Description

IMAGE CODING PREDICTION MODE SELECTION METHOD

FIELD OF THE INVENTION

[0001]The present invention relates to the field of image coding and decoding, in particular to a method for selecting an image coding prediction mode.

BACKGROUD OF THE INVENTION

[0002]Conventional image coding solutions in the prior art such as JPEG, JPEG 2000 and JPEG XS are simple to implement, yet only adopt basic prediction processing or even no prediction; they merely utilize data of adjacent blocks for reference and fail to fully exploit image redundancy information, leading to low compression efficiency.

[0003]Although video coding standards including H.264 can utilize image redundancy and provide multiple prediction modes with high compression ratios, they still have obvious drawbacks. Inter prediction involves motion estimation and other complex logic that brings heavy resource consumption. In addition, when determining the prediction mode for a target macroblock, decoded reference sample values of the current frame need to be used, which introduces large delay. Furthermore, if local reconstruction quality of encoded images is poor (i.e. the reconstructed pixels of the target macroblock contain severe distortion), such defects will propagate to all macroblocks that take this block as reference, causing error spread and expanding the influence range of distortion.

SUMMARY OF THE INVENTION

[0004]To overcome the deficiencies of the prior art, the present invention provides a method for selecting image coding prediction modes capable of lowering coding delay and boosting image compression efficiency under low hardware cost application scenarios.

[0005]To realize the above objectives, the image coding prediction mode selection method of the present invention comprises the steps below:

[0006](1)Presetting a plurality of coding prediction modes, each corresponding to a set of reference sample values, and a macroblock predicted value can be derived from the reference sample values;

[0007](2)Selecting a fixed quantity of coding prediction modes to form a selection set corresponding to each coding scene;

[0008](3)For a current macroblock, selecting an optimal coding prediction mode based on the macroblock predicted value corresponding to each coding prediction mode within the selection set;

[0009](4)Configuring a prediction mode field to store the optimal coding prediction mode value, and transmitting the field together with the encoded bit stream to the decoding side.

[0010]Wherein the coding prediction modes include Intra Coding Prediction Modes; the Intra Coding Prediction Modes consist of Conventional Intra Coding Prediction Modes and

Description

Isolated Intra Coding Prediction Modes. The Conventional Intra Coding Prediction Modes cover the intra prediction modes defined in the H.264 standard, while the Isolated Intra Coding Prediction Modes calculate reference sample values based on pixel depth during encoding.

[0011]Wherein the coding prediction modes further include Inter Coding Prediction Modes. Under an Inter Coding Prediction Mode, the reference sample value of the current macroblock is the reconstructed sample value at the matching position in the previous frame.

[0012]Wherein the coding scenes include an intra-only scene and a general scene. Only Conventional Intra Coding Prediction Modes are applicable to the intra-only scene, while both Intra Coding Prediction Modes and Inter Coding Prediction Modes are applicable to the general scene.

[0013]Wherein the sub-steps for constructing the coding prediction mode selection set for the general scene are as follows:

[0014](21)Creating an image dataset for the intra-only scene; the dataset size and image pixel dimensions are configured according to practical application requirements;

[0015](22)Configuring encoding network parameters, adopting all Conventional Intra Coding Prediction Modes as the initial selection set, selecting the optimal coding prediction mode to encode the dataset, and calculating a first Peak Signal-to-Noise Ratio (PSNR) after decoding;

[0016](23)Removing one Conventional Intra Coding Prediction Mode from the set while retaining the rest; selecting the optimal coding prediction mode from the remaining set to encode the dataset, and calculating a second Peak Signal-to-Noise Ratio (PSNR) after decoding;

[0017](24)Comparing the first PSNR with each second PSNR sequentially, screening the second PSNR with the minimum deviation from the first PSNR, and marking the correspondingly removed mode as a Negligible Conventional Intra Coding Prediction Mode;

[0018](25)Replacing the Negligible Conventional Intra Coding Prediction Mode with an Isolated Intra Coding Prediction Mode to form the Intra Coding Prediction Mode selection set for general scenes; replacing the Negligible Conventional Intra Coding Prediction Mode with an Inter Coding Prediction Mode to form the Inter Coding Prediction Mode selection set for general scenes.

