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DESCRIPTION

[0001] This application claims priority to Chinese Patent Application No. 201110057694.9, filed with the Chinese Patent Office on March 10, 2011 and entitled "METHOD AND APPARATUS FOR ENCODING AND DECODING TRANSFORM COEFFICIENTS".

TECHNICAL FIELD

[0002] The present invention relates to the field of video processing technologies, and in particular, to a method and an apparatus for encoding and decoding transform coefficients.

BACKGROUND

[0003] Entropy coding in conventional video coding technologies mainly adopts run-length coding and arithmetic coding. For example, in the H.264 coding standard, a context adaptive variable length coder (Context Adaptive Variable Length Coder, CAVLC) and a context adaptive binary arithmetic coder (Context Adaptive Binary Arithmetic Coder, CABAC) are used. The two entropy coding modes fully utilize correlation between encoded information and information that needs to be encoded currently. Specifically, a code table or a probability model of information that needs to be encoded currently is built by using the encoded information, which is called context-based entropy coding. Due to using an arithmetic encoding idea, the CABAC has better coding performance than the CAVLC, but increases complexity greatly. Because context information is used, current coding information cannot be encoded until adjacent coding information is encoded completely, while parallel operations cannot be performed. As a result, the entropy coding algorithm becomes a bottleneck in the encoding and decoding. To increase the encoding efficiency, a High Efficiency Video Coding, (HEVC) video coding standard being established, which is a next generation video compression standard, proposes the following arithmetic coding processes:

1. A. Encode a map of non-zero transform coefficients (significance map). In this step, an entire transform coefficient block that needs to be encoded is encoded in predetermined scan order, which is also called wide-range scan mode, for example, wide-range Z-shaped (zig-zag) mode; the predetermined scan order may also be scan order in wide-range vertical or wide-range horizontal mode, and accordingly, when encoding is performed subsequently in sub-block mode, scan order in narrow-range vertical mode or in narrow-range horizontal mode is used.
   In a process of performing step A, each frequency corresponds to a position in a map. When a frequency is 0, the value of a corresponding position in the map is 0; when the frequency is a non-zero value, the value of the corresponding position in the map is 1. In addition, whether a current frequency is a last non-zero frequency is judged. If the current frequency is the last non-zero frequency, the value of the corresponding position

is 11 (two Is rather than eleven); otherwise, the value of the position is 10 (1 and 0 rather than ten). In the process of encoding the map, if 11 appears in the sequence of 0s and 1s representing the map, it is determined that a transform coefficient block is encoded completely.

2. B. Encode a map (map) of transform coefficients (coefficients) greater than 1 in sub-block mode. In this step, a map of sub-blocks greater than 1 in the entire transform coefficient block is encoded in predetermined scan order, which is also called narrow-range scan mode, for example, narrow-range zig-zag mode.
3. C. Encode absolute values of coefficients greater than 1 in sub-block mode by using a narrow-range zig-zag mode.
4. D. Encode positive and negative signs of non-zero coefficients in sub-block mode and by using a narrow-range zig-zag mode. The foregoing steps B to D are performed on a cyclic basis until all the sub-blocks are encoded completely.

[0004] In the foregoing steps, the sub-block mode is defined as follows by using an 8x8 transform coefficient block as an example: An upper left 4x4 transform coefficient block is encoded firstly, followed by an upper right 4x4 transform coefficient block, a lower left 4x4 transform coefficient block, and a lower right 4x4 transform coefficient block. The foregoing 4x4 transform coefficient blocks are sub-blocks of an 8x8 transform coefficient block. The scan order of the wide-range zig-zag mode and the scan order of the narrow-range zig-zag mode are illustrated in FIG. 1A and FIG. 1B respectively, where each small box represents a frequency, and the numbers in the boxes represent the scan order. It is evident that the scan order of the wide-range zig-zag mode and the narrow-range zig-zag mode is based on the same scan rule. For different scanned objects, however, from the perspective of the entire transform coefficient block, the scan order is different between step A of encoding the significance map and step B to step D of encoding absolute values (levels) of transform coefficients and encoding positive and negative signs (signs) of non-zero transform coefficients. Due to different scan order, data needs to be read once respectively in the process of performing step A and performing step B to step D; and two table lookup modes corresponding to the two order types need to be fixed at a decoding end, causing high encoding and decoding overheads and low efficiency. In addition, in step A, if the transform coefficient block is relatively large, which is usually called a large transform unit, for example, a 32x32 significance map, encoding a large significance map causes a heavy burden during hardware designs. The following document discloses a method of scan processing for high efficiency coefficient coding, which divides the coefficients into chunks of size 16 or less within the scan, and processes the coefficients on a chunk basis:
BENJAMIN BROSS ET AL.: "High Efficiency Video Coding (HEVC) text specification draft 6", JOINT COLLABORATIVE TEAM ON VIDEO CODING (JCT-VC) OF ITU-T SG16 WP3 AND ISO/IEC JTC1/SC29/WG11 7TH MEETING, 10 February 2012 (2012-02-10).

