CODING METHOD FOR MOVING PICTURE

Technical Field

The present invention relates to a method for coding a moving picture, and more particularly, to a method for coding interlaced moving picture into frame picture having frame/field macroblock in a moving picture coding system that uses multiple reference pictures.

Background Art

Moving picture coding system compensates for motion using motion vector information. In case of moving picture coding system that uses multiple reference picture, reference picture index information as well as motion vector information is required for motion compensation. The reference picture index is a value that is used to distinguish multiple reference pictures from each other. A coder transfers the reference picture index to a decoder, and the decoder performs motion compensation from reference picture that is indicated by the reference picture index.

Generally, scanning methods are classified into a progressive scanning and an interlaced scanning. In case of the progressive scanning, an image of one frame consists of data that are sampled at the same time. In case of the interlaced scanning, an image of one frame consists of data that are sampled at different times, and the samples are alternated line by line.

The interlaced image of a frame is divided into a top field and a bottom field. In the interlaced scanning, one frame is divided into two field images. In this specification, an image is treated based on unit of picture. A frame or a field may be allocated to the picture.

Three coding methods for an interlaced moving picture are proposed. A first coding method is a field picture coding method which performs a coding process, considering each field as an independent picture at a picture or slice

level. A second coding method is the frame picture coding method which performs a coding process after combining two fields into one frame at a picture or slice level. A third coding method is a frame picture coding method with frame/field macroblock, which performs a coding process by combining two fields into one frame and selecting a frame mode or a field mode at a macroblock level.

In the third coding method, two vertically adjacent macroblocks are bound into a pair and the coding is performed in unit of macroblock pair. In FIG. 1, numbers assigned in the macroblock pairs indicate macroblock addresses that are used to distinguish the macroblocks from each other.

Here, frame macroblock is a macroblock which is coded at upper and lower macroblocks of the macroblock pair in unit of frame. In other words, each macroblock is coded in unit of frame after two fields are combined into one frame.

Meanwhile, field macroblock is a macroblock that is coded at upper and lower macroblocks of macroblock pair in unit of field. The macroblock pair is divided into top and bottom field components and each field is coded independently. At this time, the macroblock pairs are rearranged so that the upper and lower macroblocks may respectively contain only top field component and only bottom field component. The upper macroblock is called a top field macroblock and the lower macroblock is called a bottom field macroblock.

Reference buffer for storing multiple reference pictures are configured in unit of frame. In the frame picture coding, all reference pictures are considered as units of frame in which two fields are combined into one frame, and one picture among the reference frame pictures is used for motion compensation. Accordingly, values are allocated to the reference picture indexes in unit of frame.

The reference picture index for P frame is obtained by sorting all the reference frames in an order reverse to a coding order and then sequentially allocating an index, which

is increased by one, to the sorted reference frames. The reference picture index for B frame is classified into list 0 and list 1 and is determined based on a display order of the reference frame.

First, in case of the reference frame list 0, indexes are allocated in a reverse order to the reference frames whose display order lags behind the B frame, and then, the remaining indexes are allocated in the display order to the reference frames whose display order leads the B frame. In case of the reference frame list 1, in contrast to the reference frame list 0, indexes are allocated in the display order to the reference frames whose display order leads the B frame, and then, the remaining indexes are allocated in a reverse order to the reference frame whose display order lags behind the B frame. FIG. 2 shows a reference picture index for P frame when a size of the reference buffer is 5, and FIG. 3 shows the reference picture index lists 0 and 1 for B frame.

In the field picture coding, the fields of all reference pictures are considered as independent pictures and one of the reference field pictures is used for motion compensation. Accordingly, values are allocated to the reference picture indexes in unit of field. At this time, the reference fields are combined in the unit of frame, and then, the reference picture indexes in each field of the P frame are sorted in an order reverse to a coding order of the frame. Then, index values that are increased by one are alternately allocated in an order that starts from a reference field having parity equal to a current picture to a reference field having parity different from the current picture, while visiting the sorted reference frames in sequence.

