

JCT3V-E0132:
**AHG 10: Complexity Assessment on
Simplified Depth Coding (SDC)**

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Abstract

2

- Complexity assessment on SDC
 - Number of operations
 - Data storage requirement
 - Data transfer rate
- Complexity at 64x64 block with various PU sizes
- Coding performance when SDC is OFF
 - CTC: **0.29%** and **0.28%** bitrate increasing for video PSNR vs. total bitrate and synth PSNR vs. total bitrate in average and comparative decoding time.
 - AI: **0.96%** and **0.84%** bitrate increasing for video PSNR vs. total bitrate and synth PSNR vs. total bitrate in average; in addition, **18.9%** decoding time increasing for this configuration

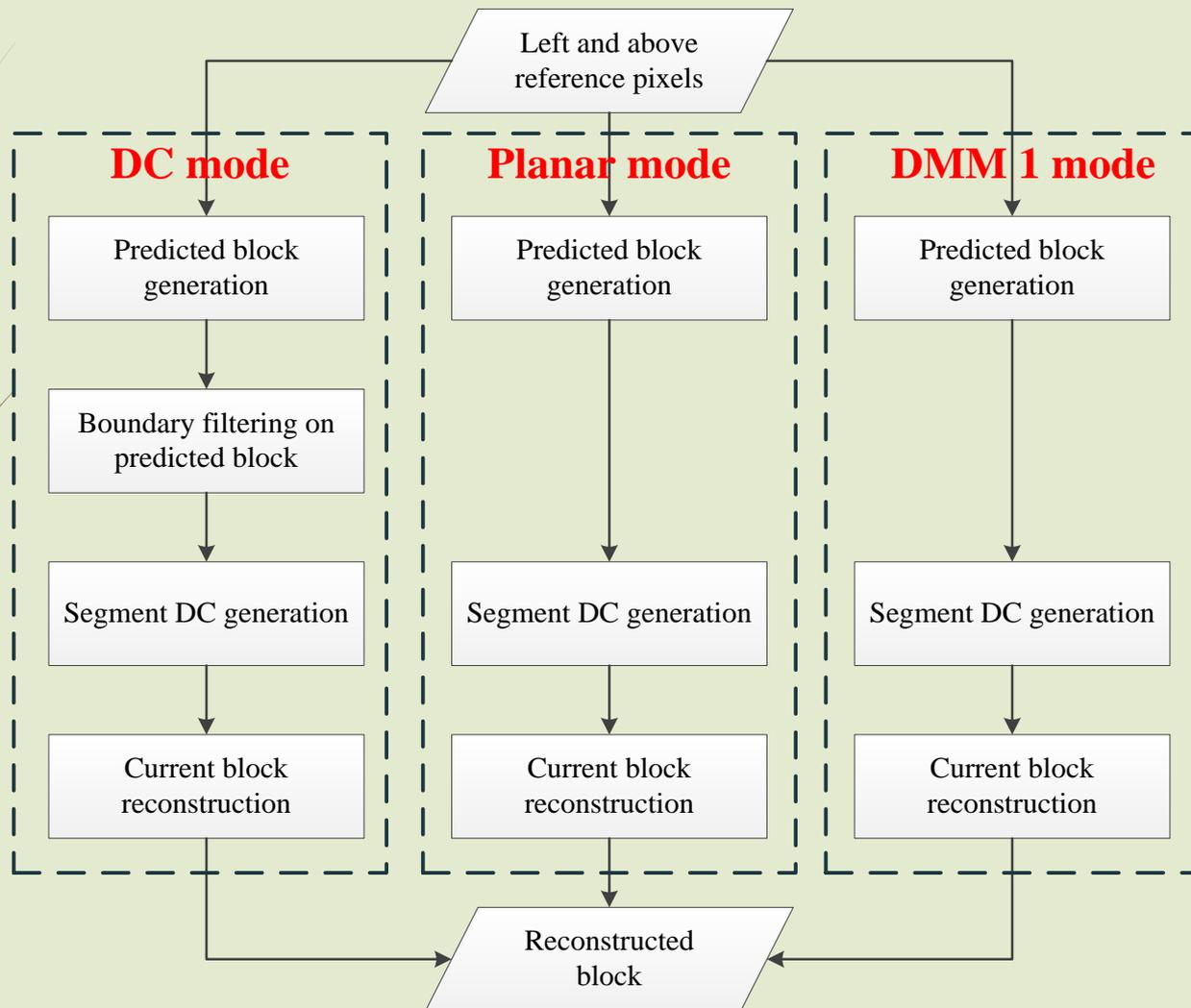
Outline

3

- Abstract
- Current design of SDC
- Complexity assessment at PU and 64x64 block level
 - Number of operations
 - Data storage requirement
 - Data transfer rate
- Coding performance without SDC
- Conclusion

Current design of SDC

4



Number of operations – DC mode

5

- ▶ Predicted block generation:
 - ▶ $2(N-1)$ additions, 1 shift
- ▶ Boundary filter:
 - ▶ $4(N-1)+2$ additions, $4(N-1)+2$ shifts
- ▶ Segment DC generation:
 - ▶ N^2 additions and 1 shift ($0.25N^2$ additions and 1 shift)
- ▶ Current block reconstruction:
 - ▶ $2(N-1)+3$ additions, 1 subtraction, and 2 LUT access

Number of operations for one PU

Type of operations	Number of operations
Mul	0
Add/Sub/Comp	N^2+8N-1 or $0.25N^2+8N-1$
Shift	$4N$
LUT access	2

N: PU size

Number of operations – Planar mode

6

- ▶ Predicted block generation:
 - ▶ $4N^2$ multiplications, $3N^2$ additions, and 1 shift
(In software, $3N^2+N$ additions, $2N$ subtractions, N^2+2N shift)
