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Early all-zero blocks detecting method for video coding based on novel threshold

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Abstract: In order to decrease both computational complexity and coding time, an improved algorithm for the early detection of all-zero blocks (AZBs) in H. 264/AVC is proposed. The previous AZBs detection algorithms are reviewed. Three types of transformed frequency-domain coefficients, which are quantized to zeros, are analyzed. Based on the three types of frequency-domain scaling factors, the corresponding spatial coefficients are derived. Then the Schwarz inequality is applied to the derivation of the three thresholds based on spatial coefficients. Another threshold is set on the basis of the probability distribution of zero coefficients in a block. As a result, an adaptive AZBs detection algorithm is proposed based on the minimum of the former three thresholds and the threshold of zero blocks distribution. The simulation results show that, compared with the existing AZBs detection algorithms, the proposed algorithm achieves a 5% higher detection ratio in AZBs and 4% to 10% computation saving with only 0. 1 dB video quality degradation.

Key words: all-zero block; video coding; threshold

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The newest international video coding standard H. 264 is developed by the joint video team (JVT). Its compression efficiency is 3 times that of the previous coding standards. However, the encoding complexity is greatly increased. Therefore, it is necessary to adopt a new efficient algorithm to decrease the computational complexity and improve the coding efficiency. Recently, many algorithms have been proposed to achieve this goal. These algorithms include efficient rate-distortion optimization[1-2], fast intra- and inter-mode prediction[3-4], and fast motion search[5-6].

In addition to the methods mentioned above, the early detection of all-zero blocks (AZBs) is also an efficient method.

All-zero blocks phenomena in discrete cosine transform (DCT) coefficients are very common in low bit-rate applications. If the AZBs are detected before the DCT and quantization, the computations of the DCT and quantization can be avoided. Thus, early detection of AZBs is an efficient method in decreasing the computational complexity. Zhou et al. [7] defined a sufficient condition under which each quantized coefficient becomes zero. Each block is detected by this condition, and the DCT and quantization will not be performed if it is an AZB. Sousa[8] proposed a threshold based on the integer transform and quantization in H. 263. If the sum of absolute difference (SAD) is smaller than the threshold, the block will be regarded as an AZB. So the process of the integer transform and quantization can be saved. Moon et al. [9] analyzed the distribution of the coefficients of integer transformation in three types of frequency components and deduced a wider threshold in H. 264 based on the Sousa method. Su[10] proposed a more tolerant threshold based on the Moon algorithm and his algorithm achieved 4% to 22. 9% computation saving compared with the Moon algorithm. Zhang et al. [11] proposed an adaptive method to detect the quantized DCT coefficient which becomes zero. In Ref. [11], a new threshold is presented to detect the AZB without any video degradation when the quantization parameter (QP) exceeds a certain value and a concept of fourteen-zeros block (FZB) is proposed to reduce redundant computations.

In this paper, a more precise detection algorithm for AZBs is proposed. The proposed algorithm takes all the frequency components into account. The decision of thresholds to determine all zero blocks in the transformation coefficients is described in detail, which makes the final AZB detecting threshold more precise. The experimental results show that compared with the previous algorithms, the proposed algorithm saves more computation time and detects more AZBs without obviously degrading video quality.

1 Existing Method

In H. 264/AVC, an integer DCT is used to avoid inverse transform mismatch problems between the encoder and the decoder. The quantization coefficient $M(Q_{\mathrm{p}}, r)$ is defined with a periodic table as follows:

$$M(Q_{\mathrm{p}}, r)=\begin{bmatrix} 5\,243 & 8\,066 & 13\,107 \\ 4\,660 & 7\,490 & 11\,916 \\ 4\,194 & 6\,554 & 10\,082 \\ 3\,647 & 5\,825 & 9\,362 \\ 3\,355 & 5\,243 & 8\,192 \\ 2\,893 & 4\,559 & 7\,282 \end{bmatrix} \tag{1}$$

where $M(Q_{\mathrm{p}}, r)$ is the function of variables Q_{p} and r; Q_{p} is the quantization step, $r = 2 - [u]_{\mathrm{mod2}} - [v]_{\mathrm{mod2}}$, and the function $[\quad]_{\mathrm{mod2}}$ is a modulo division operation; r is the grade of the scaling factor; u and v are the horizontal position and vertical position, respectively. The all-zero blocks detection is based on 4×4 blocks.