[0019]Wherein the steps of selecting the optimal coding prediction mode under Step (3) are as follows:

[0020](31)Inputting position information of the current macroblock and the coding prediction mode selection set corresponding to the current scene;

[0021](32)For each Conventional Intra Coding Prediction Mode, retrieving the matching reference sample values from the source image of the frame where the current macroblock is located;

Description

[0022](33)Obtaining the macroblock predicted value corresponding to each coding prediction mode, and selecting the optimal coding prediction mode from the set in accordance with predetermined rules.

[0023]Wherein the prediction mode field under Step (4) comprises a flag bit and data bits; the sub-steps for configuring the field to store the optimal coding prediction mode value are as follows:

[0024](41)Initialising the optimal coding prediction mode value of the previous macroblock;

[0025](42)If the optimal coding prediction mode value of the current macroblock equals that of the previous macroblock, set the flag bit to 1 and set the field length to 1; otherwise proceed to Sub-step (43);

[0026](43)If the optimal coding prediction mode value of the current macroblock is smaller than that of the previous macroblock, set the flag bit to 0, assign the current mode value to the data bits, and set the field length to 4; otherwise proceed to Sub-step (44);

[0027](44)Set the flag bit to 0, assign the value of the current optimal mode minus 1 to the data bits, and set the field length to 4.

[0028]Compared with the prior art, the present invention has the following beneficial effects:

[0029]By Presetting a plurality of coding prediction modes, reference sample values are not only extracted from the current frame but also contain absolute reference sample values and reconstructed sample values from reference frames, which fully utilizes image redundancy and improves compression efficiency. The adoption of absolute reference sample values realizes block isolation for local regions to effectively avoid error propagation and stabilize image reconstruction quality.A fixed quantity of coding prediction modes are defined within each selection set, and independent coding prediction mode selection sets are assigned for distinct coding scenes, which reduces bit occupation and saves encoded bit stream. Further optimization is conducted on prediction mode selection: for Conventional Intra Coding Prediction Modes, matching reference sample values are retrieved from the source image of the frame containing the current macroblock; the optimal coding prediction mode is screened based on macroblock predicted values in accordance with predetermined rules. This scheme reduces hardware resource consumption and coding delay, and achieves high coding efficiency and favorable subjective visual quality under low-cost deployment conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]Fig. 1 is a schematic flow chart of the method for selecting an image coding prediction mode in the present invention;

[0031]Fig. 2 is a schematic diagram of preset coding prediction modes in the present invention, where Fig. 2(a) is a schematic diagram of a conventional intra-frame coding prediction mode model_0; Fig. 2(b) is a schematic diagram of a conventional intra-frame

coding prediction mode model_1; Fig. 2(c) is a schematic diagram of a conventional intra-frame coding prediction mode model_2; Fig. 2(d) is a schematic diagram of a conventional intra-frame coding prediction mode model_3; Fig. 2(e) is a schematic diagram of a conventional intra-frame coding prediction mode model_4; Fig. 2(f) is a schematic diagram of a conventional intra-frame coding prediction mode model_5; Fig. 2(g) is a schematic diagram of a conventional intra-frame coding prediction mode model_6; Fig. 2(h) is a schematic diagram of a conventional intra-frame coding prediction mode model_7; Fig. 2(i) is a schematic diagram of a conventional intra-frame coding prediction mode model_8; Fig. 2(j) is a schematic diagram of an isolated intra-frame coding prediction mode model_9; Fig. 2(k) is a schematic diagram of an inter-frame coding prediction mode model_10;

[0032]Fig. 3 is a schematic diagram of a distribution of image frames in a general scene;

[0033]Fig. 4 is a schematic diagram of another distribution of image frames in a general scene;

[0034]Fig. 5 is a schematic flow chart of selecting the optimal coding prediction mode in the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0035]The present invention will be further described below in conjunction with the embodiments.

[0036]In the image coding process, coding prediction is generally performed by taking a macroblock as a unit, and the selection of a coding prediction mode in the coding prediction process will affect the stability of image quality, coding efficiency and compression efficiency. The present invention improves the selection of the image coding prediction mode, which can save the bitstream and improve the coding and compression performance, and can also achieve high coding efficiency and good subjective effects for FPGA or low hardware cost implementation scenarios.

[0037]As shown in Fig. 1, the method for selecting an image coding prediction mode of the present invention comprises the following steps:

[0038](1)Presetting several coding prediction modes, each corresponding to a set of reference sample values, from which macroblock prediction values can be obtained;

[0039](2)Selecting a fixed number of coding prediction modes as a selection set for the corresponding coding prediction mode according to the coding scene;

[0040](3)For the current macroblock, selecting the optimal coding prediction mode based on the macroblock prediction values corresponding to each coding prediction mode in the selection set;

[0041](4) Setting a prediction mode field to store the optimal coding prediction mode value, which is then sent to the decoding end along with the encoded bitstream.