In addition, in case of the reference picture index lists 0 and 1 for each field of B frame, all the reference fields are combined in unit of frame and then a reference frame is sorted in the same manner as a method of determining

reference frame index of B frame. Thereafter, the indexes that are increased by one are alternately allocated in an order that starts from a reference field having parity equal to a current picture to a reference field having parity different from the current picture, while visiting the sorted reference frames in sequence.

FIG. 4 shows reference picture indexes of top and bottom fields of P frame when a size of reference buffer is 5, and FIG. 5 shows reference picture index lists 0 and 1 of top and bottom fields of B frame that can be used as a reference.

In order to improve coding efficiency, the moving picture coding system using multiple reference pictures provides a function of reordering the reference picture indexes before decoding a picture or a slice. It is arbitrarily reordering the reference picture indexes so as to enhance the coding efficiency after determining initial reference picture index for the frame and field pictures. FIG. 6 shows a result of determining initial reference picture index for P frame and arbitrarily reordering indexes according to the above-described method.

When the moving picture coding system using the multiple reference pictures codes an interlaced moving picture into a frame picture having frame/field macroblock, all the reference pictures for the frame macroblock are considered as frame unit and one of the reference frame pictures must be used for motion compensation. In addition, and fields of all the reference pictures for the field macroblock are considered as independent pictures and one of the reference field pictures must be used for motion compensation.

Accordingly, in the frame picture coding that selects the frame/field coding modes at the macroblock level, it is necessary to allocate values to the reference picture index in frame unit or field unit according to the coding mode of each macroblock.

Disclosure of the Invention

Accordingly, the present invention is directed to a method for coding a moving picture that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

An object of the present invention is to provide a method for coding a moving picture, which efficiently provides reference picture information used for motion compensation by determining the reference picture index differently according a coding mode of macroblock when interlaced moving picture is coded with a frame picture having frame/field macroblocks in a moving picture coding system using multiple reference pictures.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims thereof as well as the appended drawings.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, there is provided a method for coding a moving picture in a moving picture coding system using multiple reference picture, a method for setting a reference index, when an interlaced moving picture is coded into a frame picture having frame/field macroblock. The method comprising: (a) determining reference picture index of frame unit at a picture (or slice) level; and (b) determining reference picture index according to a coding mode of the macroblock on the basis of the reference picture index of frame unit at a macroblock level.

According to another embodiment of the present invention, there is provided a method for coding an interlaced moving picture into a frame picture having

frame/field macroblock in a moving picture coding system using multiple reference picture, wherein a reference picture index of the frame macroblock is determined at a macroblock level by determining the reference picture index of frame unit at a picture (or slice) level and the reference picture index of frame unit is used.

According to further another embodiment of the present invention, there is provided a method for coding an interlaced moving picture into a frame picture having frame/field macroblock in a moving picture coding system using multiple reference picture, wherein a reference picture index of the frame macroblock is determined at a macroblock level by determining the reference picture index of frame unit at a picture (or slice) level and respectively allocating a lower index and a higher index to a top reference field and a bottom reference field while sequentially visiting the reference frames according to an order of reference picture index of frame unit, the top and bottom field indexes being giving by an equation:

top reference field index = 2 × picture index of reference frame; and

bottom reference field index = 2 × picture index of reference frame + 1.

According to further another embodiment of the present invention, there is provided a method for coding an interlaced moving picture into a frame picture having frame/field macroblock in a moving picture coding system using multiple reference picture, wherein a reference picture index of the frame macroblock is determined at a macroblock level by determining the reference picture index of frame unit at a picture (or slice) level and respectively allocating a lower index and a higher index to a bottom reference field and a top reference field while sequentially visiting the reference frames according to an order of reference picture index of frame unit, the top and bottom reference field indexes being given by an equation:

top reference field index = 2 × picture index of reference frame + 1; and

bottom reference field index = 2 × picture index of reference frame.