Sousa[8] analyzed the DCT and quantization in H. 263 and maintained that the computation of the DCT and quantization can be avoided if the SAD is smaller than a certain threshold. This threshold is defined as

$$\frac{1}{4}\cos^2\left(\frac{\pi}{16}\right)\mathrm{SAD}_{\mathrm{b}}(\boldsymbol{v}_x, \boldsymbol{v}_y) < \Delta \tag{2}$$

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where $\mathrm{SAD_b}(\boldsymbol{v}_x, \boldsymbol{v}_y)$ is the sum of absolutes of the differences between the conference block and the current block in H. 263. The coefficients $\boldsymbol{v}_x$ and $\boldsymbol{v}_y$ are the motion vectors, $\boldsymbol{\Delta}$ is the quantization step.

Based on the Sousa algorithm, Moon et al. [9] analyzed the algorithm using the following inequality:

$$|\boldsymbol{E}_i(u,v)| \leqslant \sum_{x=0}^{3}\sum_{y=0}^{3} |\boldsymbol{e}(x,y)|\,|\boldsymbol{I}_c(x,y,u,v)| \tag{3}$$

Then a threshold $T(r)$ is formulated as follows:

$$T(r) = \frac{2^q - f}{D(r)M(Q_{\mathrm{p}}, r)} \tag{4}$$

where $D(r) = 2^{2-r}$. The coefficient r denotes various frequency components. The coefficient $q = 15 + (Q_{\mathrm{p}}/6)$. Respectively, $r=0$ means the positions $(u, v) = \{(1,1), (1,3), (3,1), (3,3)\}$; $r=2$ means the positions $(u, v) = \{(0,0), (2,0), (2,2), (0,2)\}$; $r=1$ means other positions.

The final sufficient condition of an AZB is

$$S < \min\{T(0) + (\lambda/2), T(1)\} \tag{5}$$

where

$$\left.\begin{aligned} T(0) &= \frac{1}{4}\left(\frac{2^q - f}{M(Q_{\mathrm{p}}, 0)}\right) \\ T(1) &= \frac{1}{2}\left(\frac{2^q - f}{M(Q_{\mathrm{p}}, 1)}\right) \\ T(2) &= \frac{2^q - f}{M(Q_{\mathrm{p}}, 2)} \end{aligned}\right\} \tag{6}$$

Su[10] presented an inequation as

$$\lfloor|\boldsymbol{w}_{ij}|\rfloor \leqslant \lfloor|\boldsymbol{C}_{ij}|\rfloor_{4\times4}\lfloor|\boldsymbol{x}_{ij}|\rfloor_{4\times4}\lfloor|\boldsymbol{C}_{ij}|\rfloor_{4\times4}^{T} \tag{7}$$

The final threshold is defined as

$$T_p = \min[(4T(0) - 5\max_i\{S_i\}), (2T(1) - 2\max_i\{S_i\}), T(2)] \tag{8}$$

Based on the Moon algorithm, Zhang et al. [11] presented the following inequality:

$$|\boldsymbol{F}(x,y)| \leqslant \sum_{u=0}^{3}\sum_{v=0}^{3} |\boldsymbol{f}(u,v)|\,|\boldsymbol{C}(x,u)\boldsymbol{C}(y,v)| \tag{9}$$

The final threshold is

$$\left.\begin{aligned} &\mathrm{SAD}_{4\times4} < 2T(0) - \max\Big\{\max(S_0,S_3) - \frac{1}{2}\min(S_0,S_3), \\ &\qquad \max(S_1,S_2) - \frac{1}{2}\min(S_1,S_2)\Big\} && r=0 \\ &\mathrm{SAD}_{4\times4} < 2T(1) - \max(S_0,S_3) - \max(S_1,S_2) && r=1 \\ &\mathrm{SAD}_{4\times4} < T(2) && r=2 \end{aligned}\right\} \tag{10}$$