Description

[0042]The above steps will be described in detail below in conjunction with specific embodiments.

[0043]Image coding in the present invention includes intra-frame coding and inter-frame coding. Intra-frame coding codes a macroblock only through intra-frame coding prediction; inter-frame coding codes a macroblock also through inter-frame coding prediction.

Intra-frame coding prediction and inter-frame coding prediction are mainly distinguished by the reference sample values corresponding to the coding prediction modes. Intra-frame coding prediction refers to the process of predicting and generating a current macroblock by using recovered sample values in the current frame as reference sample values; inter-frame coding prediction refers to the process of predicting and generating a current macroblock by using recovered sample values of a reference image (i.e., the previous frame) as reference sample values. For the convenience of description, the coding prediction mode adopting data of the corresponding block in the current frame as reference sample values is referred to as a conventional intra-frame coding prediction mode in the present invention, and the coding prediction mode adopting recovered sample values of the corresponding position in the previous image frame as reference sample values is referred to as an inter-frame coding prediction mode in the present invention.

[0044]**(1) Setting of Coding Prediction Modes**

[0045]As shown in Fig. 2, taking the coding prediction of a 4×4 macroblock as an example, the present invention sets 11 coding prediction modes, including intra-frame coding prediction modes and inter-frame coding prediction modes, wherein the intra-frame coding prediction modes include conventional intra-frame coding prediction modes model_0 to model_8 and an isolated intra-frame coding prediction mode model_9; the above conventional coding prediction modes model_0 to model_8 are the same as the intra_4×4 intra-frame prediction modes in H264, and their corresponding reference sample values are as follows.

[0046]Conventional intra-frame coding prediction mode model_0 (Vertical)The sample values above the current macroblock are used as reference sample values to predict the current macroblock. Assuming that the values above the current macroblock are p[x,-1] (x=0,...3), the prediction value $pred4x4_L[x, y]$ (x, y = 0...3) of the current macroblock is calculated as follows:

[0047]$pred4x4_L[x, y] = p[x,-1]$， x, y = 0..3.

[0048]Conventional intra-frame coding prediction mode model_1 (Horizontal)The sample values on the left of the current macroblock are used as reference sample values to predict the current macroblock. Assuming that the values on the left of the current macroblock are p[-1, y] (y = 0,...3), the prediction value $pred4x4_L[x, y]$ (x, y = 0,...3) of the current macroblock is as follows:

Description

[0049]pred4x4$_L$[x, y] = p[-1, y] (x, y = 0,...3).

[0050]Conventional intra-frame coding prediction mode model_2 (DC)The prediction value pred4x4$_L$[x, y] (x, y = 0,...3) of the current macroblock is obtained as follows:

[0051]pred4x4$_L$[x, y] = (p[0,-1]+p[1,-1]+p[2,-1]+p[3,-1]+

[0052]p[-1, 0]+p[-1, 1]+p[-1, 2]+p[-1, 3]+4)>>3.

[0053]Conventional intra-frame coding prediction mode model_3 (Diagonal Down-Left)The prediction value pred4x4L[x, y] (x, y = 0,...3) of the current macroblock is obtained as follows:

[0054]If x=3 and y=3,

[0055]pred4x4$_L$[x, y] = (p[6,-1]+3*p[7,-1]+2)>>2;*

[0056]*Otherwise (x≠3 and y≠3),*

[0057]*pred4x4$_L$[x, y] = (p[x+y,-1]+2*p[x+y+1,-1]+p[x+y+2,-1]+2)>>2.

[0058]Conventional intra-frame coding prediction mode model_4 (Diagonal Down-Right)The prediction value pred4x4$_L$[x, y] (x, y = 0,...3) of the current macroblock is obtained as follows:

[0059]If x>y,

[0060]pred4x4$_L$[x, y] = (p[x-y-2,-1]+2*p[x-y-1,-1]+p[x-y,-1]+2)>>2;

[0061]Otherwise, if x<y,

[0062]pred4x4$_L$[x, y] = (p[-1, y-x-2]+2*p[-1, y-x-1]+p[-1, y-x]+2)>>2;

[0063]Otherwise (x=y),

[0064]pred4x4$_L$[x, y] = (p[0,-1]+2*p[-1,-1]+p[-1, 0]+2)>>2.