SUMMARY

[0005] The technical problem solved by embodiments of the present invention is to provide a method and an apparatus for encoding and decoding transform coefficients to reduce encoding and decoding overheads and increase encoding and decoding efficiency.

[0006] A method for encoding transform coefficients includes:

encoding transform coefficients of a transform coefficient block with a size of 8x8 or 32x32 according to a predetermined scan order by which a set number of transform coefficients in each group is encoded until a last group of the transform coefficient block is encoded; storing an obtained map of non-zero transform coefficients, absolute values of transform coefficients, and positive and negative signs of non-zero transform coefficients; and

when the last group is being encoded, after obtaining a map of non-zero transform coefficients encoded in the last group, writing the stored map of non-zero transform coefficients and the map of non-zero transform coefficients encoded in the last group into a bit stream; after obtaining absolute values of transform coefficients and positive and negative signs of non-zero transform coefficients encoded in the last group, writing the stored absolute values of transform coefficients and positive and negative signs of non-zero transform coefficients and the absolute values of transform coefficients and positive and negative signs of non-zero transform coefficients encoded in the last group into the bit stream,

wherein the set number is 16, and wherein the transform coefficient block is composed of sub-blocks which are sequentially encoded and each of the sub-blocks is of a size of 4x4 and contains a 4x4 group of transform coefficients;

the predetermined scan orders used to obtain the map of non-zero transform coefficients, absolute values of transform coefficients, and positive and negative signs of non-zero transform coefficients, in each group of transform coefficients of the transform coefficients blocks, are the same;

wherein the encoding transform coefficients of a transform coefficient block, and encoding a set number of transform coefficients in each group comprise: encoding a map of non-zero transform coefficients of the predetermined number of transform coefficients, encoding a map of transform coefficients greater than 1 of the set number of transform coefficients, encoding absolute values of transform coefficients greater than 1 of the set number of transform coefficients, and encoding positive and negative signs of non-zero transform coefficients of a set number of transform coefficients.

[0007] A method for decoding transform coefficients includes:
parsing transform coefficients of a bit stream according to a predetermined scan order to obtain a map of non-zero transform coefficients; and
parsing, according to the predetermined scan order, a set number of transform coefficients in each group of a transform coefficient block of the bit stream, to obtain a map of transform

coefficients greater than 1, absolute values of transform coefficients greater than 1, and positive and negative signs of non-zero transform coefficients of the bit stream;
wherein the set number is 16, and wherein the transform coefficient block is of 8x8 or 32x32 size and is composed of sub-blocks which are sequentially decoded, and each of the sub-blocks is of a size of 4x4 and contains a 4x4 group of transform coefficients; and
the predetermined scan orders used to obtain the map of non-zero transform coefficients, absolute values of transform coefficients, and positive and negative signs of non-zero transform coefficients, in each group of transform coefficients of the transform coefficients blocks, are the same.

[0008] An apparatus for encoding transform coefficients includes:
an encoding unit, configured to: encode transform coefficients of a transform coefficient block with a size of 8x8 or 32x32 according to a predetermined scan order by which a set number of transform coefficients in each group is encoded until a last group of the transform coefficient block is encoded; when the last group is being encoded, after obtaining a map of non-zero transform coefficients encoded in the last group, write a stored map of non-zero transform coefficients and the map of non-zero transform coefficients encoded in the last group into a bit stream; and after obtaining absolute values of transform coefficients and positive and negative signs of non-zero transform coefficients encoded in the last group, write stored absolute values of transform coefficients and positive and negative signs of non-zero transform coefficients and the absolute values of transform coefficients and positive and negative signs of non-zero transform coefficients encoded in the last group into the bit stream; and
a storing unit, configured to store the map of non-zero transform coefficients, absolute values of transform coefficients, and positive and negative signs of non-zero transform coefficients obtained by the encoding unit;
wherein the set number is 16, and wherein the transform coefficient block is composed of sub-blocks which are sequentially encoded and each of the sub-blocks is of a size of 4x4 and contains a 4x4 group of transform coefficients; and
the predetermined scan orders used to obtain the map of non-zero transform coefficients, absolute values of transform coefficients, and positive and negative signs of non-zero transform coefficients, in each group of transform coefficients of the transform coefficients blocks, are the same;
wherein the encoding transform coefficients of a transform coefficient block, and encoding a set number of transform coefficients in each group comprise: encoding a map of non-zero transform coefficients of the predetermined number of transform coefficients, encoding a map of transform coefficients greater than 1 of the set number of transform coefficients, encoding absolute values of transform coefficients greater than 1 of the set number of transform coefficients, and encoding positive and negative signs of non-zero transform coefficients of a set number of transform coefficients.