2 Proposed Method

2.1 Theoretical analysis

The absolute value of the core transformation $\boldsymbol{F} = \boldsymbol{CEC}^T$ is analyzed as follows:

$$|\boldsymbol{F}_{uv}| = |\boldsymbol{CE}_{xy}\boldsymbol{C}^{\mathrm{T}}| = \left|\begin{bmatrix}1&1&1&1\\2&1&-1&-2\\1&-1&-1&1\\1&-2&2&1\end{bmatrix}\begin{bmatrix}e_{00}&e_{10}&e_{20}&e_{30}\\e_{00}&e_{10}&e_{20}&e_{30}\\e_{00}&e_{10}&e_{20}&e_{30}\\e_{00}&e_{10}&e_{20}&e_{30}\end{bmatrix}\begin{bmatrix}1&2&1&1\\1&1&-1&-2\\1&-1&-1&2\\1&-2&1&1\end{bmatrix}\right| =$$

$$\left|\begin{bmatrix} e_{00}+e_{10}+e_{20}+e_{30} & e_{01}+e_{11}+e_{21}+e_{31} & e_{02}+e_{12}+e_{22}+e_{32} & e_{03}+e_{13}+e_{23}+e_{33} \\ 2e_{00}+e_{10}-e_{20}-2e_{30} & 2e_{01}+e_{11}-e_{21}-2e_{31} & 2e_{02}+e_{12}-e_{22}-2e_{32} & 2e_{03}+e_{13}-e_{23}-2e_{33} \\ e_{00}-e_{10}-e_{20}+e_{30} & e_{01}-e_{11}-e_{21}+e_{31} & e_{02}-e_{12}-e_{22}+e_{32} & e_{03}-e_{13}-e_{23}+e_{33} \\ e_{00}-2e_{10}+2e_{20}+e_{30} & e_{01}-2e_{11}+2e_{21}+e_{31} & e_{02}-2e_{12}+2e_{22}+e_{32} & e_{03}-2e_{13}+2e_{23}+e_{33} \end{bmatrix}\begin{bmatrix}1&2&1&1\\1&1&-1&-2\\1&-1&-1&2\\1&-2&1&1\end{bmatrix}\right| \tag{11}$$

To simplify the computation, let the first matrix on the right side of Eq. (11) be

$$\begin{bmatrix}A_{00}&A_{01}&A_{02}&A_{03}\\A_{10}&A_{11}&A_{12}&A_{13}\\A_{20}&A_{21}&A_{22}&A_{23}\\A_{30}&A_{31}&A_{32}&A_{33}\end{bmatrix} \tag{12}$$

Thus, Eq. (11) can be rewritten as

$$|\boldsymbol{F}_{uv}| = \left|\begin{bmatrix} A_{00}+A_{01}+A_{02}+A_{03} & 2A_{00}+A_{01}-A_{02}-2A_{03} & A_{00}-A_{01}-A_{02}+A_{03} & A_{00}-2A_{01}+2A_{02}+A_{03} \\ A_{10}+A_{11}+A_{12}+A_{13} & 2A_{10}+A_{11}-A_{12}-2A_{13} & A_{10}-A_{11}-A_{12}+A_{13} & A_{10}-2A_{11}+2A_{12}+A_{13} \\ A_{20}+A_{21}+A_{22}+A_{23} & 2A_{20}+A_{21}-A_{22}-2A_{23} & A_{20}-A_{21}-A_{22}+A_{23} & A_{20}-2A_{21}+2A_{22}+A_{23} \\ A_{30}+A_{31}+A_{32}+A_{33} & 2A_{30}+A_{31}-A_{32}-2A_{33} & A_{30}-A_{31}-A_{32}+A_{33} & A_{30}-2A_{31}+2A_{32}+A_{33} \end{bmatrix}\right| \leqslant$$

$$\left|\begin{matrix} E & 2E-E_1-E_3 & E & 2E-E_0-E_2 \\ 2E-E_2-E_3 & E+3E_0-E_1-E_2 & 2E-E_2-E_3 & E+3E_1-E_0-E_3 \\ E & 2E-E_1-E_3 & E & 2E-E_0-E_2 \\ 2E-E_0-E_1 & E+3E_2-E_0-E_3 & 2E-E_0-E_1 & E+3E_3-E_1-E_2 \end{matrix}\right| \tag{13}$$

where

$$E_0 = |e(0,0)+e(0,3)| + |e(3,0)+e(3,3)|,\quad E_1 = |e(0,1)+e(0,2)| + |e(3,1)+e(3,2)|$$
$$E_2 = |e(1,0)+e(1,3)| + |e(2,0)+e(2,3)|,\quad E_3 = |e(1,1)+e(1,2)| + |e(2,1)+e(2,2)|$$

And the coefficient E is defined as

$$E = E_0 + E_1 + E_2 + E_3 \leqslant \sum_{x=0}^{3} \sum_{y=0}^{3} |e_{xy}| = \mathrm{SAD}_{4\times4} \tag{14}$$