[0065]Conventional intra-frame coding prediction mode model_5 (Vertical-Right)Let zVR=2*x-y, the prediction value pred4x4L[x, y] (x, y = 0,...3) of the current macroblock is as follows:*

[0066]*If zVR=0, 2, 4 or 6,*

[0067]*pred4x4$_L$[x, y] = (p[x-(y>>1)-1,-1]+p[x-(y>>1),-1]+1)>>1;*

[0068]*Otherwise, if zVR=1, 3 or 5,*

[0069]*pred4x4$_L$[x, y] = (p[x-(y>>1)-2,-1]+2*p[x-(y>>1)-1,-1]+p[x-(y>>1),-1]+2)>>2;*

[0070]Otherwise, if zVR=-1,

[0071]pred4x4$_L$[x, y] = (p[-1, 0]+2*p[-1,-1]+p[0,-1]+2)>>2;*

[0072]*Otherwise (zVR=-2 or -3),*

[0073]*pred4x4$_L$[x, y] = (p[-1, y-1]+2*p[-1, y-2]+p[-1, y-3]+2)>>2.*

[0074]Conventional intra-frame coding prediction mode model_6 (Horizontal-Down)，Let zHD=2*y-x, the prediction value pred4x4L[x, y] (x, y = 0,...3) of the current macroblock is obtained as follows:*

[0075]*If zHD=0, 2, 4 or 6,*

[0076]*pred4x4$_L$[x, y] = (p[-1, y-(x>>1)-1]+p[-1, y-(x>>1)]+1)>>1;*

[0077]*Otherwise, if zHD=1, 3 or 5,*

[0078]$pred4x4_L[x, y] = (p[-1, y-(x>>1)-2]+2$p[-1, y-(x>>1)-1]+p[-1, y-(x>>1)]+2)>>2;

[0079]Otherwise, if zHD=-1,

[0080]$pred4x4_L[x, y] = (p[-1, 0]+2p[-1,-1]+p[0,-1]+2)>>2;$

[0081]*Otherwise (zHD=-2 or -3),*

[0082]$pred4x4_L[x, y] = (p[x-1,-1]+2$p[x-2,-1]+p[x-3,-1]+2)>>2.

[0083]Conventional intra-frame coding prediction mode model_7 (Vertical-Left)The prediction value $pred4x4_L[x, y]$ (x, y = 0,...3) of the current macroblock is obtained as follows:

[0084]If y=0 or 2,

[0085]$pred4x4_L[x, y] = (p[x+(y>>1),-1]+p[x+(y>>1)+1,-1]+1)>>1;$

[0086]Otherwise (y=1 or 3),

[0087]$pred4x4_L[x,y]=(p[x+(y>>1),-1]+2*p[x+(y>>1)+1,-1]+p[x+(y>>1)+2,-1]+2)>>2.$

[0088]Conventional intra-frame coding prediction mode model_8 (Horizontal-Up)Let the variable zHU=x+2*y, the prediction value pred4x4L[x, y] (x, y = 0,...3) of the current macroblock is obtained as follows:*

[0089]*If zHU=0, 2 or 4,*

[0090]$pred4x4_L[x, y] = (p[-1, y+(x>>1)]+p[-1, y+(x>>1)+1]+1)>>1;$

[0091]*Otherwise, if zHU=1 or 3,*

[0092]$pred4x4_L[x,y]=(p[-1,y+(x>>1)]+2$p[-1, y+(x>>1)+1]+p[-1, y+(x>>1)+2]+2)>>2;

[0093]Otherwise, if zHU=5,

[0094]$pred4x4_L[x, y] = (p[-1, 2]+3*p[-1, 3]+2)>>2;$

[0095]Otherwise (zHU>5),

[0096]$pred4x4_L[x, y] = p[-1, 3].$

[0097]The above isolated intra-frame coding prediction mode model_9 (Fix Value) performs prediction by taking a fixed value as the reference sample value. If the image to be coded is very complex and the network transmission bandwidth is limited, a large QP (Quantization Parameter) is required in the coding process to meet the network bandwidth; however, when the QP is large, the recovered sample values will be relatively blurred with large distortion. If a recovered sample value with poor recovery is selected as the reference sample value when coding a macroblock, the recovery of the current block will also be poor, which will lead to error accumulation and unstable quality of the recovered image. The present invention sets the isolated intra-frame coding prediction mode model_9, which takes a fixed value as the reference sample value to directly obtain the macroblock prediction value, so that the recovery of the current macroblock will not be affected by surrounding pixels regardless of the recovery quality of surrounding pixels. In addition, when the image is complex and the

surrounding pixels are poorly recovered (e.g., random images), the isolated intra-frame coding prediction mode model_9 is relatively easy to be selected.