[0009] An apparatus for decoding transform coefficients includes:

a decoding unit, configured to parse transform coefficients of a bit stream according to a predetermined scan order to obtain a map of non-zero transform coefficients, parse, according

to the predetermined scan order, a set number of transform coefficients in each group of a transform coefficient block of the bit stream, to obtain a map of transform coefficients greater than 1, absolute values of transform coefficients greater than 1, and positive and negative signs of non-zero transform coefficients of the bit stream;

wherein the set number is 16, and wherein the transform coefficient block is of 8x8 or 32x32 size and is composed of sub-blocks which are sequentially decoded, and each of the sub-blocks is of a size of 4x4 and contains a 4x4 group of transform coefficients; and

the predetermined scan orders used to obtain the map of non-zero transform coefficients, absolute values of transform coefficients, and positive and negative signs of non-zero transform coefficients, in each group of transform coefficients of the transform coefficients blocks, are the same.

[0010] According to the technical solutions provided in embodiments of the present invention, the scan order of encoding a significance map is the same as the scan order in processes of encoding levels and encoding signs; data needs to be read only once in the encoding process, and a decoding end needs a table lookup mode of only one order type. In addition, the significance map is split into smaller significance maps, which can reduce encoding and decoding overheads and increase encoding and decoding efficiency.

BRIEF DESCRIPTION OF DRAWINGS

[0011] To illustrate the technical solutions in the embodiments of the present invention or in the prior art more clearly, the following briefly introduces the accompanying drawings required for describing the embodiments or the prior art. Apparently, the accompanying drawings in the following description show merely some embodiments of the present invention, and a person of ordinary skill in the art may still derive other drawings from these accompanying drawings without creative efforts.

FIG. 1A is a schematic diagram of wide-range zig-zag scan order;

FIG. 1B is a schematic diagram of narrow-range zig-zag scan order;

FIG. 2 is a schematic flowchart of a method according to an embodiment of the present invention;

FIG. 3 is a schematic flowchart of a method according to an embodiment of the present invention;

FIG. 4 is a schematic structural diagram of an encoding apparatus according to an embodiment of the present invention; and

FIG. 5 is a schematic structural diagram of a decoding apparatus according to an embodiment

of the present invention.

DESCRIPTION OF EMBODIMENTS

[0012] The following clearly and completely describes the technical solutions in the embodiments of the present invention with reference to the accompanying drawings in the embodiments of the present invention.

[0013] As shown in FIG. 2, a method for encoding transform coefficients includes the following: 201. Encode transform coefficients of a transform coefficient block according to a predetermined scan order, and encode a set number of transform coefficients in each group until a last group of the transform coefficient block is encoded; store an obtained map of non-zero transform coefficients, absolute values of transform coefficients, and positive and negative signs of non-zero transform coefficients.

[0014] The transform coefficient block in the embodiment of the present invention may be an 8x8 transform coefficient block, a 32x32 transform coefficient block, or a transform coefficient block of another size. The size of the transform coefficient block does not affect the implementation of the embodiment of the present invention, and the embodiment of the present invention is not limited in this regard.

[0015] More specifically, the encoding transform coefficients of a transform coefficient block and encoding a set number of transform coefficients in each group in 201 include: encoding a map of non-zero transform coefficients of a predetermined number of transform coefficients, encoding a map of transform coefficients greater than 1 of the set number of transform coefficients, encoding absolute values of transform coefficients greater than 1 of the set number of transform coefficients, and encoding positive and negative signs of non-zero transform coefficients of a set number of transform coefficients.

[0016] The foregoing storage position may be a buffer. The predetermined number of transform coefficients may be determined according to the performance of a processor, the size of the buffer, and the like. Experiments show that better encoding efficiency can be achieved when the predetermined number is 16.

[0017] Alternatively, the predetermined scan order may be scan order in wide-range scan mode or scan order in narrow-range scan mode. Examples corresponding to the two types of predetermined scan order are provided in subsequent embodiments of the present invention. It is understandable that the predetermined scan order may also be other order so long as the encoding end corresponds to the decoding end, and the embodiment of the present invention is not limited in this regard.

[0018] 202. When the last group is being encoded, after a map of non-zero transform coefficients encoded in the last group is obtained, encode the stored map of non-zero transform coefficients and the map of non-zero transform coefficients encoded in the last group into a bit stream; after absolute values of transform coefficients and positive and negative signs of non-zero transform coefficients encoded in the last group are obtained, encode the stored absolute values of transform coefficients and positive and negative signs of non-zero transform coefficients and the absolute values of transform coefficients and positive and negative signs of non-zero transform coefficients encoded in the last group into the bit stream.

[0019] According to the technical solution provided in the embodiment of the present invention, the scan order of encoding a significance map is the same as the scan order in processes of encoding levels and encoding signs; data needs to be read only once in the encoding process, and a decoding end needs a table lookup mode of only one order type. In addition, the significance map is split into smaller significance maps, which can reduce encoding and decoding overheads and increase encoding and decoding efficiency.

[0020] As shown in FIG. 3, a method for decoding transform coefficients includes the following: 301. Parse transform coefficients of a bit stream according to a predetermined scan order to obtain a map of non-zero transform coefficients.

[0021] In 301, the predetermined scan order is the same as the predetermined scan order of an encoding end. The scan order may be specified by using a protocol or through negotiation in order to ensure that the encoding end and the decoding end have the same scan order, and the embodiment of the present invention is not limited in this regard.