Fig. 1 shows the distribution of different frequencies r. When $r = 0$, the following equation can be established by Eq. (13),

$$|\boldsymbol{F}_{uv}|_{\text{upbound}} = E + 5\max_i\{E_i\} \leqslant \mathrm{SAD}_{4\times4} + 5\max_i\{E_i\} \tag{15}$$

where $|\boldsymbol{F}_{uv}|_{\text{upbound}}$ denotes the maximum value of $|\boldsymbol{F}_{uv}|$. According to Ref. [9], we can obtain

$$E < T(Q_{\mathrm{p}}, 0) - 5\max\{E_i\} \tag{16}$$

where

$$T(Q_{\mathrm{p}}, r) = T(r)D(r) \tag{17}$$

2	1	2	1
1	0	1	0
2	1	2	1
1	0	1	0

Fig. 1 Distribution of different frequencies

According to Eqs. (4) and (6), the following equation can be obtained for $r = 0$,

$$E < T(Q_{\mathrm{p}}, 0) - 5\max\{E_i\} \tag{18}$$

where

$$T(Q_{\mathrm{p}}, 0) = \frac{2^q - f}{M(Q_{\mathrm{p}}, 0)} = T(0)D(0) = T(0)2^{2-0} = 4T(0) \tag{19}$$

The threshold is obtained as

$$E \leqslant 4T(0) - 5\max_i\{E_i\} \tag{20}$$

By the same method, the condition for $r = 1$ can be obtained [13] as

$$|\boldsymbol{F}_{uv}|_{\text{upbound}} = 2E - \min\{E_0, E_3\} - \min\{E_1, E_2\} \leqslant 2\mathrm{SAD}_{4\times4} - \min\{E_0, E_3\} - \min\{E_1, E_2\} \tag{21}$$

According to Ref. [9], the following equation can be obtained for $r = 1$,

$$|\boldsymbol{F}_{uv}|_{\text{upbound}} = 2T(Q_p, 1) - \min\{E_0, E_3\} - \min\{E_1, E_2\} \tag{22}$$

Based on Eqs. (6) and (8), the following equation can be obtained for $r = 1$,

$$T(Q_{\mathrm{p}}, 1) = \frac{2^q - f}{M(Q_{\mathrm{p}}, 1)} = T(1)D(1) = T(1)2^{2-1} = 2T(1) \tag{23}$$

Thus, the following inequality can be obtained,

$$E < 2T(1) - \frac{1}{2}\max_i\{E_0, E_3\} - \frac{1}{2}\max_i\{E_1, E_2\} \tag{24}$$

For $r = 2$, the following equation can be obtained from Eq. (14),

$$|\boldsymbol{F}_{uv}|_{\text{upbound}} = E \tag{25}$$

According to Ref. [9], the following equation can be obtained for $r = 2$,

$$|\boldsymbol{F}_{uv}|_{\text{upbound}} = T(Q_{\mathrm{p}}, 2) \tag{26}$$

Based on Eqs. (4) and (6), the following equation can be obtained for $r = 2$,

$$T(Q_{\mathrm{p}}, 2) = \frac{2^q - f}{M(Q_{\mathrm{p}}, 2)} = T(2)D(2) = T(2)2^{2-2} = T(2) \tag{27}$$

Thus, we can obtain

$$E < T(2) \tag{28}$$

From the deduction above, the thresholds for $r = 0$, $r = 1$ and $r = 2$, respectively, can be defined as

$$\left.\begin{aligned} T_0 &= 4T(0) - 5\max_i\{E_i\} \\ T_1 &= 2T(1) - \frac{1}{2}\max_i\{E_0, E_3\} - \frac{1}{2}\max_i\{E_1, E_2\} \\ T_2 &= T(2) \end{aligned}\right\} \tag{29}$$

The final threshold T_{p} can be obtained by

$$T_{\mathrm{p}} = \min\{T_0, T_1, T_2\} \tag{30}$$

However, the proposed algorithm adopts E as the comparison coefficient, which is smaller than $\mathrm{SAD}_{4\times4}$ presented in Refs. [8 - 11].

2.2 Proposed method

It can be seen from Fig. 2[10] that there are more AZBs than non-AZBs when $\mathrm{SAD}_{4\times4}$ is smaller than $2T(0)$. Otherwise, there are fewer AZBs than non-AZBs. Thus, $2T(0)$ is set as a threshold. In addition, more than 99% of the blocks are AZBs when their $\mathrm{SAD}_{4\times4}$ is smaller than $T(1)$ according to the statistical results in Ref. [11]. Therefore, an algorithm is proposed based on the two phenomena and the threshold T_{p} deduced above.

