

Performance of Direction-Adaptive Residual Transforms

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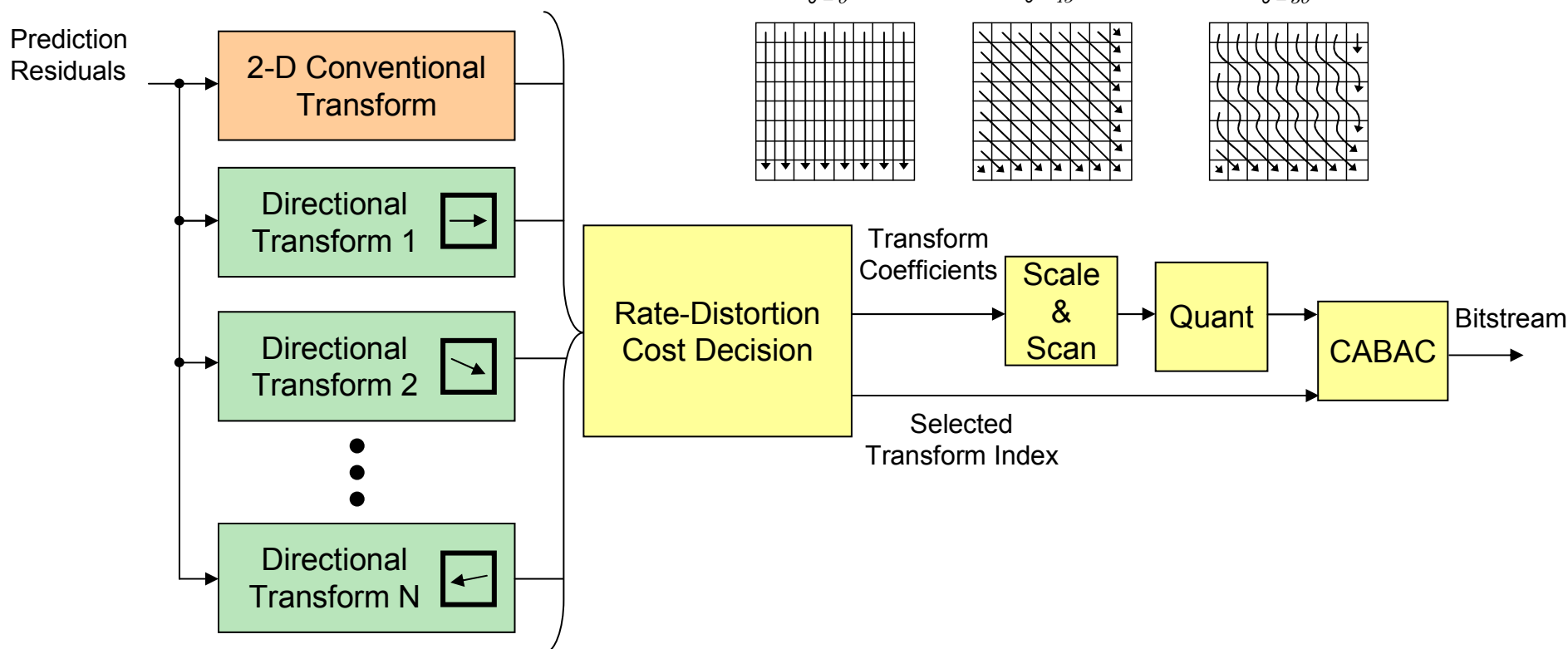
JCTVC-B092

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Direction-Adaptive Prediction Residuals

- Directional transforms (Intra & Inter) in addition to 2-D DCT
- Sets of low-complexity 1-D transforms co-aligned over block
- Conventional transforms are used – no training required
- Rate-distortion optimized selection of transform





Experimental Conditions

- Test conditions
 - Configured as discussed on reflector for AHG – Transforms
 - Extended MB sizes not used (will implement in TMuC)
 - JM11KTA2.6r1 used as reference
 - QPI=27, 30, 34, 38; +1 for QPP, +2 for QPB
 - Directional Transforms added to KTA 2.6r1 – 8x8 mode
 - All modes enabled, directional transforms available for I and P
- Experiments
 - Hierarchical-B, similar to CS1
 - IPPP, similar to CS2
 - All Intra pictures



Coding Performance on Hierarchical-B (CS1)