[0022] 302. Parse, according to the predetermined scan order, a map of transform coefficients greater than 1, absolute values of transform coefficients greater than 1, and positive and negative signs of non-zero transform coefficients of the bit stream, and parse a set number of transform coefficients of the bit stream each time.

[0023] The predetermined scan order may be scan order in wide-range scan mode or scan order in narrow-range scan mode. In this case, the parsing transform coefficients of a bit stream according to a predetermined scan order to obtain a map of non-zero transform coefficients, parsing, according to the predetermined scan order, a map of transform coefficients greater than 1, absolute values of transform coefficients greater than 1, and positive and negative signs of non-zero transform coefficients of the bit stream, and parsing a set number of transform coefficients of the bit stream each time include:

parsing the bit stream according to a scan order in wide-range scan mode to obtain a map of non-zero transform coefficients, parsing, according to the scan order in wide-range scan mode, a map of transform coefficients greater than 1, absolute values of transform coefficients greater than 1, and positive and negative signs of non-zero transform coefficients of the bit stream, and parsing a set number of transform coefficients of the bit stream each time; or

parsing the bit stream according to a scan order in narrow-range scan mode to obtain a map of non-zero transform coefficients, and parsing a set number of transform coefficients of the bit stream each time; and

parsing, according to the scan order in narrow-range scan mode, a map of transform coefficients greater than 1, absolute values of transform coefficients greater than 1, and positive and negative signs of non-zero transform coefficients of the bit stream, and parsing a set number of transform coefficients of the bit stream each time.

[0024] According to the technical solution provided in the embodiment of the present invention, the scan order of encoding a significance map is the same as the scan order in processes of encoding levels and encoding signs; data needs to be read only once in the encoding process, and a decoding end needs a table lookup mode of only one order type. In addition, the significance map is split into smaller significance maps, which can reduce encoding and decoding overheads and increase encoding and decoding efficiency.

[0025] In the following embodiments, it is assumed that an 8x8 transform coefficient block is used and that 16 transform coefficients are scanned or parsed each time.

Example 1: It is assumed that the predetermined scan order is in wide-range scan mode. If the predetermined scan order is in wide-range Z-shaped (zig-zag) mode, reference may be made to FIG. 1A.

[0026] The encoding end performs the following operations in sequence:

1. (1) Encode a significance map of the first 16 coefficients according to the predetermined scan order of the 8x8 transform coefficient block, and store the encoded significance map in the buffer; encode a map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of the coefficients in sequence, and store obtained levels and signs in the buffer.
2. (2) Encode a significance map of next 16 coefficients in the scan order according to the predetermined scan order of the 8x8 transform coefficient block, and store the encoded significance map in the buffer; encode a map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of the coefficients in sequence, and store obtained levels and signs in the buffer.
3. (3) Encode a significance map of next 16 coefficients in the scan order according to the predetermined scan order of the 8x8 transform coefficient block, and store the encoded significance map in the buffer; encode a map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of the coefficients in sequence, and store obtained levels and signs in the buffer.
4. (4) Encode a significance map of the last 16 coefficients in the scan order according to the predetermined scan order of the 8x8 transform coefficient block, and encode the

significance map information in the buffer and the obtained significance map information of the last 16 coefficients into a bit stream; encode a map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of coefficients in sequence, and encode the level and sign information in the buffer and the obtained levels and signs of the last 16 coefficients into the bit stream. After the encoding is completed, the encoding end can send the bit stream to a decoding end. It is understandable that end flag information is obtained when the significance map of the last coefficients is encoded.

[0027] The decoding end performs the following operations in sequence:

1. (1) Read the bit stream, and parse numerical values of the significance map according to the predetermined scan order of the 8x8 transform coefficient block. In this step, numerical values of the significance map of 64 coefficients can be directly parsed.
   The code of transform coefficients includes the map of the transform coefficients and numerical values of the transform coefficients, where the numerical values of the transform coefficients include absolute values of the transform coefficients and signs of the transform coefficients; the absolute values of the transform coefficients include a map of transform coefficients greater than 1 (according to this map, non-zero transform coefficients whose absolute values are 1 can be known) and absolute values of transform coefficients greater than 1.
2. (2) Read the bit stream, and parse, according to the predetermined scan order of the 8x8 transform coefficient block, the map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of all non-zero coefficients of the first 16 coefficients in the scan order.
3. (3) Read the bit stream, and parse, according to the predetermined scan order of the 8x8 transform coefficient block, the map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of all non-zero coefficients of the next 16 coefficients in the scan order.
4. (4) Read the bit stream, and parse, according to the predetermined scan order of the 8x8 transform coefficient block, the map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of all non-zero coefficients of the next 16 coefficients in the scan order.
5. (5) Read the bit stream, and parse, according to the predetermined scan order of the 8x8 transform coefficient block, the map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of all non-zero coefficients of the last 16 coefficients in the scan order.