According to further another embodiment of the present invention, there is provided a method for coding an interlaced moving picture into a frame picture having frame/field macroblock in a moving picture coding system using multiple reference picture, wherein a reference picture index of the frame macroblock is determined at a macroblock level by determining the reference picture index of frame unit at a picture (or slice) level and alternately allocating indexes, which are increased by one, to reference fields, starting from a reference field having parity equal to a current field to reference field having parity different from the current field while sequentially visiting the reference frames according to an order of reference picture index of frame unit in the field macroblock.

According to further another embodiment of the present invention, there is provided a method for coding an interlaced moving picture into a frame picture having frame/field macroblock in a moving picture coding system using multiple reference picture, wherein a reference picture index of the frame macroblock is determined at a macroblock level by determining the reference picture index of frame unit at a picture (or slice) level allocating a lower index to a reference field close to a current field in view of time and allocating higher index to a reference field far from the current field in view of time while sequentially visiting the reference frames according to an order of reference picture index of frame unit, the indexes of the reference fields being given by an equation:

index of the reference field close to the current field = 2 × picture index of reference frame; and

index of the reference field far from the current field = 2 × picture index of reference frame + 1.

Brief Description of the Drawings

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

In the drawings:

FIG. 1 shows macroblock pair in frame picture having general frame/field macroblock;

FIG. 2 shows reference picture indexes of P frame coding in a moving picture coding system according to the related art;

FIG. 3 shows the reference picture index lists 0 and 1 of B frame coding in a moving picture coding system according to the related art;

FIG. 4 shows reference picture indexes in a coding of top and bottom fields of P frame in a moving picture coding system according to the related art;

FIG. 5 shows reference picture index lists 0 and 1 in a coding of top and bottom fields of B frame in a moving picture coding system according to the related art;

FIG. 6 shows reference picture indexes reordered in a coding of P frame in a moving picture coding system according to the related art;

FIG. 7 shows reference picture indexes of P frame and B frame having frame macroblock in a moving picture coding system according to the present invention;

FIG. 8 shows reference picture indexes of P frame and B frame having field macroblock in a moving picture coding system according to the present invention (case 1);

FIG. 9 shows reference picture indexes of P frame and B frame having field macroblock in a moving picture coding system according to the present invention (case 2);

FIG. 10 shows reference picture indexes of P frame having field macroblock in a moving picture coding system according to the present invention (case 3);

FIG. 11 shows reference picture indexes of B frame having field macroblock in a moving picture coding system according to the present invention (case 3); and

FIG. 12 shows reference picture indexes of P frame and B frame having field macroblock in a moving picture coding system according to the present invention (case 4).

Best Mode for Carrying Out the Invention

Hereinafter, preferred embodiments of the present invention will be described in detail with reference to accompanying drawings.

When an interlaced moving picture is coded into frame picture having frame/field macroblock, a moving picture coding system using multiple reference pictures must performs a motion compensation from a reference frame in order for frame coding in the frame macroblock. In other words, all reference pictures must be considered as frame unit. The moving picture coding system, however, must performs a motion compensation from a reference field in order for a field coding in the field macroblock. In other words, all reference pictures must be considered as field unit.

Accordingly, the frame pictures having frame/field macroblock must use indexes having different structures at macroblock level. For example, the frame macroblock uses a reference picture index of frame unit and the field macroblock uses a reference picture index of field unit. It should be considered that the reference picture indexes can be reordered at a picture or slice level.

Therefore, the frame picture having frame/field macroblocks should consider the reference picture in frame unit at a picture or slice level and have the reordered reference picture indexes of frame unit. It is necessary to determine reference picture index according to a coding mode of macroblock based on the reference picture indexes of the frame unit at the macroblock level.

