

JVET-L0408

CE4-related: Improvement on ultimate motion  
vector expression

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# Introduction

- Improvement on ultimate motion vector expression
  - Diagonal direction candidate
  - Adaptive distance table
  - Full-pel motion vector for large distance
- 0.49% gain for Class A1 relative to CE4.5.4.b
- 0.11% gain for RA relative to CE4.5.4.b
- 1.40% gain for RA relative to VTM-2.0.1

# Background

- UMVE is a new expression of motion vector

Base candidate IDX	0	1	2	3
N <sup>th</sup> MVP	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>

Direction IDX	00	01	10	11
x-axis	+	–	N/A	N/A
y-axis	N/A	N/A	+	–

Distance IDX	0	1	2	3	4	5	6	7
Pixel distance	1/4-pel	1/2-pel	1-pel	2-pel	4-pel	8-pel	16-pel	32-pel

## Example

Assuming MV precision is 1/16-pel

Base candidate IDX: 0

Direction IDX : 1

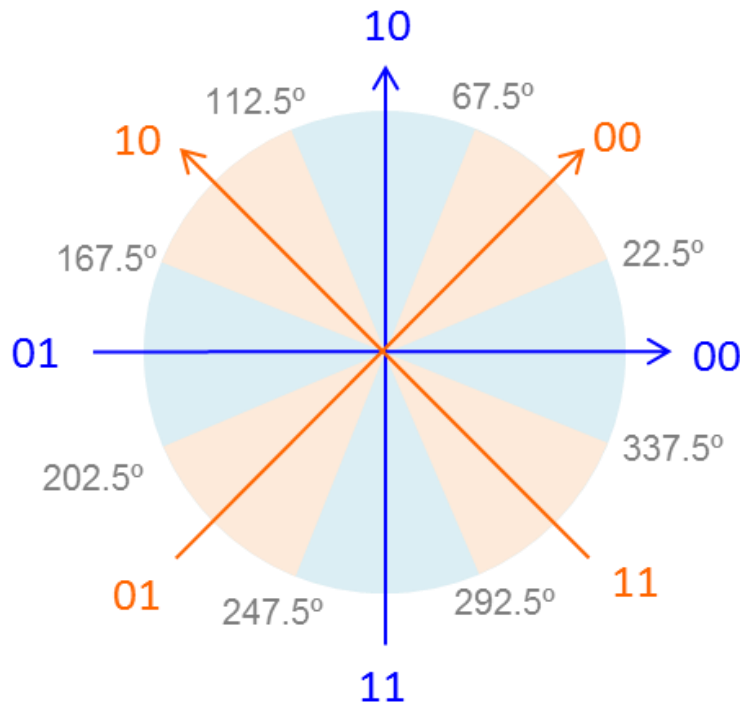
Distance IDX : 2

$MV = 1^{\text{st}} \text{ MVP} + (-16, 0)$

# Diagonal direction candidate

- Selecting direction table according to MVP direction

	hor./ver. direction				diagonal direction			
Direction IDX	00	01	10	11	00	01	10	11
x-axis	+	-	N/A	N/A	+	-	-	+
y-axis	N/A	N/A	+	-	+	-	+	-



## Example 1

MVP = (-1, -1) → diagonal direction

## Example 2

MVP = (-2, 0) → hor./ver. direction

# Adaptive distance table

- Selecting distance table according to picture resolution

For picture resolution  $\leq 2K$

Distance IDX	0	1	2	3	4	5	6	7
Pixel distance	1/4-pel	1/2-pel	1-pel	2-pel	4-pel	8-pel	16-pel	32-pel

For picture resolution  $> 2K$

Distance IDX	0	1	2	3	4	5	6	7
Pixel distance	1-pel	2-pel	4-pel	8-pel	16-pel	32-pel	64-pel	128-pel

# Adaptive distance table

- Reordering distance according to occurrence in previous coded picture

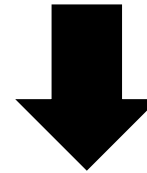
## Example

Occurrence in previous coded pic. (from high to low)
2-pel
4-pel
1-pel
8-pel
$\frac{1}{2}$ -pel
$\frac{1}{4}$ -pel
16-pel
32-pel

