

Consideration of reference pixel availability for mode-dependent DCT/DST decision

Youji Shibahara
Takahiro Nishi

Panasonic Corporation

Summary

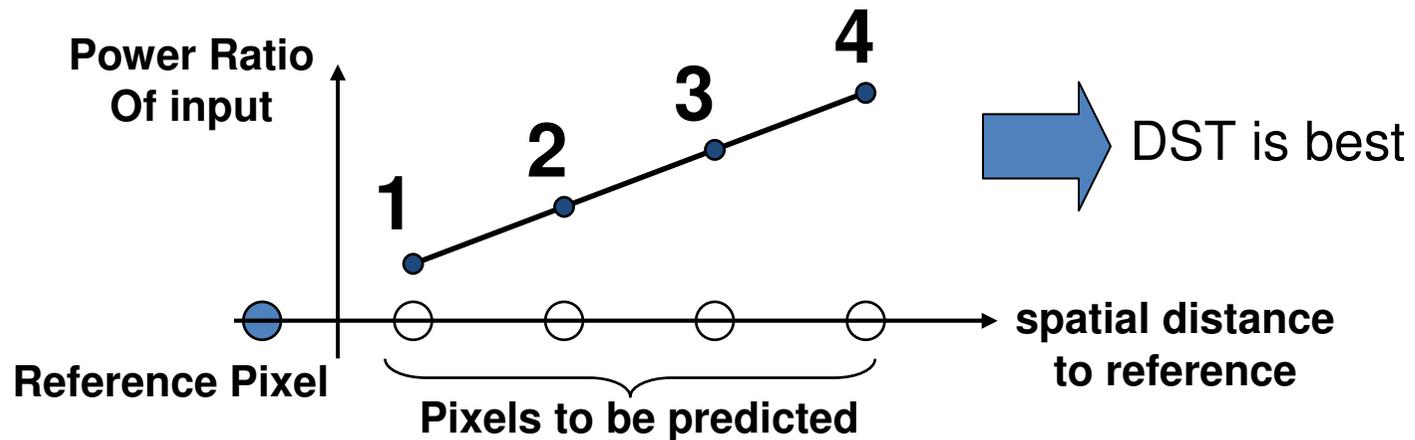
- ▶ HM3.0 has dst4x4 for intra prediction
- ▶ DCT and DST are decided depending on the intra prediction mode
- ▶ DST model assumes that the reference pixel locates nearest.

- ▶ However, in some cases, picture boundary, slice boundary and constrained intra prediction, the reference picture is made by copy or interpolation from pixel locates far, not nearest.
- ▶ In this case, recommend to use DCT, not DST.

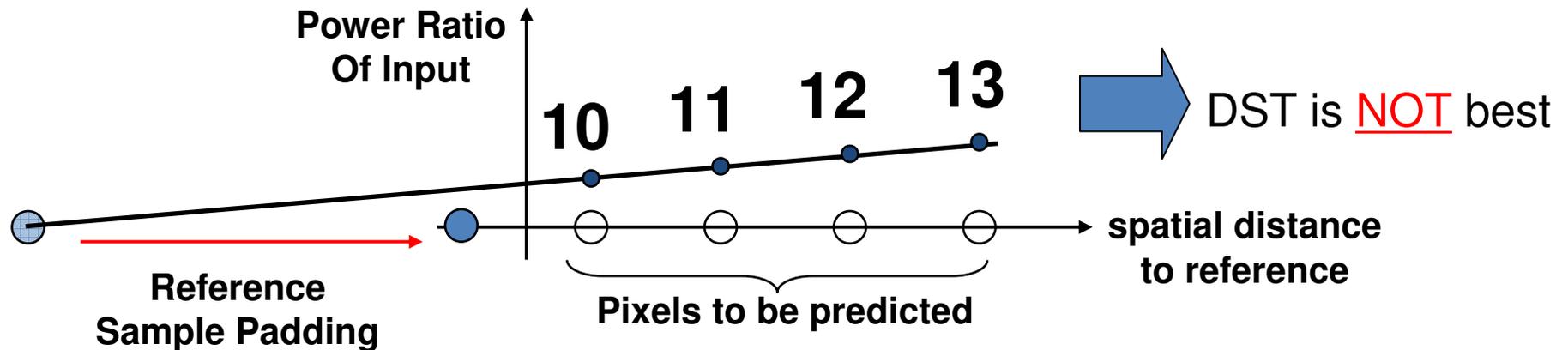
- ▶ The proposed change provides
 - 0.1% gain for slice coding in AI
 - 0.07% gain for coding with CIP in RA HE

Theoretical Analysis

- ▶ If the reference sample is not necessary to be applied.



