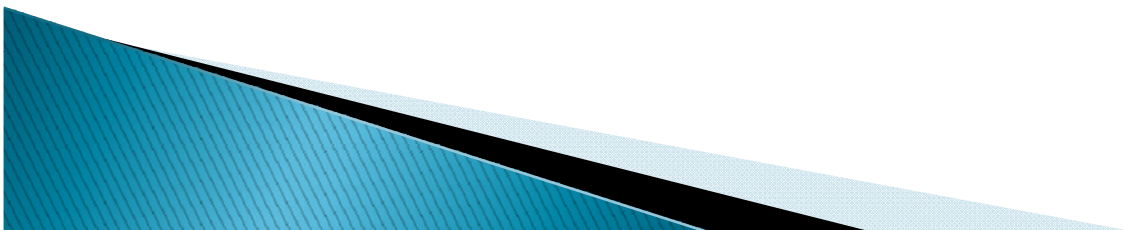


# Enhanced Switching of Interpolation Filter for HEVC

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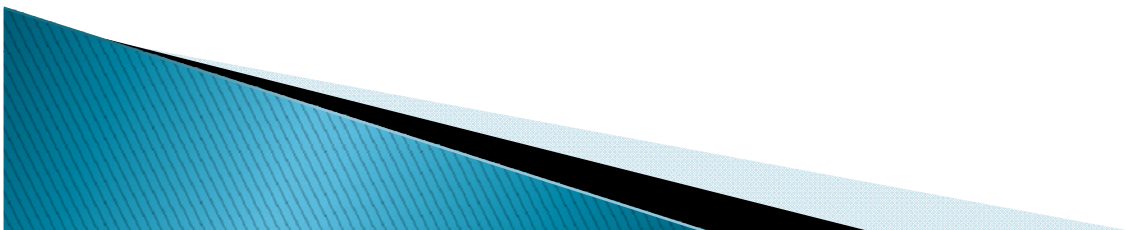
# Introduction

- ▶ About this contribution
  - Propose a new syntax for Switch Interpolation Filter (SIF) technology
- ▶ Background
  - AIF requires huge computational cost
  - Switch Interpolation Filter (SIF) approach
  - A lot of candidates contributes to high coding efficiency
- ▶ Related Work
  - Single-pass SIFO (JCTVC-A121)
- ▶ Proposal
  - Enhanced syntax for SIF
  - Flexibility of pre-defining filter coefficients