[0098]The above fixed value is calculated according to the pixel depth in the coding process, and the calculation method is fix_val = 1<<(depth-1), where fix_val is the fixed value and depth is the pixel depth in the coding process. For example, if the pixel depth in the coding process is 10 bits, then fix_val is 512 (1<<9).

[0099]The above symbol "<<" denotes left shift, and ">>" denotes right shift.

[0100]Based on the control of hardware cost, the present invention does not perform motion estimation, but directly uses the block data of the corresponding position in the previous frame to obtain reference sample values, and sets an inter-frame coding prediction mode model_10 (Ref Blk). That is, in the coding process, the inter-frame coding prediction mode model_10 takes the 4×4 recovered sample values of the corresponding position in the reference frame, i.e., the previous frame, as the reference sample values to directly obtain the macroblock prediction value.

[0101]**(2) Determining the Selection Set of Coding Prediction Modes According to Coding Scenes and Coding Modes**

[0102]The present invention involves two scenes: one is a scene where only intra-frame coding can be used, which is marked as an all-intra scene in the present invention; the other is a scene where both intra-frame coding and inter-frame coding can be used, which is marked as a general scene in the present invention.

[0103]In different scenes, the present invention limits the selection set of coding prediction modes to 9 types, which can save the bitstream and improve the coding and compression performance.

[0104]The all-intra scene can be applied in the case of limited hardware conditions without a DDR (Double Data Rate), and the entire coding process only uses the data of the current frame and only involves intra-frame coding modes. In the present invention, the selection set of coding prediction modes for the all-intra scene is set to the nine modes including the conventional intra-frame coding prediction modes model_0 to model_8 in Fig. 2.

[0105]For the general scene where intra-frame coding and inter-frame coding are used, the present invention involves two types of general scenes.

[0106]For the general scene, determining the selection set of coding prediction modes comprises the following steps:

[0107](21)Creating an image data set for the all-intra scene, where the size and image pixel dimension of the image data set are set specifically according to actual applications;

[0108](22)Configuring network parameters, taking all conventional intra-frame coding prediction modes model_0 to model_8 as the selection set of coding prediction modes,

selecting an optimal coding prediction mode to code the image data set, and calculating a first peak signal-to-noise ratio (PSNR) after decoding;

[0109](23)Removing one conventional intra-frame coding prediction mode model_i (i=0,1,2,.....,8) from the selection set while retaining the other coding prediction modes, then selecting an optimal coding prediction mode from the remaining coding prediction modes to code the image data set, and calculating a second peak signal-to-noise ratio PSNRi after decoding;

[0110](24)Comparing the values of the first peak signal-to-noise ratio PSNR and the second peak signal-to-noise ratio PSNRi in sequence, selecting the second peak signal-to-noise ratio PSNRi with the smallest difference from the first peak signal-to-noise ratio PSNR, determining which conventional intra-frame coding prediction mode has the smallest impact on the first peak signal-to-noise ratio PSNR when replaced, and marking the corresponding removed conventional intra-frame coding prediction mode model_i as a negligible conventional intra-frame coding prediction mode;

[0111](25) Replacing the negligible conventional intra-frame coding prediction mode with an isolated intra-frame coding prediction mode to form a selection set of coding prediction modes for intra-frame coding in the general scene; and replacing the negligible conventional intra-frame coding prediction mode with an inter-frame coding prediction mode to form a selection set of coding prediction modes for inter-frame coding in the general scene.

As an implementation manner, an image data set consisting of 265 pieces of image data is created, including natural images, screen images, etc., with an image size of 3840×2160 and a network bandwidth of 500 Mbps. The above relevant parameters can be set according to actual needs. The general scene in the present invention includes the following two manners.