- ▶ Segment DC generation:
 - ▶ N^2 additions and 1 shift ($0.25N^2$ additions and 1 shift)
- ▶ Current block reconstruction:
 - ▶ $1+N^2$ additions, 1 subtraction, and 2 LUT access

Number of operations for one PU

Type of operations	Number of operations	
Mul	0	$4N^2$
Add/Sub/Comp	$5N^2+3N+2$ or $4.25N^2+3N+2$	$5N^2+2$ or $4.25N^2+2$
Shift	N^2+2N+1	N^2+1
LUT access	2	2

N: PU size

Number of operations – DMM 1 mode

7

- Predicted block generation:
 - 2 additions, 4 comparisons, and 2 shifts
- Segment DC generation:
 - It did not need any computation to obtain segment DCs.
- Current block reconstruction:
 - 4 additions, 2 subtractions, and 4 LUT access

Number of operations for one PU

Type of operations	Number of operations
Mul	0
Add/Sub/Comp	12
Shift	2
LUT access	4

N: PU size

Data storage requirement and data transfer rate

► Data storage requirement

- Reference pixels: $2(N+1)$ pixels
- Segment DC: at most 2 DC values
- Reconstructed block: N^2 pixels

Data	Required size (bits)
Reference pixels	$2 \times (N+1) \times 8$
Segment DC	2×8
Reconstructed block	$N^2 \times 8$

► Data transfer rate

- Reference pixels: $2(N+1)$ pixels
- Reconstructed block: N^2 pixels

Data	Amount of transferred data per PU
Reference pixels	$2(N+1) \times 8$
Reconstructed block	$N^2 \times 8$

Complexity at 64x64 block level with various PU sizes

PU_size	Number of operations (Add/Sub/Comp)		
	DC mode	Planar mode	DMM 1 mode
64x64	1,535	17,602	-
32x32	2,044	17,800	48
16x16	6,128	21,280	192
8x8	8,128	22,144	768

PU_size	Data storage (bits)		
	Reference pixels	Segment DC	Reconstructed block
64x64	1,040	16	32,768
32x32	528	16	8,192
16x16	272	16	2,048
8x8	144	16	512

