CE5: Run and level mode coding improvement in CAVLC (JCTVC-F408)

Yonsei University

Samsung Electronics Co., Ltd.

Contents

- **Table insertion of Intra run mode**
- **Vlc writing for {run, level} and remained Level**
- **Table selection of Level coding**

Intra run mode coding

- **Table modification**
  - Current : two parameter tables is used for 4x4 and (8x8, 16x16, 32 x32) to generate codeNum of {run, level} pair
  - 8x8 and 16x16 has different distribution in run-level coding
    - New table is inserted for to separate 8x8 and (16x16, 32x32) blocks
      - Table size [5][29]
    - Original table value is also modified since statistics change

Intra run mode coding

	HM 3.0		Proposed	
	vlcTableNum Table	Parameter table	vlcTableNum Table	Parameter table
4x4	1x29	5x15	1x15	5x15
8x8		5x29 (same table)	5x29	5x29
≥ 16x16	1x29		5x29	5x29

vlc modification (13 elements)

Vlc writing for {run, level} and remained Level

- ## Parameterized vlc
  - Insert unary-max coding
  - "transition prefix length" can be adapted according to parameter and vlcNum

```
                    ┌──────────┐
                    │  START   │
                    └────┬─────┘
                         │
                         ▼
                    ╱◇◇◇◇◇◇◇◇╲          N      ╱◇◇◇◇◇◇◇◇◇◇◇◇╲       N
                   ◇          ◇ ─────────────▶ ◇  cn < param  ◇ ──────────┐
                   ◇ Unary     ◇              ◇  x 1<<vlcNum  ◇           │
                    ╲coding? ╱                 ╲◇◇◇◇◇◇◇◇◇◇◇◇╱            │
                      ◇◇◇                           │                     │
                       │ Y                           │ Y                   │
                       ▼                             ▼                     ▼
               ┌───────────────┐          ┌───────────────┐     ┌───────────────┐
               ││ Unary-Max   ││          ││   Coding     ││     ││   Coding     ││
               ││  coding     ││          ││  Methods1    ││     ││  Methods 2   ││
               └───────┬───────┘          └───────┬───────┘     └───────┬───────┘
                       │                          │                     │
                       ▼                          └──────────┬──────────┘
                 ┌──────────┐                                │
                 │   END    │◀───────────────────────────────┘
                 └──────────┘       5
```
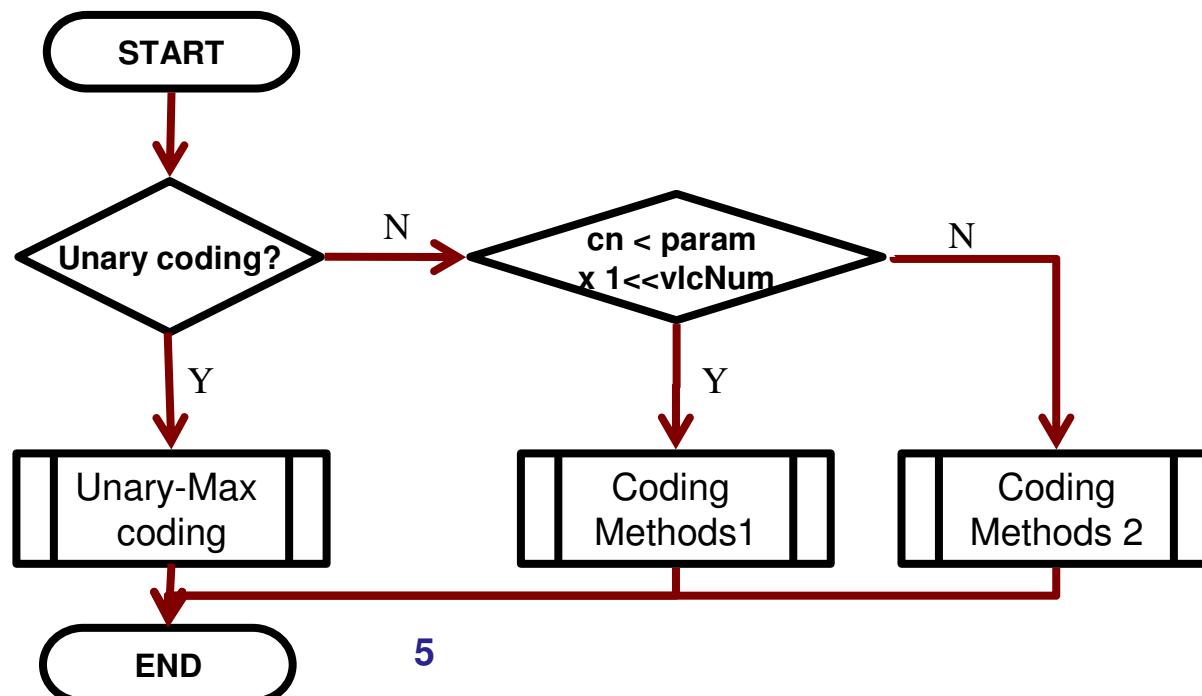
Vlc writing for {run, level} and remained Level