[0113]As shown in Fig. 3, in the coding process, intra-frame coding is performed on image frames at fixed time intervals, the corresponding frames are marked as I-frames (intraframe frames), and the remaining frames are coded by inter-frame coding and marked as P-frames (forward Predicted frames). If replacing the conventional intra-frame coding prediction mode model_8 has the least impact on the first peak signal-to-noise ratio PSNR, then it is the negligible conventional intra-frame coding prediction mode. For I-frames, the nine prediction modes including the conventional intra-frame coding prediction modes model_0 to model_7 and the isolated intra-frame coding prediction mode model_9 in Fig. 2 are selected as the selection set; for P-frames, the nine prediction modes including the conventional intra-frame coding prediction modes model_0 to model_7 and the inter-frame coding prediction mode model_10 in Fig. 2 are selected as the selection set.

[0114]As shown in Fig. 4, a GDR (Gradual Decoding Refresh) mode is adopted, and each frame contains both intra-frame and inter-frame coding modes. Specifically, each frame is divided into n equal parts, 1 part of which is selected for intra-frame coding (referred to as an

intra-slice), and the remaining parts are coded by inter-frame coding (referred to as inter-slices). The advantage of the second manner over the first is that the bitstream size of each frame is more uniform, which is conducive to network transmission. In this scene, intra-slices are coded by intra-frame coding; if the conventional intra-frame coding prediction mode model_8 has the least impact on the first peak signal-to-noise ratio PSNR, it is the negligible conventional intra-frame coding prediction mode, and the nine prediction modes including the conventional intra-frame coding prediction modes model_0 to model_7 and the isolated intra-frame coding prediction mode model_9 are selected as the selection set. Inter-slices are coded by inter-frame coding, and the nine prediction modes including the conventional intra-frame coding prediction modes model_0 to model_7 and the inter-frame coding prediction mode model_10 are selected as the selection set in the present invention.

[0115]**(3) Selecting the Optimal Coding Prediction Mode from the Selection Set of Coding Prediction Modes**

[0116]As shown in Fig. 5, the selection of the optimal coding prediction mode requires the following steps:

[0117](31)Inputting position information of a current macroblock and a selection set of coding prediction modes for a corresponding scene;

[0118](32)For a conventional intra-frame coding prediction mode, acquiring a reference sample value corresponding to the coding prediction mode from a source image of an image frame where the current macroblock is located; for an inter-frame coding prediction mode, the reference sample value of the current macroblock is still the recovered sample value of the corresponding position in the previous image frame; for an isolated intra-frame coding prediction mode, the reference sample value is still a fixed value;

[0119](33) Acquiring a macroblock prediction value corresponding to each coding prediction mode in the selection set, and selecting an optimal coding prediction mode from the selection set according to a preset rule.

[0120]The preset rule in the above step (33) is as follows: subtracting the pixel components of the current macroblock and the macroblock prediction value at the corresponding positions, summing the absolute values of the differences, taking the obtained value as an evaluation index, and selecting the coding prediction mode with the smallest value as the optimal coding prediction mode, i.e., the SAD (Sum of Absolute Difference) of H264.

[0121]In the prior art, when selecting the optimal coding prediction mode for the next macroblock, the reference sample values adopted by each intra-frame coding prediction mode need to use the decoded image information of the previous macroblock, i.e., the next macroblock can complete a new round of optimal coding prediction mode selection by using the decoded image information of the current macroblock only after the current macroblock is processed through steps such as DCT, quantization, inverse quantization and IDCT.

[0122]Compared with the prior art, although in the actual coding process, the conventional intra-frame prediction coding mode in the present invention still uses the recovered sample values in the current frame as reference sample values to predict and generate the current macroblock; the inter-frame coding prediction still uses the recovered sample values of the reference image (i.e., the previous frame) as reference sample values to predict and generate the current macroblock. However, when selecting the optimal coding prediction mode in the present invention, the conventional intra-frame prediction coding mode directly uses source image information as the reference sample values, so that the next macroblock can be processed directly after determining the optimal coding prediction mode of the current macroblock, reducing the delay.

[0123]**(4) Coding of the Optimal Coding Prediction Mode**

[0124]Considering that 9 coding prediction modes can be represented by 3-bit data bits combined with 1-bit flag bit, but more than 9 modes must use 4 bits, so each macroblock has one more bit for the prediction mode, which will increase the coding overhead. For example, for a 3840×2160 image, there are a total of 518,400 4×4 macroblocks; if the prediction mode of each block is coded, the prediction algorithm with more than 9 modes will have 518,400 more bits than that with 9 modes; if the network bandwidth is 500 Mbps and 60 frames per second, the average compressed size of a 3840×2160 image is 8,333,333 bits, so 518,400 bits occupy 6% of the bitstream. To save the bitstream, the infrequently used prediction modes are directly replaced, and finally 9 prediction modes are limited in all scenes.