121 Frames, lbBbBbBbP, directional transforms available on I and P pictures

Format	Sequence	fps	Intra Period	BD-Rate (%)	BD-PSNR (dB)	BD-Rate avg for this format
Class A	Traffic	30	32	0.06	0.00	-0.03
	PeopleOnStreet	30	32	-0.12	0.01	
Class B	Kimono	24	24	0.03	0.00	-0.12
	ParkScene	24	24	0.05	0.00	
	Cactus	50	48	-0.45	0.01	
	BasketballDrive	50	48	-0.27	0.01	
	BQTerrace	60	64	0.04	0.00	
Class C	BasketballDrill	50	48	-2.43	0.10	-0.93
	BQMall	60	64	-0.56	0.02	
	PartyScene	50	48	-0.48	0.02	
	RaceHorsesC	30	32	-0.26	0.01	
Class D	BasketballPass	50	48	-0.86	0.04	-0.44
	BQSquare	50	48	-0.53	0.02	
	BlowingBubbles	50	48	-0.26	0.01	
	RaceHorsesD	30	32	-0.12	0.01	



Coding Performance on IPP... (CS2)

121 Frames

Format	Sequence	fps	Intra Period	BD-Rate (%)	BD-PSNR (dB)	BD-Rate avg for this format
Class A	Traffic	30	32	0.18	-0.01	-0.02
	PeopleOnStreet	30	32	-0.22	0.01	
Class B	Kimono	24	24	0.24	-0.01	-0.20
	ParkScene	24	24	0.12	0.00	
	Cactus	50	48	-0.42	0.01	
	BasketballDrive	50	48	-0.59	0.02	
	BQTerrace	60	64	-0.35	0.01	
Class C	BasketballDrill	50	48	-1.58	0.06	-0.75
	BQMall	60	64	-0.41	0.02	
	PartyScene	50	48	-0.86	0.04	
	RaceHorsesC	30	32	-0.15	0.01	
Class D	BasketballPass	50	48	-0.60	0.03	-0.56
	BQSquare	50	48	-0.77	0.03	
	BlowingBubbles	50	48	-0.78	0.03	
	RaceHorsesD	30	32	-0.08	0.00	
Class E	vidyo1	60	64	0.14	-0.01	0.06
	vidyo2	60	64	-0.17	0.01	
	vidyo3	60	64	0.20	-0.01	