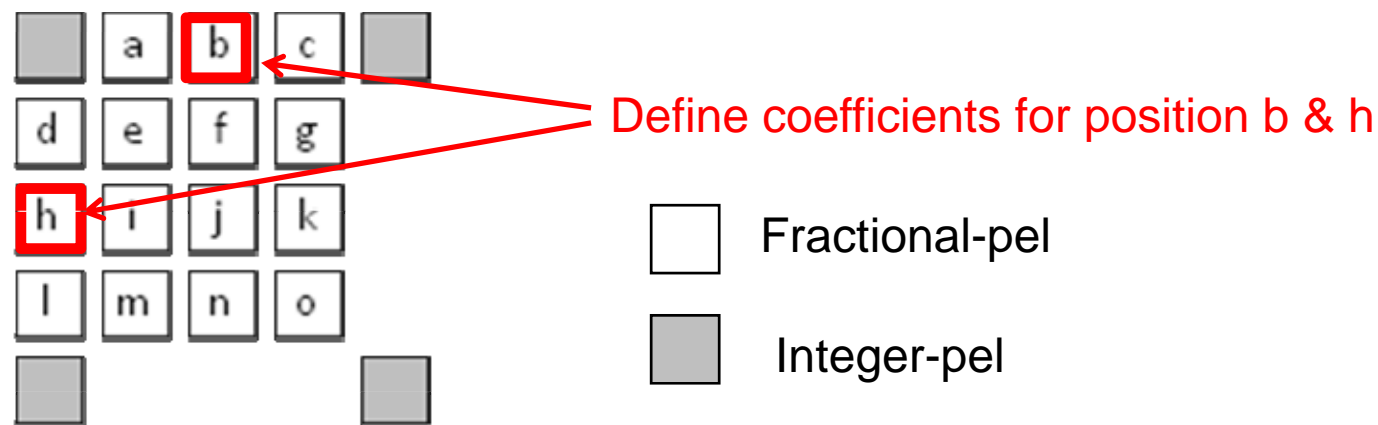
# Overview of Enhanced SIF syntax

- ▶ **Concept**
  - Flexible syntax for SIF
- ▶ **Assumption**
  - 6-tap symmetric interpolation filter
- ▶ **Feature**
  - Pre-define a lot of filter coefficient candidates
  - Update filter coefficients
  - Update the number of filter coefficient candidates
- ▶ **Variety of coefficient set**
  - Define the coefficients for 1/2-pel position
  - Select coefficient set independently for horizontal/vertical (separable filter)



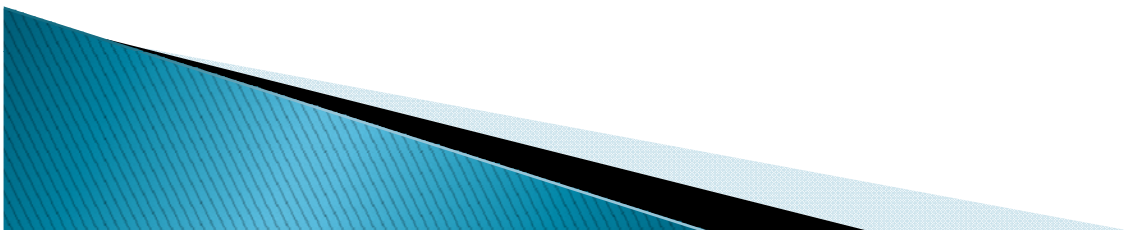
# Proposal (1) : Filter coefficients

- ▶ Pre-define filter coefficients
  - Pre-define **filter coefficients**
  - Encode coefficients for  $\frac{1}{2}$ -pel position (pos\_b & pos\_h)
  - Generate the other ( $\frac{1}{4}$ -pel) coefficients based on linear interpolation
- ▶ Choose best pre-defined filter slice by slice



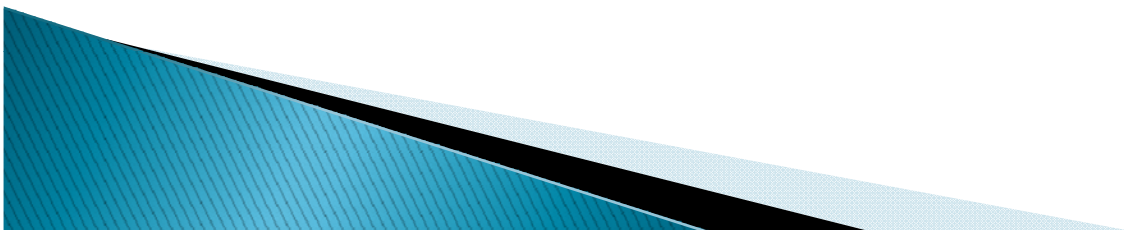
# Proposal (2) : Syntax

- ▶ Picture Parameter Set
  - **Flag** : Identify ESIF ON/OFF
  - **The number of pre-defined filter coefficient sets**
  - **Filter coefficients**
- ▶ Slice header
  - **Flag** : Identify whether ESIF is available for the current slice or not
  - **Idx\_hor / Idx\_ver** : Indicate the selected coefficient set for pos\_b / pos\_h, if ESIF available in the current slice



# Coding Conditions

- ▶ Coding condition : N11113
  - Constraints Set 2 (IpPp)
- ▶ Software : Implemented on JM17.0
- ▶ Search Method : EPZS
- ▶ Evaluation : VCEG-AI11 (BD-bitrate, BD-PSNR)