Step 1 If $\mathrm{SAD}_{4\times4} > 2T(0)$, the block is a non-AZB. Perform the integer transform and quantization and go to next block, otherwise go to step 2.

Step 2 If $\mathrm{SAD}_{4\times4} < T(1)$, the block is an AZB. Go to the next block. Otherwise, calculate $T_{\mathrm{p}} = \min\{T_0, T_1, T_2\}$ and go to step 3.

Step 3 If the coefficient E of the current block is smaller than T_p, it is an AZB. Go to the next block. Otherwise, perform the integer transform and quantization.

3 Simulation Results

In order to invalidate the performance of the proposed algorithm, a simulation is performed with the H. 264/AVC

JM12.2 encoder. Four QCIF (176 × 144) sequences, "mother" "silent" "foreman" and "news", are tested in the simulation. There are 300 frames for all the sequences. The QPs are set to 28, 32, 36 and 40, respectively. In addition, the search range is 16 and the number of the conference frames is 5.

Simulation results are listed in Tabs. 1 to 3. Tab. 1 shows all the AZBs detecting rates (ADR) of the four sequences in certain QPs under the algorithms of Moon[9], Su[10], Zhang[10] and the proposed algorithm. The coefficient ADR is defined as follows:

$$\mathrm{ADR}=\frac{N_{\mathrm{p}}}{N}\times 100\% \tag{31}$$

where N_{p} denotes the number of the detected AZBs and N denotes the total number of the residual blocks. Tab. 1 shows that the proposed algorithm can detect more AZBs than the other three algorithms.

Tab. 1 Comparison of AZBs detection ratio %

Sequence	Method	QP			
		28	32	36	40
Mother	Ref. [9]	33.8	52.3	68.1	80.1
	Ref. [10]	39.1	61.7	82.2	87.7
	Ref. [11]	44.2	62.6	84.4	90.7
	The proposed	52.8	65.9	87.0	92.3
Silent	Ref. [9]	26.6	40.9	61.1	74.9
	Ref. [10]	31.8	46.7	68.3	83.2
	Ref. [11]	40.3	54.6	76.8	85.8
	The proposed	48.2	59.5	79.0	87.6
Foreman	Ref. [9]	32.7	48.8	64.3	78.9
	Ref. [10]	38.2	56.3	71.7	86.1
	Ref. [11]	42.9	66.7	79.1	88.5
	The proposed	50.3	68.9	81.7	90.2
News	Ref. [9]	51.2	59.1	73.0	82.5
	Ref. [10]	59.5	68.3	79.2	87.4
	Ref. [11]	64.0	69.3	84.9	91.6
	The proposed	71.5	74.1	87.0	92.8

From the experimental results in Tab. 1, it can be seen that the proposed algorithm outperforms the other three in detecting AZBs. It is reasonable because of the following facts: The threshold $2T(0)$ in step 1 in the proposed algorithm is greater than the threshold $T(2)$ in Zhang's algorithm, which can be seen in Ref. [11]; the coefficient E in step 3 in the proposed algorithm is smaller than the coefficient $\mathrm{SAD}_{4\times4}$ in Zhang's algorithm.

Tab. 1 only shows the superiority of the proposed algorithm over other algorithms in ADR. According to Ref. [11], the computation includes addition (ADD), multiplication (MUL), shift (SFT) and comparison (CMP). When a 4 × 4 residual block is detected as an AZB, the number of computations included in the DCT/Q is 80 in ADD, 16 in MUL and 32 in SFT, respectively. In addition, the number of computations in computing the threshold of T_0, T_1 and T_2 should also be taken into consideration. In the process of computing E, the coefficients E_0, E_1, E_2 and E_3 are computed, which can also be used in computing the threshold of T_0, T_1 and T_2. Therefore, to prove the comprehensive performance of the proposed algorithm, the running time of the four algorithms in various QPs is measured. ΔT is defined to denote the time saving that the algorithms have achieved compared with the H.264/AVC video coding standard. The coefficient ΔT is defined as

$$\Delta T=\frac{t_{\mathrm{s}}-t_{\mathrm{a}}}{t_{\mathrm{s}}}\times 100\% \tag{32}$$

where t_{s} and t_{a} denote the time spent by the standard algorithm and the four other algorithms, respectively.