- **Run mode parameterization**
  - Four modes are available.
  - In very low maxrun(< th1), unary-max,
  - In low maxrun (< th2), vlcNum = 1 & parameter = maxrun+1
  - In high maxrun(< th3), vlcNum = 2 & parameter = (maxrun+1)>>1
  - In very high maxrun, pre-difined vlcNum and parameter

- **Level mode parameterization**
  - vlcNum is same to current HM
  - Parameter is determined by previously coded level value and col or type(luma and chroma)

Table selection of Level coding

- **Modifications to VLC table selection in level mode**
  - Use different threshold set depends on block type (intra luma, inter P luma, inter B luma, or chroma)
  - Threshold refinement using RQT depth.
    - Intra Luma, $Th = \tau - RQTdepth$
    - Inter Luma, $Th = \tau - RQTdepth - (RQTdepth>0?1:0)$
    - Chroma, $Th = \tau$

Algorithm	Feature	Predefined threshold, predefined_Th				
HM3.0	x	4	6	14	28	x
Proposal	I	4	8	18	37	102
	P	4	7	14	23	56
	B	6	11	14	27	74
	Chroma	2	5	11	25	88

intra parameter table insertion

All Intra LC			Random Access LC			Low delay B LC		
Y	U	V	Y	U	V	Y	U	V
-0.2	-0.1	-0.1	-0.1	0.1	0.2			
-0.4	0.0	0.0	-0.1	0.0	0.0	0.0	-0.2	-0.4
-0.5	-0.1	-0.1	-0.2	-0.1	-0.2	-0.1	0.0	-0.2
-0.6	-0.2	-0.2	-0.2	-0.2	0.1	0.0	-0.3	0.1
-0.4	-0.1	-0.2				-0.2	0.4	0.2
-0.4	**-0.1**	**-0.1**	**-0.2**	**-0.1**	**0.0**	**-0.1**	**-0.1**	**-0.1**
101%			100%			100%		
100%			98%			99%		

Vlc writing for {run, level} and remained Level

All Intra LC			Random Access LC			Low delay B LC		
Y	U	V	Y	U	V	Y	U	V
-0.2	0.0	0.2	0.0	0.1	0.5			
-0.1	-0.1	0.0	0.0	0.0	0.1	0.0	-0.1	-0.3
-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2
-0.2	-0.1	-0.2	0.0	-0.2	0.1	0.0	0.0	0.1
-0.1	-0.1	-0.1				-0.1	0.8	-0.8
-0.2	**-0.1**	**-0.1**	**0.0**	**0.0**	**0.2**	**0.0**	**0.1**	**-0.3**
101%			100%			100%		
100%			98%			98%		

Table selection of Level coding methods

All Intra LC			Random Access LC			Low delay B LC		
Y	U	V	Y	U	V	Y	U	V
-0.1	-0.2	-0.2	-0.2	-0.3	0.0			
-0.3	-0.1	-0.1	-0.1	0.2	0.2	-0.1	0.2	-0.2
-0.4	-0.3	-0.3	-0.2	-0.2	-0.1	-0.1	0.3	0.0
-0.5	-0.4	-0.3	-0.3	-0.4	0.1	-0.1	0.2	0.2
-0.2	-0.1	-0.1				0.0	0.7	-0.3
-0.3	**-0.2**	**-0.2**	**-0.2**	**-0.2**	**0.0**	**-0.1**	**0.3**	**-0.1**
102%			100%			100%		
100%			99%			98%		

Combined results

All Intra LC			Random Access LC			Low delay B LC		
Y	U	V	Y	U	V	Y	U	V
-0.5	-0.2	-0.1	-0.2	0.3	0.5			
-0.6	-0.1	-0.2	-0.2	0.1	0.1	-0.1	0.3	0.0
-0.7	-0.4	-0.4	-0.4	-0.2	-0.2	-0.2	0.1	-0.2
-0.9	-0.5	-0.5	-0.4	-0.3	-0.3	-0.2	0.1	-0.1
-0.6	-0.2	-0.2				-0.2	0.6	-0.5
-0.7	**-0.3**	**-0.3**	**-0.3**	**0.0**	**0.0**	**-0.2**	**0.3**	**-0.2**
103%			100%			100%		
100%			100%			100%		

Table size modification

Table	Features	HM3.0	Proposal	Diff
INTRA table	4x4	5*15	5*15	**+136**
	8x8	5*29	5*29	
	16x16		5*29	
	all	**220**	**356**	
threshold for level	I	1*5	1*6	**+19**
	P		1*6	
	B		1*6	
	Chroma		1*6	
	all	**5**	**24**	
vlcNum	INTRA	1*29	4*4 (13 elems)	**-68** **(-73 elems)**
		1*29		
	INTER	1*29	2*4 (8 elems)	
		1*29		
	Chroma	0	3*4 (10 elems)	
	level	0	2*6	
	all	**116**	**48**	
sum		341	428	**87**

Summary

- Performance improvement.
  - RA: -0.7%, -0.3%, LD -0.2%
  - With 87 bytes table increasing which is very small portion of total tables

- We recommend considering adoption of proposed method into next version of HM

- The proposed method is cross-verified by SHARP (JCTVC-F404) and Qualcomm (JCTVC-F635)

END

- Thank you !