PU_size	Data transfer rate (bits per 64x64 block)	
	Reference pixels	Reconstructed block
64x64	1,040	32,768
32x32	2,112	32,768
16x16	4,352	32,768
8x8	9,216	32,768

Coding performance without SDC

10

CTC configuration

	video 0	video 1	video 2	video PSNR / video bitrate	video PSNR / total bitrate	synth PSNR / total bitrate	enc time	dec time	ren time
Balloons	0.00%	-0.10%	-0.12%	-0.05%	0.35%	0.35%	99.5%	100.8%	99.2%
Kendo	0.00%	0.04%	-0.19%	-0.04%	0.77%	0.67%	99.1%	101.6%	99.2%
Newspaper_CC	0.00%	0.02%	-0.09%	0.01%	0.55%	0.16%	99.1%	101.1%	99.0%
GT_Fly	0.00%	-0.39%	-0.53%	-0.11%	0.17%	0.31%	96.9%	101.2%	96.7%
Poznan_Hall2	0.00%	-0.11%	-0.02%	-0.05%	0.07%	0.14%	99.6%	100.9%	100.2%
Poznan_Street	0.00%	-0.17%	-0.24%	-0.07%	0.06%	0.07%	99.2%	100.3%	99.5%
Undo_Dancer	0.00%	0.42%	0.46%	0.12%	0.07%	0.24%	97.3%	101.0%	95.4%
1024x768	0.00%	-0.01%	-0.13%	-0.03%	0.56%	0.39%	99.2%	101.1%	99.1%
1920x1088	0.00%	-0.06%	-0.08%	-0.03%	0.09%	0.19%	98.2%	100.8%	97.9%
average	0.00%	-0.04%	-0.10%	-0.03%	0.29%	0.28%	98.7%	101.0%	98.5%

AI configuration

	video 0	video 1	video 2	video PSNR / video bitrate	video PSNR / total bitrate	synth PSNR / total bitrate	enc time	dec time	ren time
Balloons	0.00%	0.00%	0.00%	0.00%	1.71%	1.23%	97.2%	121.8%	97.8%
Kendo	0.00%	0.00%	0.00%	0.00%	2.45%	1.74%	95.1%	121.5%	98.4%
Newspaper_CC	0.00%	0.00%	0.00%	0.00%	1.06%	0.91%	96.3%	118.3%	100.1%
GT_Fly	0.00%	0.00%	0.00%	0.00%	0.85%	1.01%	96.8%	118.6%	99.8%
Poznan_Hall2	0.00%	0.00%	0.00%	0.00%	0.50%	0.69%	99.1%	121.4%	100.2%
Poznan_Street	0.00%	0.00%	0.00%	0.00%	0.28%	0.18%	96.5%	117.4%	97.1%
Undo_Dancer	0.00%	0.00%	0.00%	0.00%	-0.11%	0.13%	98.6%	113.5%	98.9%
1024x768	0.00%	0.00%	0.00%	0.00%	1.74%	1.29%	96.2%	120.5%	98.8%
1920x1088	0.00%	0.00%	0.00%	0.00%	0.38%	0.50%	97.8%	117.8%	99.0%
average	0.00%	0.00%	0.00%	0.00%	0.96%	0.84%	97.1%	118.9%	98.9%

Conclusion

11

- ▶ Coding performance when SDC is OFF
 - ▶ CTC: **0.29%** and **0.28%** bitrate increasing for video PSNR vs. total bitrate and synth PSNR vs. total bitrate in average and comparative decoding time.
 - ▶ AI: **0.96%** and **0.84%** bitrate increasing for video PSNR vs. total bitrate and synth PSNR vs. total bitrate in average; in addition, **18.9%** decoding time increasing for this configuration
- ▶ The intrinsic complexity of SDC is presented to be anchor complexity to evaluate SDC tools.

Thanks for your attention!