%					
Class A2	-0.42%	-1.26%	-0.86%	115%	98%					
Class B	-0.45%	-0.86%	-0.93%	114%	96%	n/a	n/a	n/a		
Class C	-0.26%	-0.42%	-0.62%	114%	100%	-0.21%	-0.10%	-0.02%	121%	99%
Class E						-0.14%	0.14%	-0.59%	117%	101%
<b>Overall</b>	<b>-0.36%</b>	<b>-0.79%</b>	<b>-0.73%</b>	<b>114%</b>	<b>98%</b>	n/a	n/a	n/a		
Class D	-0.26%	-0.47%	-0.47%	114%	98%	-0.13%	0.18%	-0.54%	123%	101%
Class F	-0.12%	-0.13%	-0.19%	108%	101%	-0.23%	-0.19%	-0.12%	116%	97%