

JCTVC-C079

TE6.a: Bidirectional Intra Prediction

Taichiro Shiodera
Akiyuki Tanizawa
Takeshi Chujoh
Tomoo Yamakage

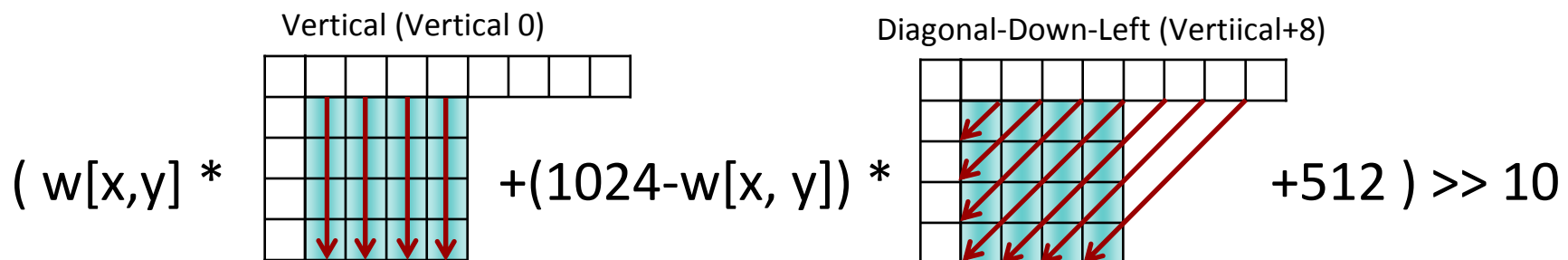
Toshiba Corporation

Summary

- **TE6 : Intra prediction improvement**
 - BIP (Bidirectional Intra prediction)
- **BIP into TMuC S/W**
- **Experimental results compared with TE12 common anchor**
 - **Bitrate Reduction**
 - I-only : 2.1% (HE), 2.3% (LC)
 - Random access : 1.1% (HE), 1.3% (LC)
 - **Encoding and decoding time**
 - Not increased

Bidirectional Intra Prediction (BIP)

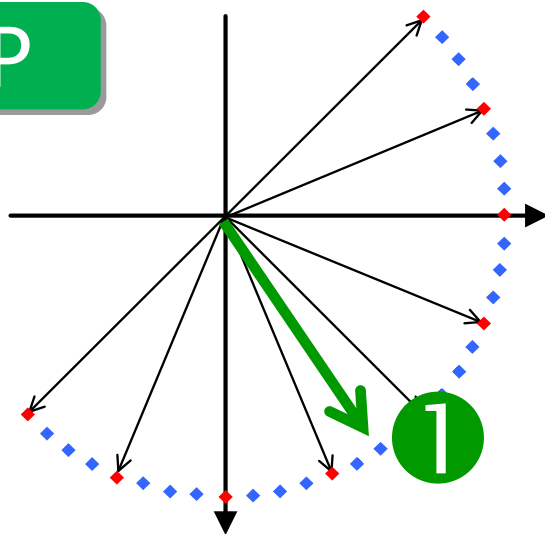
- **Coding efficiency improvement tool for intra coding**
 - Originally proposed at Marrakech VCEG meeting (VCEG-AE14)
 - Detailed specification is shown at Geneva VCEG meeting (C181)
 - KTA software is provided at ShenZhen VCEG meeting (VCEG-AG08)
 - Experimental results based on Intra AHG in HEVC are reported (JCTVC-B042)
- **BIP has two technical schemes.**
 - Adaptive Sub-block Coding Order (ASCO) → not included in proposal.
 - **Weighted Bidirectional Prediction (WBP)**
 - **Weighted average of two kinds of uni-directional prediction**



BIP based on Unidirectional Intra Prediction (UIP)

- An intra prediction mode is selected from unidirectional modes (UIP modes) and bidirectional mode (BIP modes) for each PU.
- One BIP mode is based on two UIP modes.