[0125]The present invention sets a prediction mode field to store the value of the optimal coding prediction mode. Taking that the coding prediction selection set in the present invention includes 9 prediction coding modes as an example, the prediction mode field includes a 1-bit flag bit and 3-bit data bits, and the length code_len of the prediction mode field is adjusted according to the magnitude relationship between the value of the optimal coding prediction mode of the current macroblock and that of the previous macroblock, with a value of 1 or 4. Specifically, the coding of the optimal coding prediction mode comprises the following steps:

[0126](41) Initializing the value prev_mode of the optimal coding prediction mode of a previous macroblock;

[0127](42) If the value curr_mode of the optimal coding prediction mode of the current macroblock is equal to the value prev_mode of the optimal coding prediction mode of the previous macroblock, setting the flag bit mode_is_equal_flag of the prediction mode field to 1 and the value of the length code_len of the prediction mode field to 1; otherwise, proceeding to step (43);

[0128](43) If the value curr_mode of the optimal coding prediction mode of the current macroblock is less than the value prev_mode of the optimal coding prediction mode of the

previous macroblock, setting the flag bit mode_is_equal_flag of the prediction mode field to 0, the value code_val of the data bit to the value curr_mode of the optimal coding prediction mode of the current macroblock, and the value of the length code_len of the prediction mode field to 4; otherwise, proceeding to step (44);

[0129](44) Setting the flag bit mode_is_equal_flag of the prediction mode field to 0, the value code_val of the data bit to the value obtained by subtracting 1 from the value curr_mode of the optimal coding prediction mode of the current macroblock, and the value of the length code_len of the prediction mode field to 4.

[0130]The value range of the value prev_mode of the optimal coding prediction mode of the previous macroblock in the above step (43) is 0~8; since the value curr_mode of the optimal coding prediction mode of the current macroblock is less than the value prev_mode of the optimal coding prediction mode of the previous macroblock, the maximum value of the value curr_mode of the optimal coding prediction mode of the current macroblock is 7, so only 3-bit data bits and a 1-bit flag bit "0" need to be coded.

[0131]The value range of the value curr_mode of the optimal coding prediction mode of the current macroblock in the above step (44) is 1~8; since it is greater than the value prev_mode of the optimal coding prediction mode of the previous macroblock, it cannot be less than 1. Therefore, if the value curr_mode of the optimal coding prediction mode of the current macroblock is less than 8, the value code_val (curr_mode-1) of the data bit is less than 7, and 3-bit data bits are sufficient; if the value curr_mode of the optimal coding prediction mode of the current macroblock is 8, the value code_val of the data bit is 7 (curr_mode-1), and 3 bits are still sufficient, so only 3-bit data bits and a 1-bit flag bit "0" need to be coded.

[0132]At the decoding end, corresponding to the coding end, the decoding of the optimal coding prediction mode comprises the following steps:

[0133](51) Initializing the value prev_mode of the optimal coding prediction mode of a previous macroblock, with the initial value being consistent with that at the coding end;

[0134](52) If the flag bit mode_is_equal_flag of the prediction mode field is 1, setting the value curr_mode of the optimal coding prediction mode of the current macroblock to be equal to the value prev_mode of the optimal coding prediction mode of the previous macroblock; otherwise, proceeding to step (53);

[0135](53) If the value code_val of the data bit is greater than the value prev_mode of the optimal coding prediction mode of the previous macroblock, setting the value curr_mode of the optimal coding prediction mode of the current macroblock to the value code_val+1 of the data bit; otherwise, proceeding to step (54);

[0136](54) Setting the value curr_mode of the optimal coding prediction mode of the current macroblock to the value code_val of the data bit.

[0137]That is, the present invention can code 9 coding prediction modes in the selection set with only 4 bits (including the flag bit), and effective decoding can also be performed at the decoding end.

[0138]The present invention only takes the coding prediction of a 4×4 macroblock as an example, and the method of the present invention is still applicable to macroblocks of other sizes such as 8×8, with the only difference being the total number of macroblocks per image.

[0139]The preferred embodiments of the present invention have been described in detail above, however, the present invention is not limited to the specific details in the above embodiments, and various equivalent transformations can be made to the technical solutions of the present invention within the scope of the technical concept of the present invention, and these equivalent transformations all fall within the protection scope of the present invention.