Example 2: It is assumed that the predetermined scan order is in narrow-range scan mode. If the predetermined scan order is in narrow-range Z-shaped (zig-zag) mode, reference may be made to FIG. 1B.

[0028] The encoding end performs the following operations in sequence:

1. 1. Take the upper left 4x4 points in a frequency-domain position, encode a significance map according to the predetermined scan order of the 4x4 points, and store the encoded significance map in the buffer; encode a map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of non-zero coefficients in sequence, and store obtained levels and signs in the buffer.
2. 2. Take the upper right 4x4 points in a frequency-domain position, encode a significance map according to the predetermined scan order of the 4x4 points, and store the encoded significance map in the buffer; encode a map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of non-zero coefficients in sequence, and store obtained levels and signs in the buffer.
3. 3. Take the lower left 4x4 points in a frequency-domain position, encode a significance map according to the predetermined scan order of the 4x4 points, and store the encoded significance map in the buffer; encode a map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of non-zero coefficients in sequence, and store obtained levels and signs in the buffer.
4. 4. Take the lower right 4x4 points in a frequency-domain position and encode a significance map according to the predetermined scan order of the 4x4 points; encode the significance map information in the buffer and the obtained significance map information of the last 16 coefficients (the obtained significance map information of the last 16 coefficients includes end information of the map) into a bit stream; encode a map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of non-zero coefficients in sequence, and encode level and sign information in the buffer and the obtained levels and signs of the last 16 coefficients into the bit stream.

[0029] The decoding end performs the following operations in sequence:

1. (1) Read the bit stream; parse numerical values of the significance map of the first 16 points according to the predetermined scan order of 4x4 points, and store the numerical values in an upper left sub-block of the map; parse numerical values of the significance map of next 16 points according to the predetermined scan order of 4x4 points, and store the numerical values in an upper right sub-block of the map; parse numerical values of the significance map of next 16 points according to the predetermined scan order of 4x4 points, and store the numerical values in a lower left sub-block of the map; and parse numerical values of the significance map of the last 16 points according to the predetermined scan order of 4x4 points, and store the numerical values in a lower right sub-block of the map.
2. (2) Read the bit stream, and parse, according to the predetermined scan order of the 4x4 points, the map of coefficients greater than 1, absolute values of coefficients greater

than 1, and positive and negative signs of all non-zero coefficients of the first 16 coefficients, and use the results as coefficients in the position of the upper left sub-block.

3. (3) Read the bit stream, and parse, according to the predetermined scan order of the 4x4 points, the map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of all non-zero coefficients of next 16 coefficients, and use the results as coefficients in the position of the upper right sub-block.
4. (4) Read the bit stream, and parse, according to the predetermined scan order of the 4x4 points, the map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of all non-zero coefficients of next 16 coefficients, and use the results as coefficients in the position of the lower left sub-block.
5. (5) Read the bit stream, and parse, according to the predetermined scan order of the 4x4 points, the map of coefficients greater than 1, absolute values of coefficients greater than 1, and positive and negative signs of all non-zero coefficients of the last 16 coefficients, and use the results as coefficients in the position of the lower right sub-block.

[0030] As shown in FIG. 4, an apparatus for encoding transform coefficients includes:

an encoding unit 401, configured to: encode transform coefficients of a transform coefficient block according to a predetermined scan order, and encode a set number of transform coefficients in each group until a last group of the transform coefficient block is encoded; when the last group is being encoded, after obtaining a map of non-zero transform coefficients encoded in the last group, encode a stored map of non-zero transform coefficients and the map of non-zero transform coefficients encoded in the last group into a bit stream; and after obtaining absolute values of transform coefficients and positive and negative signs of non-zero transform coefficients encoded in the last group, encode stored absolute values of transform coefficients and positive and negative signs of non-zero transform coefficients and the absolute values of transform coefficients and positive and negative signs of non-zero transform coefficients encoded in the last group into the bit stream; and

a storing unit 402, configured to store the map of non-zero transform coefficients, absolute values of transform coefficients, and positive and negative signs of non-zero transform coefficients obtained by the encoding unit.

[0031] Alternatively, the encoding unit 401 being configured to encode transform coefficients of a transform coefficient block according to a predetermined scan order includes:

encoding transform coefficients of the transform coefficient block according to a scan order in wide-range scan mode; or

encoding transform coefficients of the transform coefficient block according to a scan order in

narrow-range scan mode.

[0032] According to the technical solution provided in the embodiment of the present invention, the scan order of encoding a significance map is the same as the scan order in processes of encoding levels and encoding signs; data needs to be read only once in the encoding process, and a decoding end needs a table lookup mode of only one order type. In addition, the significance map is split into smaller significance maps, which can reduce encoding and decoding overheads and increase encoding and decoding efficiency.

[0033] As shown in FIG. 5, an apparatus for decoding transform coefficients includes:
a decoding unit 501, configured to parse transform coefficients of a bit stream according to a predetermined scan order to obtain a map of non-zero transform coefficients, parse, according to the predetermined scan order, a map of transform coefficients greater than 1, absolute values of transform coefficients greater than 1, and positive and negative signs of non-zero transform coefficients of the bit stream, and parse a set number of transform coefficients of the bit stream each time.