Tab. 2 Comparison of time saving for the four algorithms %

Sequence	Method	QP			
		28	32	36	40
Mother	Ref. [9]	12.3	22.5	45.3	57.4
	Ref. [10]	14.2	25.5	54.6	68.7
	Ref. [11]	18.6	28.2	60.8	76.3
	The proposed	22.6	35.0	67.5	84.1
Silent	Ref. [9]	11.5	20.6	43.8	51.0
	Ref. [10]	13.3	24.9	537	65.4
	Ref. [11]	17.0	28.1	60.5	75.8
	The proposed	23.4	35.7	68.9	87.3
Foreman	Ref. [9]	12.7	23.1	46.0	56.5
	Ref. [10]	14.4	26.2	55.0	69.6
	Ref. [11]	19.2	29.0	59.4	78.8
	The proposed	24.6	36.2	69.0	89.5
News	Ref. [9]	13.6	24.0	47.4	57.3
	Ref. [10]	15.8	32.6	59.5	74.7
	Ref. [11]	21.3	36.6	64.2	84.9
	The proposed	26.8	42.4	74.3	92.1

From Tab. 2, it can be seen that the proposed algorithm saves more running time than the other three. In addition to the computation saving, it is expected to measure the reduction in the peak signal noise ratio (PSNR) of the proposed algorithm.

The comparison of PSNR between JM12.2 and the proposed algorithm is shown in Tab. 3. From Tab. 3, we can see that the PSNR degrades less than 0.15 dB in the proposed algorithm compared with JM12.2. It can be found from the proposed algorithm that there is less than 1% non-AZBs under the threshold $T(1)$, which will cause some degradation in video quality. The smaller the QPs, the less degradation the PSNR will have. However, the degradation in the PSNR in video quality is insignificant compared with the computation saving that the proposed algorithm obtains.

Tab. 3 Comparison of PSNR between JM12.2 and proposed algorithm dB

Sequence	Method	QP			
		28	32	36	40
Mother	JM12.2	38.13	35.39	33.03	31.01
	The proposed	38.10	35.31	32.96	30.89
	PSNR	0.03	0.08	0.07	0.12
Silent	JM12.2	36.60	33.59	31.00	28.69
	The proposed	36.56	33.56	30.88	28.66
	PSNR	0.04	0.03	0.12	0.13
Foreman	JM12.2	37.31	34.49	31.99	29.36
	The proposed	37.28	34.43	31.86	29.21
	PSNR	0.03	0.06	0.13	0.15
News	JM12.2	37.78	34.57	31.51	28.66
	The proposed	37.73	34.51	31.47	28.59
	PSNR	0.05	0.06	0.04	0.07

4 Conclusion

In order to reduce the computations in H. 264/AVC, an improved algorithm for the early detection of all-zero blocks is proposed. The existing AZBs detection methods are reviewed. Three types of transformed frequency-domain coefficients, which are quantized to zeros, are analyzed. The corresponding spatial coefficients are deduced based on the frequency-domain scaling factors. Then the Schwarz inequality is applied to the derivation of the three thresholds. Another threshold is derived based on the distribution of spatial coefficients, which will lead the block coefficients to become zeros. Finally, a more effective AZB detection algorithm is proposed based on the threshold and the comparison coefficient. The simulation results show that the proposed algorithm outperforms the existing AZB detection algorithms not only in the AZB detection ratio but also in computation saving with insignificant PSNR degradation. For future work, the proposed algorithm is planned to be integrated with the inter/intra mode prediction and the HEVC video encoding.

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一种基于新阈值的视频编码全零块提早判决方法

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摘要:为了降低计算复杂度和编码时间,提出了一种改进的 H. 264/AVC 全零块提早判决方法. 首先,介绍了已有的全零块判决算法,分析了 3 种变换后将量化为零的频域系数,并在 3 种不同频域伸缩因子的基础上推导出对应的空域系数. 然后,根据这些空域系数,并应用 Schwarz 不等式原理,设定了 3 个全零块判决阈值,并根据全零块空域系数的分布情况设定另一个阈值. 最后,结合前 3 个阈值的最小值和后一阈值,提出一种比目前全零块判决算法更为精确的方法. 仿真结果表明,所提方法比目前的全零块判决方法提高了 5% 的全零块判决率,并节省了 4% ~10% 的编码时间,同时仅有 0. 1 dB 的视频质量的降低.

关键词:全零块;视频编码;阈值

中图分类号:TN919. 81