Distance table of previous coded picture

Distance IDX	0	1	2	3	4	5	6	7
Pixel distance	1/4-pel	1/2-pel	1-pel	2-pel	4-pel	8-pel	16-pel	32-pel

reordering according  
to occurrence



Distance table of current picture

Distance IDX	0	1	2	3	4	5	6	7
Pixel distance	2-pel	4-pel	1-pel	8-pel	1/2-pel	1/4-pel	16-pel	32-pel

# Full-pel motion vector for large distance value

- Rounding motion vector if selected distance  $\geq 4$ -pel

## Example

Assuming MV precision is 1/16-pel

Base MVP: (13, 0)

Direction : ( + , N/A)

Distance : 64

$$\begin{aligned} \text{MV} &= \text{rounding}((13, 0) + (64, 0)) \\ &= (64, 0) \end{aligned}$$

# Simulation results

- Anchor: CE4.5.4.b
- Test : Proposal
- 0.49% gain for Class A1
- 0.11% gain for RA

	Random Access Main 10				
	Over CE4.5.4 Test B				
	Y	U	V	EncT	DecT
Class A1	-0.49%	-0.64%	-0.85%	101%	101%
Class A2	0.22%	-0.26%	-0.21%	102%	102%
Class B	-0.08%	-0.08%	-0.09%	105%	101%
Class C	-0.11%	-0.19%	-0.13%	107%	101%
Class E					
<b>Overall</b>	-0.11%	-0.26%	-0.28%	104%	101%
Class D	0.00%	-0.16%	0.02%	108%	101%

	Low delay B Main 10				
	Over CE4.5.4 Test B				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	-0.10%	0.08%	-0.08%	105%	101%
Class C	-0.12%	-0.31%	-0.36%	107%	100%
Class E	-0.01%	-0.08%	0.10%	107%	100%
<b>Overall</b>	-0.08%	-0.09%	-0.13%	106%	100%
Class D	-0.01%	-0.25%	-0.17%	109%	100%



# Simulation results

- Anchor: VTM-2.0.1
- Test : CE4.5.4.b + Proposal
- 1.40% gain for RA, 0.46% gain for LB

	Random Access Main 10				
	Over CE4.5.4 Test B				
	Y	U	V	EncT	DecT
Class A1	-1.59%	-1.44%	-1.96%	111%	98%
Class A2	-1.55%	-2.12%	-2.27%	112%	97%
Class B	-1.54%	-1.40%	-1.46%	113%	96%
Class C	-0.97%	-0.92%	-1.01%	115%	96%
Class E					
<b>Overall</b>	-1.40%	-1.42%	-1.60%	113%	97%
Class D	-1.19%	-1.34%	-1.43%	116%	91%

	Low delay B Main 10				
	Over CE4.5.4 Test B				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	-0.53%	-0.59%	-0.68%	114%	97%
Class C	-0.52%	-0.66%	-0.63%	113%	96%
Class E	-0.27%	-0.04%	0.25%	110%	94%
<b>Overall</b>	-0.46%	-0.47%	-0.43%	113%	96%
Class D	-0.59%	-0.86%	-1.12%	114%	92%

# Simulation results

- Anchor: CE4.5.4.c
- Test : Proposal
- 0.54% gain for Class A1
- 0.13% gain for RA

	Random Access Main 10				
	Over CE4.5.4 Test C				
	Y	U	V	EncT	DecT
Class A1	-0.54%	-0.73%	-1.04%	105%	101%
Class A2	0.17%	-0.36%	-0.19%	106%	102%
Class B	-0.08%	-0.17%	-0.15%	111%	100%
Class C	-0.12%	-0.23%	-0.42%	115%	101%
Class E					
<b>Overall</b>	-0.13%	-0.34%	-0.41%	110%	101%
Class D	-0.01%	-0.01%	-0.23%	117%	101%

	Low delay B Main 10				
	Over CE4.5.4 Test C				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	-0.15%	-0.34%	-0.51%	111%	101%
Class C	-0.23%	-0.18%	-0.25%	115%	101%
Class E	-0.14%	0.04%	-0.23%	113%	101%
<b>Overall</b>	-0.17%	-0.19%	-0.35%	113%	101%
Class D	-0.08%	-0.89%	-0.05%	117%	101%

# Conclusions

- We propose
  - diagonal direction candidate
  - adaptive distance table
  - full-pel motion vector for large distance
- 0.49% gain for class A1 relative to CE4.5.4.b
  - ➡ It is recommended to further study in CE
- Thank Sharp for the cross-checking

Thank you!