New intra prediction using the correlation between pixels and lines

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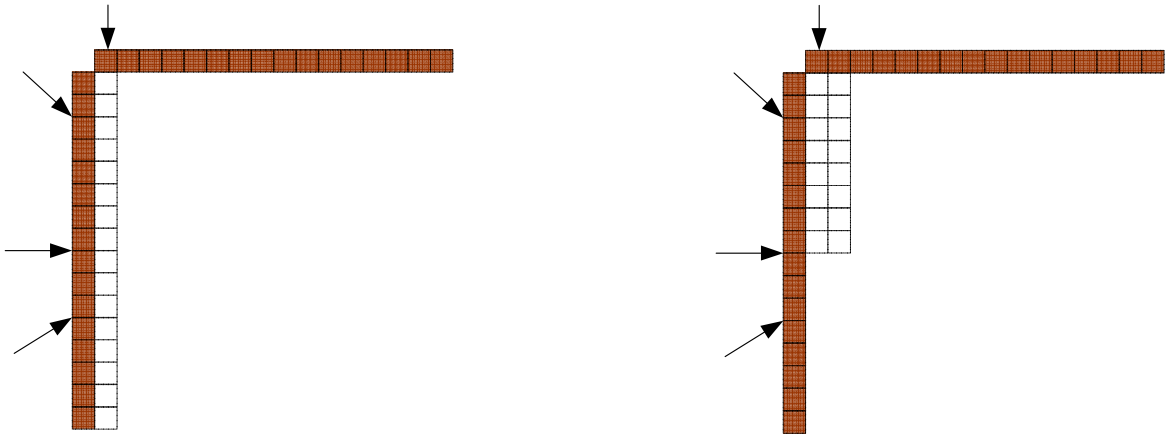
Summary

- 2 techniques for intra frame coding
  - Line-based intra prediction (LIP)
  - Resample-based intra prediction (RIP)
- Compression performance
  - About 4% BD-Bitrate reduction under all Intra picture coding

Motivation

- Block by block Intra prediction is used in H.264/AVC, where reference pixels are from neighboring blocks. A problem of this design is that prediction error increases as the increase of the distance between current pixel and its reference
- Line by line and pixel by pixel intra prediction by taking full use of the correlation between lines and pixels are proposed