# Filter Coefficients

- ▶ No.1 : [ 13 -40 155 155 -40 13]
- ▶ No.2 : [ -5 -28 161 161 -28 -5]
- ▶ No.3 : [-30 30 128 128 30 -30]
- ▶ No.4 : [-22 38 112 112 38 -22]
- ▶ No.5 : [ 7 24 97 97 24 7]
- ▶ No.6 : [-26 73 81 81 73 -26]
- ▶ No.7 : [ 5 -20 143 143 -20 5]
- ▶ No.8 : [ 8 -40 160 160 -40 8] (same as H.264)

Case 1 (4 sets) : No.5 - No.8

Case 2 (8 sets) : No.1 - No.8

# Experimental result (Case 1: 4 sets)

Class	Sequence	BD-bitrate[%]	BD-PSNR[dB]
B1 (1080p)	Kimono	-3.51	0.15
	ParkScene	-1.79	0.07
B2 (1080p)	Cactus	-0.60	0.02
	BasketBallDrive	-2.84	0.10
	BQTerrace	-4.98	0.13
C (WVGA)	BasketBallDrill	-1.20	0.05
	BQMall	-1.23	0.06
	PartyScene	-0.34	0.01
	RaceHorses	-1.18	0.05
D (WQVGA)	BasketBallPass	-3.18	0.15
	BQSquare	-0.87	0.03
	BlowingBubbles	-0.79	0.03
	RaceHorses	-0.70	0.03
E (720p)	Vidyo1	-2.77	0.13
	Vidyo3	-2.53	0.12
	Vidyo4	-4.40	0.18
<b>Average</b>		<b>-2.06</b>	<b>0.08</b>



# Experimental result (Case 2: 8 sets)

Class	Sequence	BD-bitrate[%]	BD-PSNR[dB]
B1 (1080p)	Kimono	-3.86	0.17
	ParkScene	-2.45	0.09
B2 (1080p)	Cactus	-0.68	0.02
	BasketBallDrive	-3.00	0.11
	BQTerrace	-4.72	0.12
C (WVGA)	BasketBallDrill	-1.36	0.05
	BQMall	-1.56	0.07
	PartyScene	-0.43	0.02
	RaceHorses	-1.50	0.06
D (WQVGA)	BasketBallPass	-3.45	0.16
	BQSquare	-0.43	0.02
	BlowingBubbles	-1.10	0.04
	RaceHorses	-0.98	0.05
E (720p)	Vidyo1	-3.24	0.14
	Vidyo3	-4.14	0.20
	Vidyo4	-3.74	0.15
<b>Average</b>		<b>-2.29</b>	<b>0.09</b>

# Complexity

Case 1 (4 sets)

Class	Enc	Dec
B1		
B2		
C		
D		
E		

Case 2 (8 sets)

Class	Enc	Dec
B1		
B2		
C		
D		
E		

# Low-complexity approach

[1] “Low-complexity Scheme for Adaptive Interpolation Filter Based on Amplitude Characteristic Analysis”, ICIP2010, Sep. 2010

## BD-PSNR (v.s. H.264) [dB]

Sequence	EAI	[1]
A	0.45	0.33
B	0.35	0.29
C	0.36	0.25
D	0.42	0.27

## Computing time

Sequence	EAI	[1]
AIF processing time [msec]	2490.6	802.2
Reduction ratio [%]	--	67.8

# Conclusion

- ▶ Proposed **ESIF** (Enhanced Switch Interpolation Filter)
- ▶ Support a new syntax for flexible SIF design
  - Adaptively updating **filter coefficients** and **the number of filter sets**
  - Encode filter coefficients for **½-pel position (b & h)**
- ▶ BD-bitrate against H.264 reached **2.3%**
- ▶ Flexibility of pre-defined filter coefficients is important to optimize the coding performance
- ▶ Suggestion : Flexible syntax for defining filter coefficients

# Thank you

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