[0034] Alternatively, the decoding unit 501 is specifically configured to: parse the bit stream according to a scan order in wide-range scan mode to obtain a map of non-zero transform coefficients, parse, according to the scan order in wide-range scan mode, a map of transform coefficients greater than 1, absolute values of transform coefficients greater than 1, and positive and negative signs of non-zero transform coefficients of the bit stream, and parse a set number of transform coefficients of the bit stream each time; or the decoding unit 501 is specifically configured to:

parse the bit stream according to a scan order in narrow-range scan mode to obtain a map of non-zero transform coefficients, and parse a set number of transform coefficients of the bit stream each time; and

parse, according to the scan order in narrow-range scan mode, a map of transform coefficients greater than 1, absolute values of transform coefficients greater than 1, and positive and negative signs of non-zero transform coefficients of the bit stream, and parse a set number of transform coefficients of the bit stream each time.

[0035] According to the technical solution provided in the embodiment of the present invention, the scan order of encoding a significance map is the same as the scan order in processes of encoding levels and encoding signs; data needs to be read only once in the encoding process, and a decoding end needs a table lookup mode of only one order type. In addition, the significance map is split into smaller significance maps, which can reduce encoding and decoding overheads and increase encoding and decoding efficiency.

[0036] It is understandable to persons of ordinary skill in the art that all or part of the steps in the methods provided in the foregoing embodiments may be performed by hardware instructed by a program. The program may be stored in a computer readable storage medium, such as a read-only memory, a magnetic disk, and a CD-ROM.

[0037] The technology provided in the embodiments of the present invention can be applied in the field of digital signal processing and is implemented by using an encoder and a decoder. Video encoders and decoders are widely applied in various communications devices or electronic devices, for example, a digital television, a set-top box, a media gateway, a mobile phone, a wireless device, a personal data assistant (PDA), a handheld or portable computer, a GPS receiver/navigator, a camera, a video player, a video camera, a video recorder, a surveillance device, a videoconferencing and videophone device, and the like. Such devices include a processor, a memory, and interfaces for data transmission. The video encoder and decoder can be directly implemented by using a digital circuit or a chip, for example, a DSP (digital signal processor), or by using a processor driven by software codes to perform processes in the software codes.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN201110057694 [0001]

Non-patent literature cited in the description

- **BENJAMIN BROSS et al.**High Efficiency Video Coding (HEVC) text specification draft 6JOINT COLLABORATIVE TEAM ON VIDEO CODING (JCT-VC) OF ITU-T SG16 WP3 AND ISO/IEC JTC1/SC29/WG11 7TH MEETING, 2012, [0004]

Patentkrav

1. Fremgangsmåde til kodning af transformationskoefficienter, der omfatter:
kodning af transformationskoefficienter i en blok af transformationskoefficienter med en størrelse på 8x8 eller 32x32 ifølge en på forhånd scannet rækkefølge, hvor et fastsat antal transformationskoefficienter i hver gruppe kodes, indtil en sidste gruppe af blokken af transformationskoefficienter kodes; lagring af et opnået diagram over transformationskoefficienter, der ikke er lig med nul, absolutte værdier af transformationskoefficienter og positive og negative fortegn på transformationskoefficienter, der ikke er lig med nul; og
når den sidste gruppe er ved at blive kodet, efter opnåelse af et diagram over transformationskoefficienter, der ikke er lig med nul, som er kodet i den sidste gruppe, skrivning af det gemte diagram over transformationskoefficienter, der ikke er lig med nul, og diagrammet over transformationskoefficienter, der ikke er lig med nul, som er kodet i den sidste gruppe, i den sidste gruppe i en bitstrøm; efter opnåelse af absolutte værdier af transformationskoefficienter og positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, som er kodet i den sidste gruppe, skrivning af de gemte absolutte værdier af transformationskoefficienter og positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, og de absolutte værdier for transformationskoefficienter og positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, som er kodet i den sidste gruppe i bitstrømmen,
hvor det fastsatte antal er 16, og hvor blokken af transformationskoefficienter består af underblokke, der kodes sekventielt, og hvor af underblokkene har en størrelse på 4x4 og indeholder en gruppe på 4x4 transformationskoefficienter;
de på forhånd fastsatte scanningsrækkefølger, der bruges til at opnå diagrammet over transformationskoefficienter, der ikke er lig med nul, absolutte værdier for transformationskoefficienter og positive og negative fortegn

for transformationskoefficienter, der ikke er lig med nul, i hver gruppe af transformationskoefficienter i blokkene af transformationskoefficienter, er de samme;
hvor de kodende transformationskoefficienter af en blok af transformationskoefficienter og kodningen af et fastsat antal transformationskoefficienter i hver gruppe omfatter: kodning af et diagram af transformationskoefficienter, der ikke er lig med nul, for det på forhånd fastsatte antal transformationskoefficienter, kodning af et diagram for transformationskoefficienter, der er større end 1, af det fastsatte antal transformationskoefficienter, kodning af absolutte værdier af transformationskoefficienter, der er større end 1, af det fastsatte antal transformationskoefficienter, og kodning af positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, af et fastsat antal transformationskoefficienter.