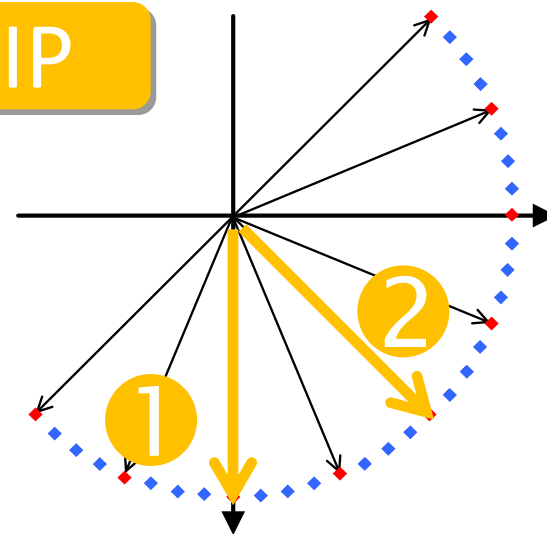
UIP



Select one prediction direction

plus...

BIP



Select two prediction direction
based on UIP mode

Number of intra prediction mode in proposal

- **BIP on top of UIP**

- Add BIP modes for PU_4x4, PU_8x8, PU_16x16, PU_32x32

Number of intra prediction mode for each PU size

PuSize	Number of UIP modes	Number of BIP modes	Total Number of pred. modes
PU_2x2	3	0	3
PU_4x4	17	8	25
PU_8x8	33	16	49
PU_16x16	33	16	49
PU_32x32	33	16	49
PU_64x64	5	0	5
PU_128x128	5	0	5

add BIP modes

Specification of proposed intra prediction mode

- **eg. PU8x8, 16x16, 32x32**
 - UIP modes : IntraPredMode = 0 ... 32
 - BIP modes : IntraPredMode = 33 ... 48

IntraPredMode	IntraBipredFlag	IntraPredTypeL0	IntraPredAngleIdL0	IntraPredTypeL1	IntraPredAngleIdL1
0	0	Intra_Vertical	0	-	-
1	0	Intra_Horizontal	0	-	-
2	0	Intra_DC	0	-	-
⋮					
32	0	Intra_Horizontal	+5	-	-
33	1	Intra_Horizontal	0	Intra_Vertical	0
34	1	Intra_DC	-	Intra_Vertical	0
⋮					
45	1	Intra_Vertical	+4	Intra_Vertical	0
46	1	Intra_Vertical	+4	Intra_Horizontal	0
47	1	Intra_Horizontal	+4	Intra_Vertical	0
48	1	Intra_Horizontal	+4	Intra_Horizontal	0

Modified intra prediction mode coding for each PU

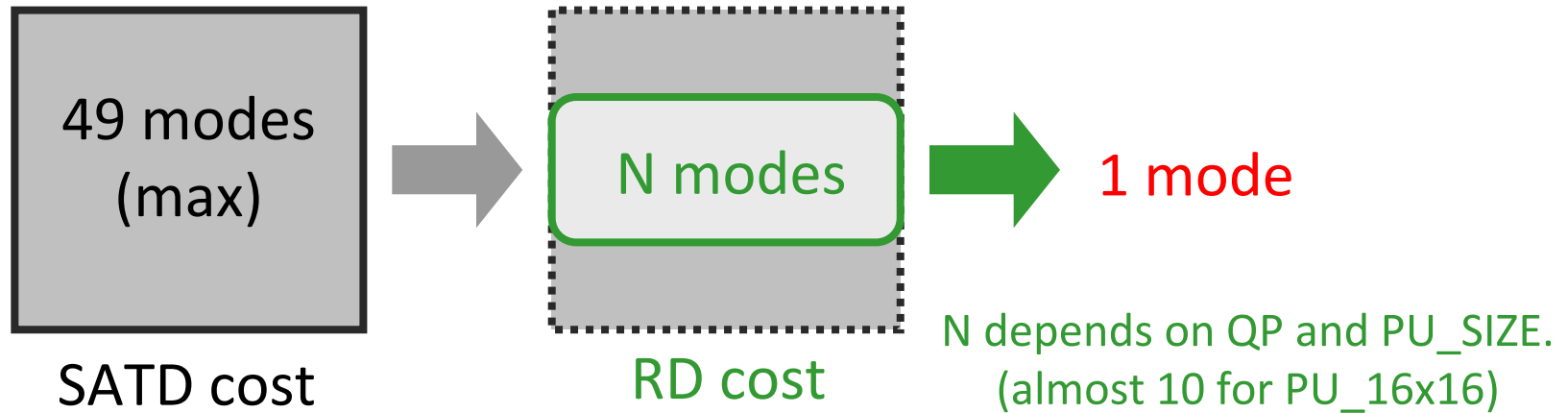
- **UIP modes are coded based on spatial prediction.**
 - Most probable mode (MPM) and Rest of UIP modes
- **BIP modes are coded using Fixed-length-bin.**