- ▶ If the reference pixel is made by copy or interpolation from pixel locate far



Proposed Change

- ▶ If the Above pixel is made by reference sample padding
 - Vertical transform is decided to use DCT
- ▶ Otherwise
 - Vertical transform is decided depending on intra prediction mode (as same as HM3.0)

- ▶ If the Left pixel is made by reference sample padding
 - Horizontal transform is decided to use DCT
- ▶ Otherwise
 - Horizontal transform is decided depending on intra prediction mode (as same as HM3.0)

Experimental Results

- ▶ Experiment 1: on Common Condition.
- ▶ proposed change is effective at the picture boundary.

	Intra			Intra LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	0.00	-0.05	0.03	0.00	-0.03	0.00
Class B	-0.01	0.03	0.02	0.00	-0.01	-0.01
Class C	-0.02	0.00	0.02	-0.01	0.00	-0.03
Class D	-0.02	-0.03	-0.04	-0.02	-0.02	-0.01
Class E	0.02	0.04	0.01	-0.02	-0.03	-0.02
All	-0.01	0.00	0.01	-0.01	-0.02	-0.01
Enc Time[%]	101 %			101 %		
Dec Time[%]	100 %			100 %		

Thanks to NHK for performing the cross check in F485

Experimental Results

- ▶ Experiment 2: on Slice (1500byte /slice)
- ▶ proposed change is effective at the slice and picture boundary.

	Intra			Intra LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	-0.06	-0.04	-0.03	-0.04	-0.03	-0.02
Class B	-0.08	-0.07	-0.04	-0.08	-0.06	-0.04
Class C	-0.12	-0.15	-0.17	-0.13	-0.12	-0.12
Class D	-0.08	-0.14	-0.14	-0.08	-0.08	-0.08
Class E	-0.18	-0.07	-0.11	-0.19	-0.04	-0.04
All	-0.10	-0.09	-0.09	-0.10	-0.07	-0.06
Enc Time[%]	100 %			101 %		
Dec Time[%]	100 %			101 %		

Thanks to Samsung for performing the cross check in F656

Experimental Results

- ▶ Experiment 3: on Constrained Intra Prediction
(the pixel in Inter block is not used as reference pixel for Intra prediction)
- ▶ proposed change is effective at the intra block in inter frame.

	Intra			Intra LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	-0.10	-0.04	-0.09	-0.03	-0.06	-0.15
Class B	-0.04	0.01	-0.04	-0.03	-0.05	-0.04
Class C	-0.10	0.02	-0.17	-0.08	-0.20	-0.13
Class D	-0.04	-0.06	-0.06	-0.05	-0.33	-0.12
Class E						
All	-0.07	-0.02	-0.09	-0.05	-0.15	-0.11
Enc Time[%]	100 %			100 %		
Dec Time[%]	100 %			100 %		

Thanks to NHK for performing the cross check in F485

Conclusions

- ▶ For DST/DCT decision, this theoretical analysis suggested the room to improve at the boundary block.
- ▶ Proposed a consideration of reference pixel availability (reference pixel padding is applied or not) in the decision of mode dependent DST/DCT.
 - Less than 1% increase of runtime
 - Small but consistent gain with slice or CIP
- ▶ Recommend adoption of the proposal in HM.

	AI HE	AI LC	RA HE	RA LC
Common Condition	-0.01	-0.01	-0.02	0.00
Slice	-0.10	-0.10	-0.03	-0.05
CIP			-0.07	-0.05

Thank you

DST

$$\begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 \\ 1 & 2 & 3 & 3 \\ 1 & 2 & 3 & 4 \end{pmatrix}$$

Covariance Matrix

$$\begin{pmatrix} 29 & 55 & 74 & 84 \\ 74 & 74 & 0 & -74 \\ 84 & -29 & -74 & 55 \\ 55 & -84 & 74 & -29 \end{pmatrix}$$

Transform Matrix

→ The full theory can be found in B024(I2R) and C108(Samsung)