Coding Performance on all Intra

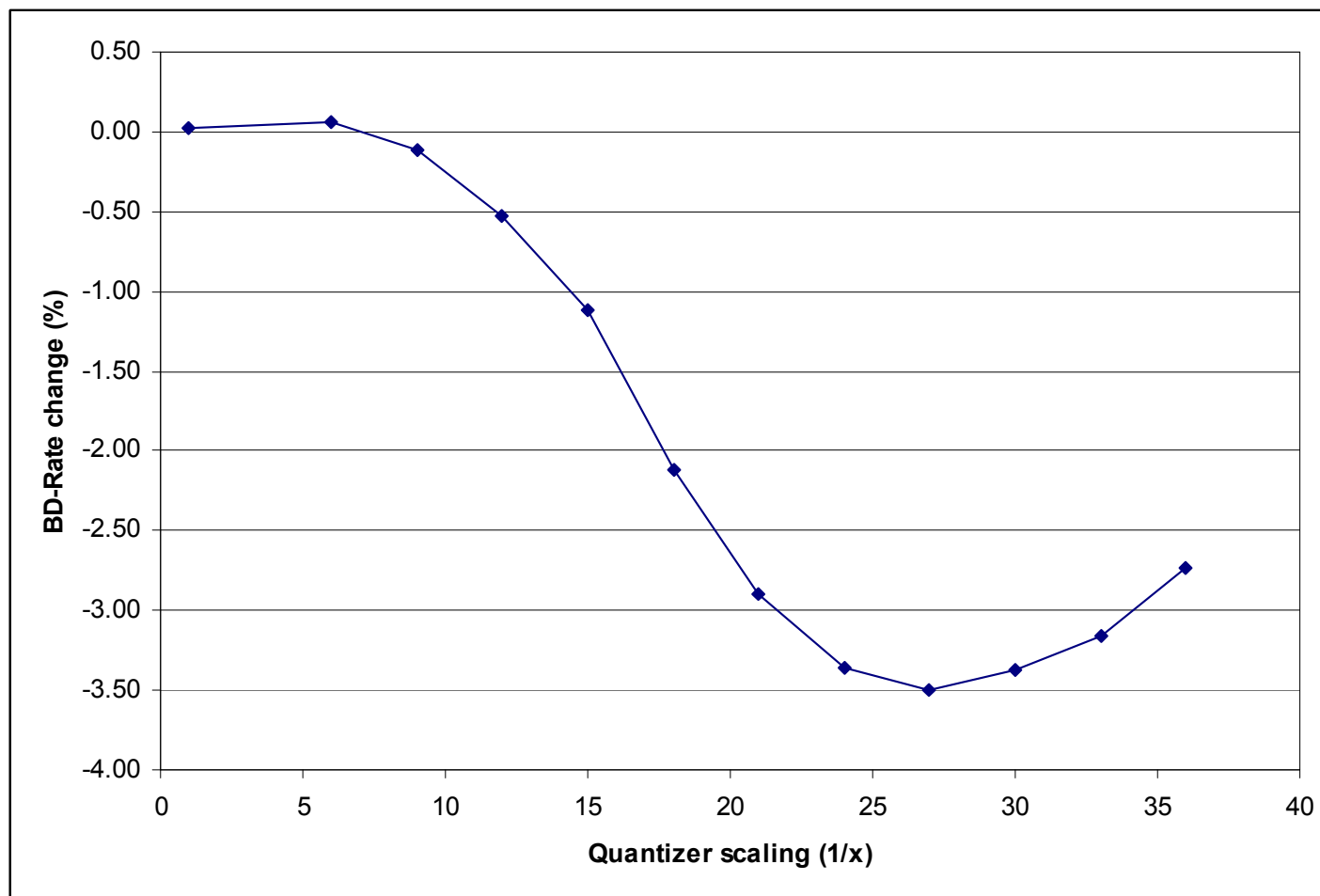
121 Frames

Format	Sequence	fps	Intra Period	BD-Rate (%)	BD-PSNR (dB)	BD-Rate avg for this format
Class A	Traffic	30	32	0.10	-0.01	0.04
	PeopleOnStreet	30	32	-0.02	0.00	
Class B	Kimono	24	24	0.33	-0.01	-0.25
	ParkScene	24	24	0.01	0.00	
	Cactus	50	48	-0.60	0.02	
	BasketballDrive	50	48	-0.52	0.02	
	BQTerrace	60	64	-0.47	0.02	
Class C	BasketballDrill	50	48	-3.38	0.15	-1.41
	BQMall	60	64	-1.09	0.06	
	PartyScene	50	48	-0.94	0.06	
	RaceHorsesC	30	32	-0.24	0.01	
Class D	BasketballPass	50	48	-1.82	0.09	-0.98
	BQSquare	50	48	-0.68	0.05	
	BlowingBubbles	50	48	-1.09	0.06	
	RaceHorsesD	30	32	-0.35	0.02	
Class E	vidyo1	60	64	-0.30	0.02	-0.44
	vidyo2	60	64	-0.46	0.03	
	vidyo3	60	64	-0.54	0.03	