2. Fremgangsmåde til afkodning af transformationskoefficienter, der omfatter:
parsing af transformationskoefficienter i en bitstrøm ifølge en på forhånd fastsat scanningsrækkefølge for at opnå et diagram over transformationskoefficienter, der ikke er lig med nul; og
parsing, ifølge den på forhånd fastsatte scanningsrækkefølge, af et fastsat antal transformationskoefficienter i hver gruppe af en blok af transformationskoefficienter i bitstrømmen, for at opnå et diagram over transformationskoefficienter, der er større end 1, absolutte værdier for transformationskoefficienter, der er større end 1, samt positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, i bitstrømmen;
hvor det fastsatte antal er 16, og hvor blokken af transformationskoefficienter har en størrelse på 8x8 eller 32x32 består af underblokke, der afkodes sekventielt, og hvor af underblokkene har en størrelse på 4x4 og indeholder en gruppe på 4x4 transformationskoefficienter; og
de på forhånd fastsatte scanningsrækkefølger, der bruges til at opnå diagrammet over transformationskoefficienter, der ikke

er lig med nul, absolutte værdier for transformationskoefficienter og positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, i hver gruppe af transformationskoefficienter i blokkene af transformationskoefficienter, er de samme.

3. Anordning til kodning af transformationskoefficienter, der omfatter:

en kodningsenhed, der er konfigureret til at: kode transformationskoefficienter i en blok af transformationskoefficienter med en størrelse på 8x8 eller 32x32 ifølge en på forhånd fastsat scanningsrækkefølge, hvor et fastsat antal transformationskoefficienter i hver gruppe kodes, indtil en sidste gruppe af blokken af transformationskoefficienter er kodet; når den sidste gruppe er ved at blive kodet, efter opnåelse af et diagram over transformationskoefficienter, der ikke er lig med nul, som er kodet i den sidste gruppe, skrivning af det gemte diagram over transformationskoefficienter, der ikke er lig med nul, og diagrammet over transformationskoefficienter, der ikke er lig med nul, som er kodet i den sidste gruppe, i den sidste gruppe i en bitstrøm; efter opnåelse af absolutte værdier af transformationskoefficienter og positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, som er kodet i den sidste gruppe, skrivning af de gemte absolutte værdier af transformationskoefficienter og positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, og de absolutte værdier for transformationskoefficienter og positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, som er kodet i den sidste gruppe i bitstrømmen; og

en lagringsenhed, der er konfigureret til at lagre diagrammet over transformationskoefficienter, der ikke er lig med nul, absolutte værdier af transformationskoefficienter, og positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, opnået ved hjælp af kodningsenheden;

hvor det fastsatte antal er 16, og hvor blokken af transformationskoefficienter består af underblokke, der kodes

sekventielt, og hvor af underblokkene har en størrelse på 4x4 og indeholder en gruppe på 4x4 transformationskoefficienter; og

de på forhånd fastsatte scanningsrækkefølger, der bruges til at opnå diagrammet over transformationskoefficienter, der ikke er lig med nul, absolutte værdier for transformationskoefficienter og positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, i hver gruppe af transformationskoefficienter i blokkene af transformationskoefficienter, er de samme;

hvor de kodende transformationskoefficienter af en blok af transformationskoefficienter og kodningen af et fastsat antal transformationskoefficienter i hver gruppe omfatter: kodning af et diagram af transformationskoefficienter, der ikke er lig med nul, for det på forhånd fastsatte antal transformationskoefficienter, kodning af et diagram for transformationskoefficienter, der er større end 1, af det fastsatte antal transformationskoefficienter, kodning af absolutte værdier af transformationskoefficienter, der er større end 1, af det fastsatte antal transformationskoefficienter, og kodning af positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, af et fastsat antal transformationskoefficienter.

4. Anordning til afkodning af transformationskoefficienter, der omfatter:

en afkodningsenhed, der er konfigureret til at parse transformationskoefficienter i en bitstrøm ifølge en på forhånd fastsat scanningsrækkefølge for at opnå et diagram over transformationskoefficienter, der ikke er lig med nul, parsing, ifølge den på forhånd fastsatte scanningsrækkefølge, af et fastsat antal transformationskoefficienter i hver gruppe af en blok af transformationskoefficienter i bitstrømmen, for at opnå et diagram over transformationskoefficienter, der er større end 1, absolutte værdier for transformationskoefficienter, der er større end 1, samt positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, i bitstrømmen;

hvor det fastsatte antal er 16, og hvor blokken af transformationskoefficienter har en størrelse på 8x8 eller 32x32 består af underblokke, der afkodes sekventielt, og hvor af underblokkene har en størrelse på 4x4 og indeholder en gruppe på 4x4 transformationskoefficienter; og

de på forhånd fastsatte scanningsrækkefølger, der bruges til at opnå diagrammet over transformationskoefficienter, der ikke er lig med nul, absolutte værdier for transformationskoefficienter og positive og negative fortegn for transformationskoefficienter, der ikke er lig med nul, i hver gruppe af transformationskoefficienter i blokkene af transformationskoefficienter, er de samme.