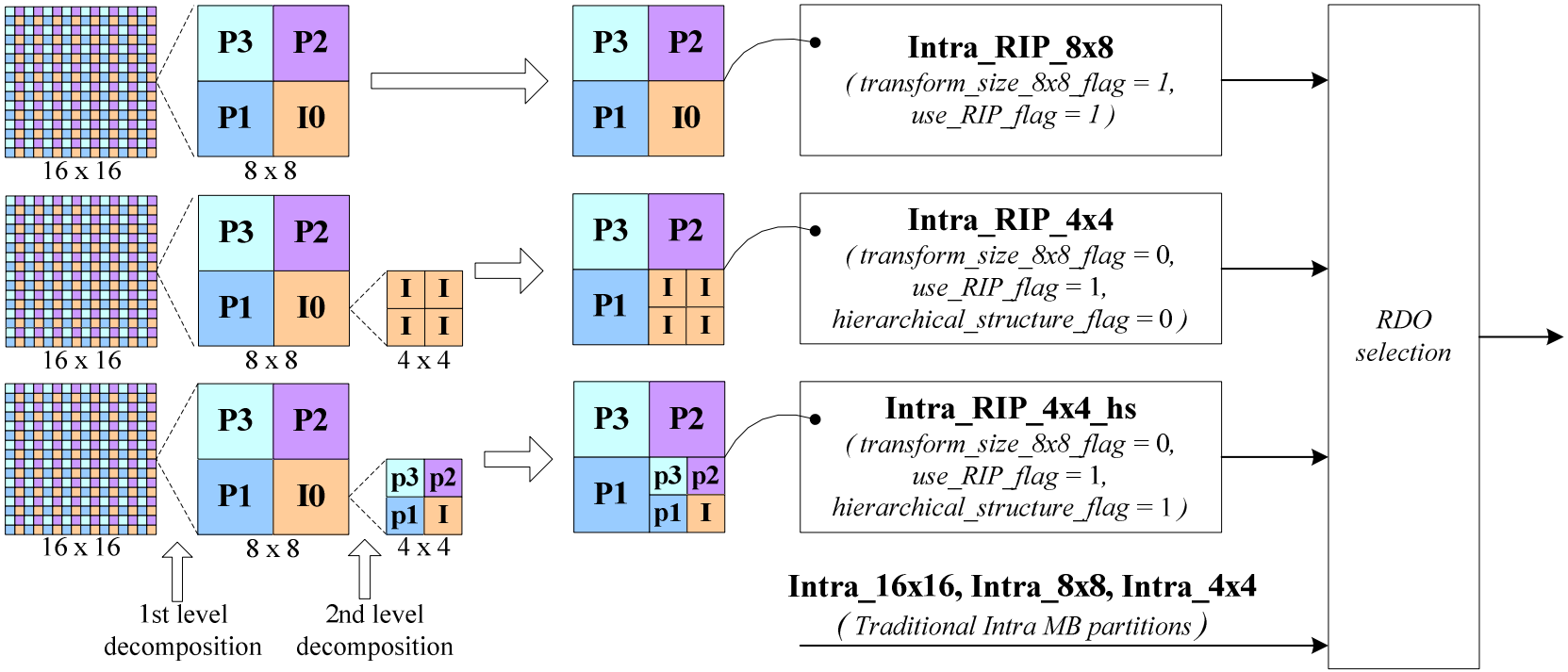
Line-based intra prediction (LIP)



Directional prediction of 1x16 and 2x8 partitions

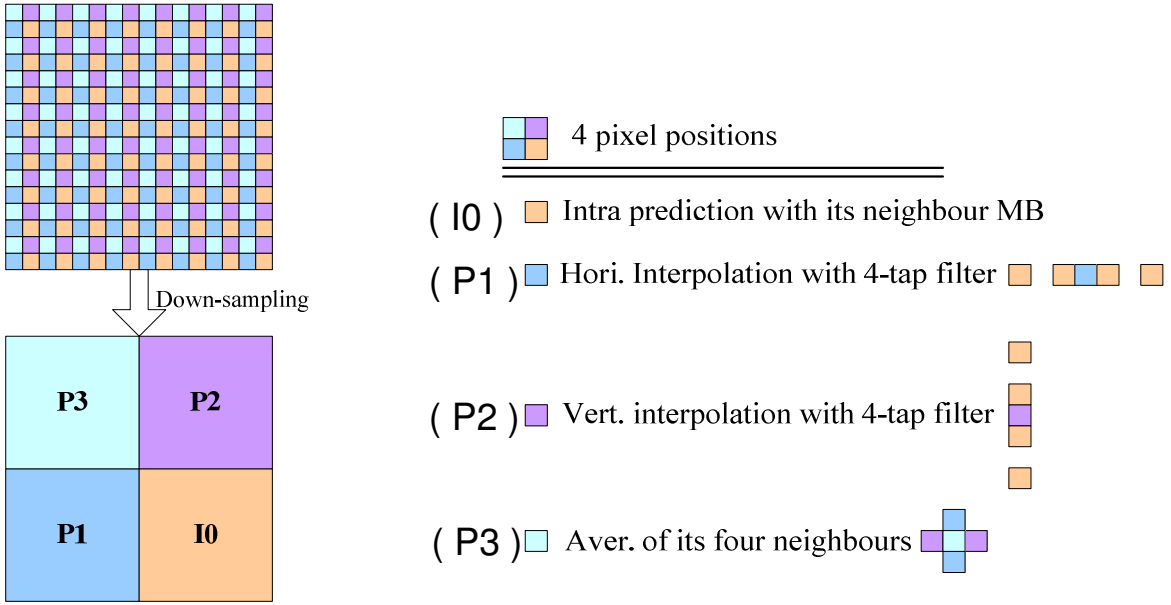
- 1x16, 16x1, 2x8 and 8x2 partitions are designed
- For each partition, nine directional prediction are used similar to intra prediction in H.264/AVC
- DCT of size 1x16, 16x1, 2x8 or 8x2 are applied