luma_pred_mode_code_type	Name of luma_pred_mode_code_type	Prefix bins	Suffix bins
0	UIP MPM	00	--
1	Rest of UIP Modes	01 10	S bins FLB S bins FLB
2	BIP Modes	11	T bins FLB

Note. S and T are set to “3” for PU_4x4, “4” for PU_8x8, 16x16, 32x32.

Encoding technique

- **fast prediction mode selection**
 - similar to mode decision method of UIP



- **Our implementation**

- CIP (Combined Intra Prediction) and PP (Planar Prediction) are turned on.
- AIS (Adaptive Intra Smoothing) is turned off.
 - Cause over-filtering when BIP is used.
 - AIS: 0, #define DEFAULT_IS 0
- EBP (Edge Base Prediction) is turned off.
 - The prediction direction of EBP is not pre-defined to calculate it as the decoding process. → difficult to apply the weighted average.
 - Use DC_MODE.

- **TE12 Anchor**

- All tools are turned on.

Experimental Conditions

- TMuC Software version 0.7.1 (default configuration, same as version 0.7)
- Platform : Windows XP 64 bits
- Compiler : VS 2008
- **Followed on TE12 common condition completely.** (B300 ,B312)
- Coding structure :
 - Intra-only (high efficiency, low complexity)
 - random access (high efficiency, low complexity)
- Verified by Sharp(C179) and Renesas(C187)

Experimental results for I-only case

	High efficiency			Low complexity		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	-2.7	-2.1	-2.1	-2.5	-1.8	-1.6
Class B	-2.1	-1.4	-1.4	-2.1	-1.3	-1.2
Class C	-1.9	-1.5	-1.4	-2.4	-1.5	-1.4
Class D	-2.0	-1.4	-1.4	-2.4	-1.4	-1.4
Class E	-2.2	-2.0	-1.9	-2.5	-2.2	-2.2
All	-2.1	-1.6	-1.6	-2.3	-1.6	-1.5
Enc Time[%]	94%			100%		
Dec Time[%]	101%			104%		

- The coding gain of BIP is **2.1%** (for HE), **2.3%** (for LC) on average .
- The encoding time and the decoding time is almost same as the anchor.

Experimental results for random access case

	High efficiency			Low complexity		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	-1.4	-0.9	-0.9	-1.5	-0.7	-0.5
Class B	-1.1	-1.0	-1.1	-1.1	-0.7	-0.6
Class C	-1.1	-1.0	-0.8	-1.2	-0.8	-0.8
Class D	-0.9	-0.5	-0.5	-1.0	-0.5	-0.5
Class E	N/A			N/A		
All	-1.1	-0.9	-0.8	-1.1	-0.7	-0.6
Enc Time[%]	99%			99%		
Dec Time[%]	99%			100%		

- The coding gain of BIP is promising.
- The encoding time and the decoding time is almost same as the anchor.

Conclusion

- **Experimental results of BIP for TE6**

- **Bitrate Reduction**

- I-only : 2.1% (HE), 2.3% (LC)
 - Random access : 1.1% (HE), 1.3% (LC)

- **Encoding and decoding time**

- Not increased

- **Suggestion**

- BIP is introduced in the HEVC test model as the tool of the coding efficiency improvement.

TOSHIBA

Leading Innovation >>>