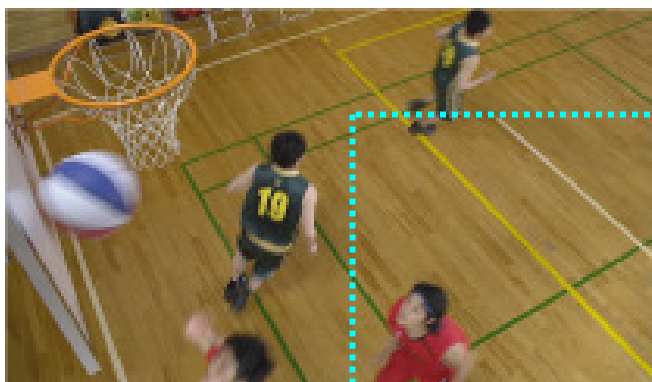
Quantization Matrix Scaling

BasketballDrill, Hierarchical-B

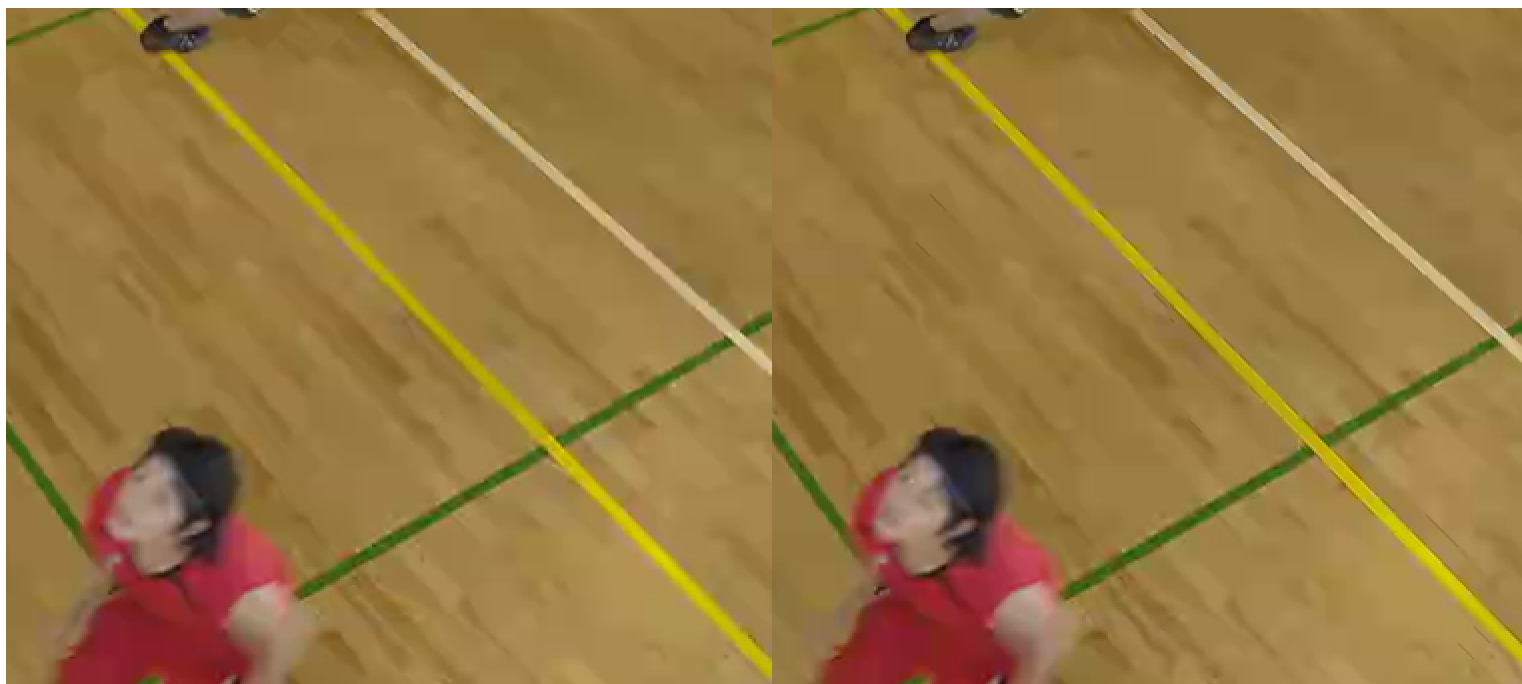
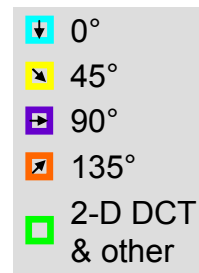
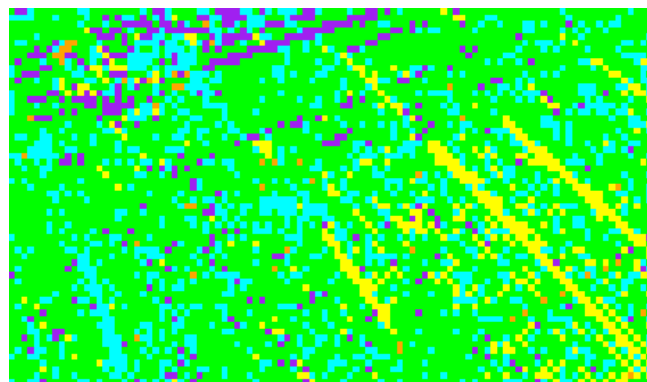