Claims

1.A method for selecting image coding prediction modes, the method comprises the steps below:
(1)Presetting a plurality of coding prediction modes; each coding prediction mode corresponds to a set of reference sample values, and a macroblock predicted value can be derived from the reference sample values;
(2)Selecting a fixed quantity of coding prediction modes to form a selection set corresponding to each coding scene;
(3)For a current macroblock, selecting an optimal coding prediction mode based on the macroblock predicted value corresponding to each coding prediction mode within the selection set;
(4) Configuring a prediction mode field to store the optimal coding prediction mode value, and transmitting the field together with the encoded bit stream to the decoding side.
2.The method according to Claim 1, wherein the coding prediction modes include Intra Coding Prediction Modes; the Intra Coding Prediction Modes consist of Conventional Intra Coding Prediction Modes and Isolated Intra Coding Prediction Modes; the Conventional Intra Coding Prediction Modes cover the intra prediction modes defined in the H.264 standard; the Isolated Intra Coding Prediction Modes calculate reference sample values based on pixel depth during encoding.
3.The method according to Claim 2,wherein the coding prediction modes further include Inter Coding Prediction Modes; under an Inter Coding Prediction Mode, the reference sample value of the current macroblock is the reconstructed sample value at the matching position in the previous frame.
4.The method according to Claim 3,wherein the coding scenes include an intra-only scene and a general scene, and both Intra Coding Prediction Modes and Inter Coding Prediction Modes are applicable to the general scene.
5.The method according to Claim 4,wherein only Conventional Intra Coding Prediction Modes are applicable to the intra-only scene.
6.The method according to Claim 4,wherein the sub-steps for constructing the coding prediction mode selection set for the general scene are as follows:
(21) Creating an image dataset for the intra-only scene; the dataset size and image pixel dimensions are configured according to practical application requirements;
(22) Configuring encoding network parameters, adopting all Conventional Intra Coding Prediction Modes as the initial selection set, selecting the optimal coding prediction mode to encode the dataset, and calculating a first Peak Signal-to-Noise Ratio (PSNR) after decoding;
(23) Removing one Conventional Intra Coding Prediction Mode from the set while retaining the rest; selecting the optimal coding prediction mode from the remaining set to encode the dataset, and calculating a second Peak Signal-to-Noise Ratio (PSNR) after decoding;

(24) Comparing the first PSNR with each second PSNR sequentially, screening the second PSNR with the minimum deviation from the first PSNR, and marking the correspondingly removed mode as a Negligible Conventional Intra Coding Prediction Mode;
(25) Replacing the Negligible Conventional Intra Coding Prediction Mode with an Isolated Intra Coding Prediction Mode to form the Intra Coding Prediction Mode selection set for general scenes; replacing the Negligible Conventional Intra Coding Prediction Mode with an Inter Coding Prediction Mode to form the Inter Coding Prediction Mode selection set for general scenes.

7.The method according to Claim 6,wherein the image frames in the general scene include I-frames and P-frames; intra coding is applied to I-frames, and inter coding is applied to P-frames.

8.The method according to Claim 6,wherein the image frames in the general scene adopt GDR coding mode; intra-slice regions use intra coding, and inter-slice regions use inter coding.

9.The method according to any one of Claims 5 to 8,wherein the steps of selecting the optimal coding prediction mode under Step (3) are as follows:
(31) Inputting position information of the current macroblock and the coding prediction mode selection set corresponding to the current scene;
(32) For each Conventional Intra Coding Prediction Mode, retrieving the matching reference sample values from the source image of the frame where the current macroblock is located;
(33) Obtaining the macroblock predicted value corresponding to each coding prediction mode, and selecting the optimal coding prediction mode from the set in accordance with predetermined rules.

10.The method according to any one of Claims 5 to 8,wherein the prediction mode field under Step (4) comprises a flag bit and data bits; the sub-steps for configuring the field to store the optimal coding prediction mode value are as follows:
(41) Initialising the optimal coding prediction mode value of the previous macroblock;
(42) If the optimal coding prediction mode value of the current macroblock equals that of the previous macroblock, set the flag bit to 1 and set the field length to 1; otherwise proceed to Sub-step (43);
(43) If the optimal coding prediction mode value of the current macroblock is smaller than that of the previous macroblock, set the flag bit to 0, assign the current mode value to the data bits, and set the field length to 4; otherwise proceed to Sub-step (44);
(44) Set the flag bit to 0, assign the value of the current optimal mode minus 1 to the data bits, and set the field length to 4.