JCTVC-254 Multi-parameter probability up-date for CABAC

Elena Alshina, Alexander Alshin
Samsung Electronics Ltd

Idea description

- Probability up-date (the most often used):

$$p_{new} = \alpha y + (1 - \alpha)\, p_{old;}\ y{=}{=}MPS?\ 1{:}0.$$

here $N=1/\alpha$ is "window size"

- AVC CABAC "window size" N=19.69
- Multi-parameter probability up-date:

$$p_{i\ new} = \alpha_i\, y + (1 - \alpha_i)\, p_{i\ old}$$

$$p_{new} = \Sigma \beta_i\, p_{i\ new}$$

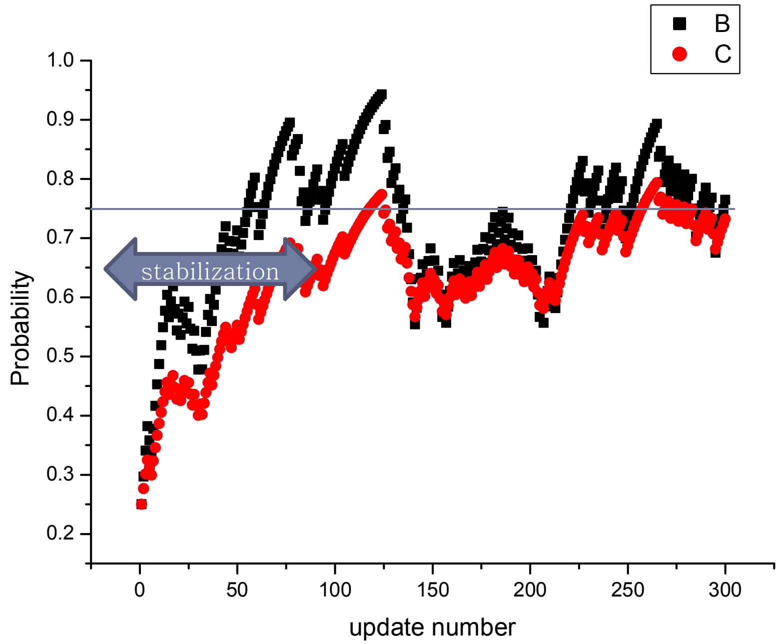
- If $N_i = 1/\alpha = 2^{Mi}$ then probability up-date is multiplication-free:

$$P_i = (Y >> M_i) + P - (P_i >> M_i).$$

Up-date of every P_i is independent and can be done as parallel processing.

- How many p_i are needed? What M_i should be?

Probability up-date for artificial source



- Random signal with pre-determined constant probability: $\frac{3}{4}$
- Initialized by $\frac{1}{4}$
- (B) one parameter probability up-date:

$$P_0 \text{ with } M_0=4$$

- (C) two parameters probability up-date:

$$P=(P0+P1+1)>>1$$

$$M_0=4\ ;\ M_1=7$$

- Short distance prediction (B) quickly converges to true value $\frac{3}{4}$; but this model is subject to fluctuations in a large measure.
- "Semi-sum" (C) tends to optimal value slowly but later reaction for small perturbations is not so noticeable

Proposed combination

- Short-distance probability up-date model (M_0=4) is used after initialization for rapid content adaptation
- **Counter** for the number of up-dates is measure of stabilization
- After stabilization (**counter**> threshold) the semi-sum of two probabilities (M_0=4, M_1=7) is used.

```
if (counter <50)  return     (iP0);
else return      ((iP0+iP1+1)>> 1;
if (counter <50) counter ++;
```

Summary of proposed changes

Removed	Added
UChar m_ucState;	UChar m_ucCounter; unsigned short iP0,iP1; (4 bytes per context model)
static const UChar m_aucNextStateMPS[64];	
static const UChar m_aucNextStateLPS[64];	
const static UChar sm_aucLPSTable[64][4];	const static unsigned short sm_aucLPSTable [128][32];(table size has no big effect on performance)
const UChar getState () ; const UChar getMps ();	const unsigned short getCombination() ;

```
Void        updateLPS ()
{
            iP0-=(iP0>>4);     iP1-=(iP1>>7);
}
Void        updateMPS ()
{
        iP0+ =4096-(iP0>>4);
        iP1+ =256-(iP1>>7);
}
```

Test results

Common test conditions JCTVC-E700, HE case only

	All Intra HE			Random Access HE			Low delay B HE		
	Y	U	V	Y	U	V	Y	U	V
Class A	-0.9	0.0	0.6	-0.8	0.7	1.0			
Class B	-0.9	-0.9	-0.7	-0.9	-0.5	0.0	-0.8	0.1	0.4
Class C	-0.8	-1.0	-1.0	-0.7	-0.4	-0.6	-0.7	-0.3	-0.1
Class D	-0.8	-0.7	-0.7	-0.5	-0.2	-0.4	-0.5	0.4	0.4
Class E	-0.9	-0.4	-0.6				-0.6	1.3	-0.6
Overall	**-0.9**	**-0.6**	**-0.5**	**-0.7**	**-0.1**	**0.0**	**-0.7**	**0.3**	**0.1**
Enc Time[%]	101%			100%			100%		
Dec Time[%]	100%			100%			100%		

We would like to thank RIM for verification of this test results, deep analysis of our code and a lot of useful comments about design improvement.

Conclusion

Based on presented test results

Avg. gain 0.8% ; Avg. Enc/Dec time 100%

we propose to create core experiment for study of multi-parameters probability up-date for HEVC-CABAC or directly adopt proposed multi-parameters probability up-date for CABAC to the next version of HM s/w and WD.