Resample-based intra prediction (RIP)



- Three new MB partitions based on resample are proposed
  - A MB is decomposed into 4 blocks by down-sampling in the first level decomposition
  - One of the down-sampled block is decomposed into 4 sub-blocks in the second level decomposition
- Signal method: two new flags combined with the existing transform_size_8x8_flag

Intra prediction and interpolation in RIP



1. **Block I0** is firstly encoded with conversional block-based intra prediction. 9 intra prediction modes
2. **Block P1&P2** are predicted pixel-by-pixel with the reference of the reconstructed block I0 by interpolation horizontally and vertically, respectively.
3. **Block P3** is predicted pixel-by-pixel with the reference of the reconstructed block P1&P2 by averaging four neighboring pixels.

Experiment conditions

- KTA2.6r1, H.264/AVC High Profile
- CfP common test condition except all intra pictures coding
- 5 QP points same as CfP anchor
- Full length of all CfP sequences are tested
- The proposed technique is applied to luminance component

Experimental results

sequence	low-bitrate range		high-bitrate range	
	BD-bitrate	BD-PSNR	BD-bitrate	BD-PSNR
RaceHorses_416x240_30	-2.07%	0.13	-1.90%	0.14
BasketballPass_416x240_50	-3.35%	0.18	-2.77%	0.17
BlowingBubbles_416x240_50	-2.00%	0.12	-1.82%	0.14
BQSquare_416x240_60	-1.98%	0.15	-1.60%	0.13
Average QWVGA	**-2.35%**	**0.15**	**-2.02%**	**0.15**
RaceHorses_832x480_30	-3.14%	0.14	-2.84%	0.15
BasketballDrill_832x480_50	-6.51%	0.29	-6.27%	0.28
PartyScene_832x480_50	-3.36%	0.16	-2.88%	0.16
BQMall_832x480_60	-3.94%	0.21	-3.73%	0.21
Average WVGA	**-4.24%**	**0.20**	**-3.93%**	**0.20**
vidyo1_720p_60	-6.30%	0.35	-6.48%	0.36
vidyo3_720p_60	-4.79%	0.29	-4.34%	0.27
vidyo4_720p_60	-5.18%	0.27	-4.93%	0.25
Average 720P	**-5.42%**	**0.30**	**-5.25%**	**0.29**
Kimono1_1920x1080_24	-8.68%	0.32	-5.60%	0.17
ParkScene_1920x1080_24	-1.57%	0.07	-0.74%	0.03
BasketballDrive_1920x1080_50	-4.66%	0.16	-3.95%	0.12
Cactus_1920x1080_50	-3.65%	0.14	-2.76%	0.10
BQTerrace_1920x1080_60	-5.14%	0.22	-4.27%	0.18
Average 1080P	**-4.74%**	**0.18**	**-3.46%**	**0.12**
PeopleOnStreet_2560x1600_30_crop	-6.28%	0.35	-5.43%	0.30
Traffic_2560x1600_30_crop	-3.89%	0.21	-3.10%	0.17
Average 1600P	**-5.09%**	**0.28**	**-4.27%**	**0.24**
Average	**-4.25%**	**0.21**	**-3.63%**	**0.19**

Conclusion

- 2 Intra frame coding techniques
  - Line-based intra prediction
  - Resample-based intra prediction
- Average 4% bit reduction is achieved under CfP common condition except that GOP structure is all intra pictures
- Further work:
  - Extension to chroma component
  - Modified deblocking in-loop filter for the proposed techniques

Thank you

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