Subjective Evaluation

Original BasketballDrill



Transform map



For Frame 0: JM-KTA 2.6r1 81336 bits, 32.70 dB

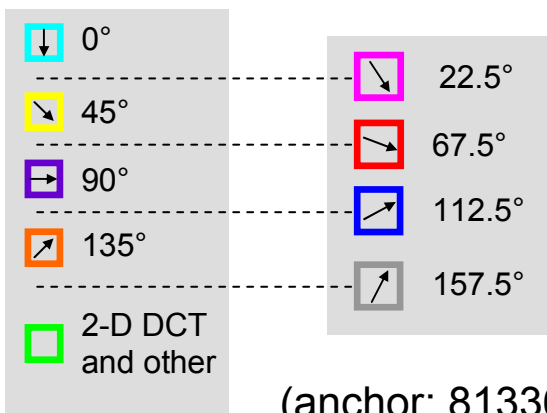
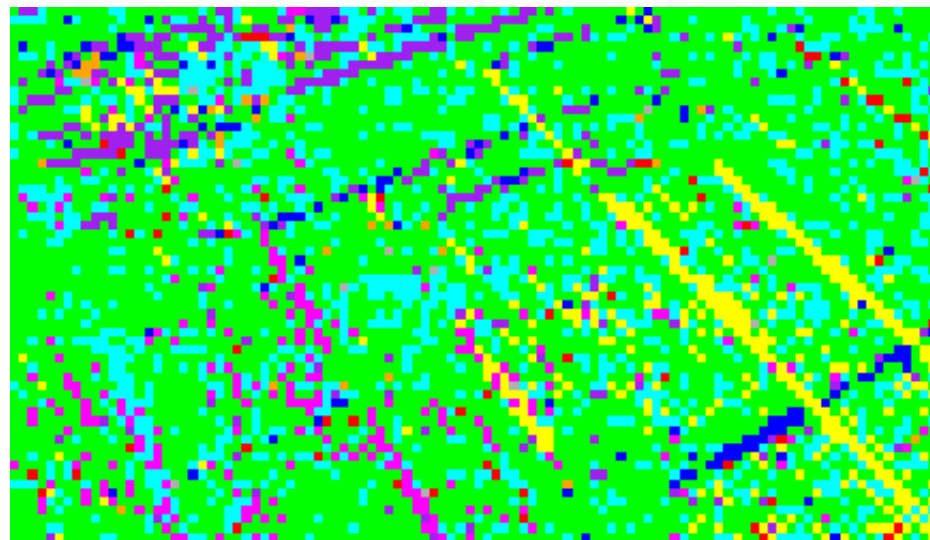
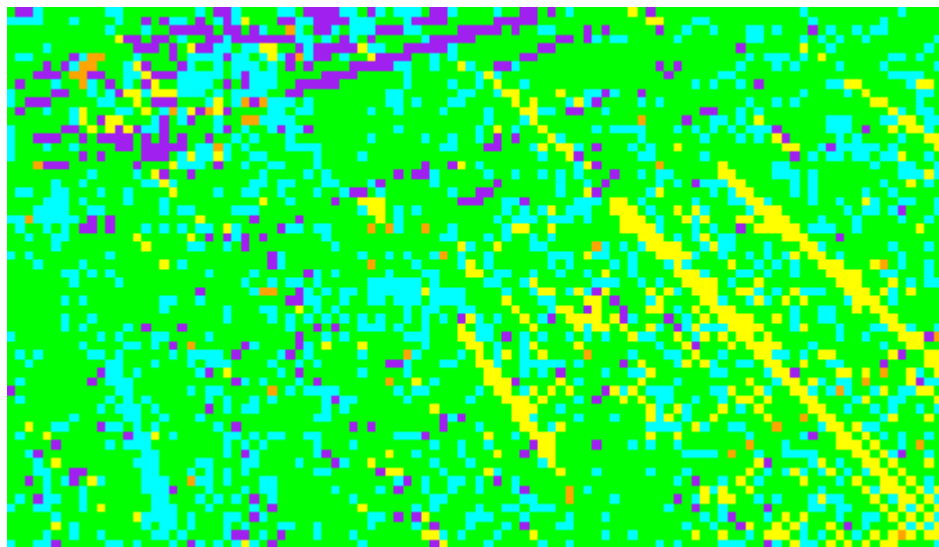
JM-KTA 2.6r1 with directional transforms 81928 bits, 32.82 dB



Increasing Number of Available Directions

4 directions: 81928 bits, 32.825 dB (Frame 0)
BD-Rate: -2.42, BD-PSNR: 0.098 dB

8 directions: 81656 bits, 32.863 dB (Frame 0)
BD-Rate: -2.80, BD-PSNR: 0.113 dB



Original



Summary and Conclusions

- Added simple 8x8 directional transforms to KTA for both Intra and Inter blocks
- Based test conditions on AHG – Alternative Transforms
- Up to 1.4% average improvement within a given resolution, higher gains for sequences with strong directional content (e.g. BasketballDrill)
- Recommend continued study and improvements of alternative transforms (in common platform)
- Also important to evaluate subjective performance with alternative transforms
 - Improvements and artifacts
 - Consistency of artifacts (spatial and temporal) when using mixed transform types