DRAWINGS

0	1	5	6	14	15	27	28
2	4	7	13	16	26	29	42
3	8	12	17	25	30	41	43
9	11	18	24	31	40	44	53
10	19	23	32	39	45	52	54
20	22	33	38	46	51	55	60
21	34	37	47	50	56	59	61
35	36	48	49	57	58	62	63

FIG. 1A

0	1	5	6	16	17	21	22
2	4	7	12	18	20	23	28
3	8	11	13	19	24	27	29
9	10	14	15	25	26	30	31
32	33	37	38	48	49	53	54
34	36	39	44	50	52	55	60
35	40	43	45	51	56	59	61
41	42	46	47	57	58	62	63

FIG. 1B

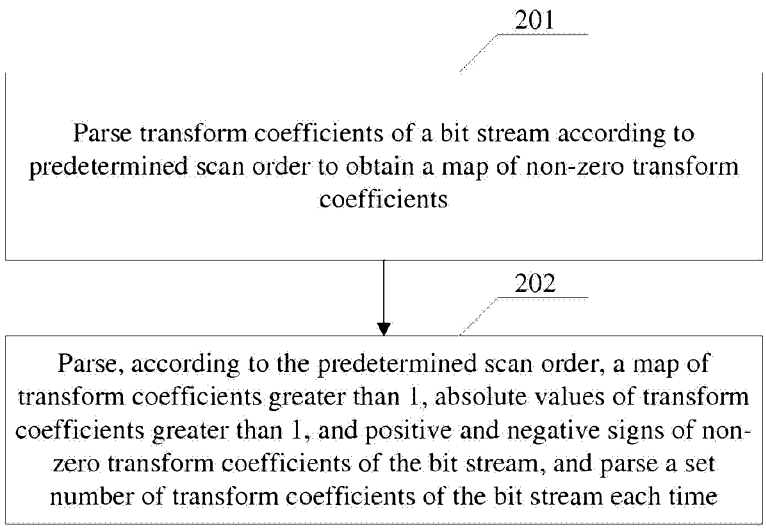
201
Parse transform coefficients of a bit stream according to predetermined scan order to obtain a map of non-zero transform coefficients
202
Parse, according to the predetermined scan order, a map of transform coefficients greater than 1, absolute values of transform coefficients greater than 1, and positive and negative signs of non-zero transform coefficients of the bit stream, and parse a set number of transform coefficients of the bit stream each time

FIG. 2

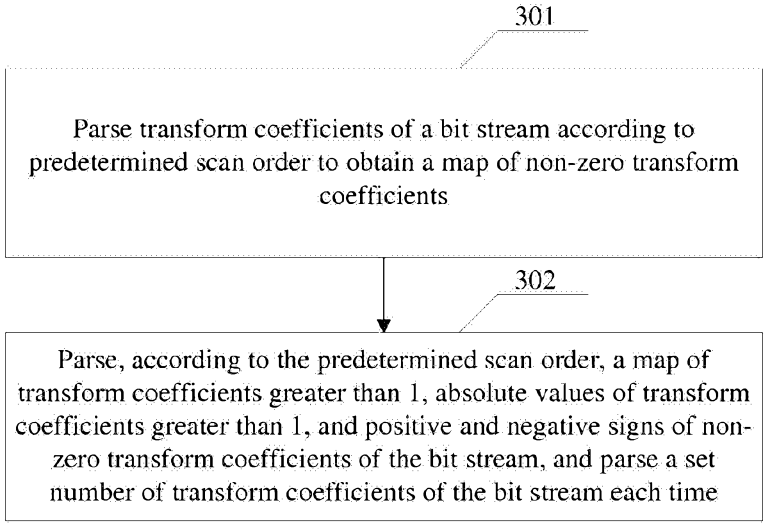
301
Parse transform coefficients of a bit stream according to predetermined scan order to obtain a map of non-zero transform coefficients
302
Parse, according to the predetermined scan order, a map of transform coefficients greater than 1, absolute values of transform coefficients greater than 1, and positive and negative signs of non-zero transform coefficients of the bit stream, and parse a set number of transform coefficients of the bit stream each time

FIG. 3

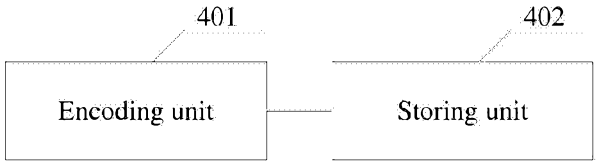

FIG. 4

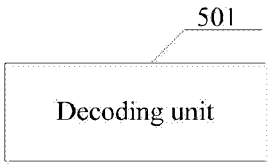

FIG. 5