The present invention provides a method for determining

reference picture index in frame picture having frame/field macroblock. The method includes a process of determining reference picture index at a picture (or slice) level and a process of determining reference picture index at a macroblock level.

[1] Determination of Reference Picture Index at Picture (or Slice) Level

All the reference pictures are considered in frame unit at a picture or slice level and reference picture indexes of frame unit are calculated.

In the method or determining a reference picture index for P frame, reference frames are sorted in an order reverse to a coding order and indexes are allocated while visiting the sorted reference frames in sequence.

Reference picture indexes for B frame are determined based on a display order of the reference frames. First, in case of a reference frame list 0, indexes are allocated in a reverse order to reference frames whose display orders lag behind the B frame and the remaining indexes are allocated in the display order to reference frames whose display order lead the B frame.

In case of a reference frame list 1, in contrast to the reference frame list 0, indexes are allocated in the display order to reference frames whose display orders are higher than the B frame and the remaining indexes are allocated in a reverse order to reference frames whose display orders are lower than the B frame. When the reference picture indexes are reordered so as to enhance a coding efficiency, the reference picture indexes of frame unit are reordered.

[2] Determination of Reference Picture Index at Macroblock Level

The reference picture index is modified according to the coding mode of the macroblock while performing a coding in unit of macroblock pair with respect to the reference picture indexes of frame unit, which are obtained at the picture (or slice) level. This process will be described

below.

[2.1] Case of Frame Macroblock

Since motion compensation must be performed to frame macroblocks from reference frame, the reference picture index should be frame unit. Accordingly, the reference picture indexes of frame unit, which are obtained at the picture (or slice) level, are used.

Reference frame stored in a reference buffer should be configured with field pair having parities opposite to each other. FIG. 7 shows reference picture indexes for frame macroblock in P frame and B frame when a size of the reference buffer is 5.

[2.2] Case of Field Macroblock

Since motion compensation must be performed to field macroblocks from reference field, the reference picture index should be field unit. In this case, field pair having parities opposite to each other is also present in the reference buffer. Accordingly, each reference frame is divided into two fields while sequentially visiting the reference frame according to the reference picture indexes of frame unit, which are obtained at the picture (or slice) level. Then, the reference picture indexes are newly allocated to each field. The reference picture indexes for two fields of each reference frame are allocated in various methods (Cases 1 to 4).

(Case 1)

Regardless of the top and bottom field macroblocks of a current field macroblock, a lower index is allocated to the top reference field and a higher index is allocated to the bottom reference field while sequentially visiting the reference frames in an order of the reference picture indexes, which are obtained at the picture (or slice) level.

In other words, the top and bottom reference field indexes can be given by an equation below.

Top reference field index = 2 × picture index of reference frame

Bottom reference field index = 2 × picture index of reference frame + 1

FIG. 8 shows reference picture indexes for field macroblocks of P frame and B frame.

(Case 2)

Regardless of the top and bottom field macroblocks of a current field macroblock, a lower index is allocated to the bottom reference field and a higher index is allocated to the top reference field while sequentially visiting the reference frames in an order of the reference picture indexes, which are obtained at the picture (or slice) level.

In other words, the top and bottom reference field indexes can be given by an equation below.

Top reference field index = 2 × picture index of reference frame + 1

Bottom reference field index = 2 × picture index of reference frame

FIG. 9 shows reference picture indexes for field macroblocks of P frame and B frame.

(Case 3)

Indexes that are increased by one are alternately allocated to reference fields, starting from the reference field having a parity equal to the current field to the reference field having a parity different from the current field, while sequentially visiting the reference frames according to a reference picture index order of the picture (or slice) level. FIGs. 10 and 11 show reference picture indexes for the field macroblocks of P frame and B frame.

(Case 4)

Regardless of the top and bottom field macroblocks of a current field macroblock, a lower index is allocated to reference field close to the current field in view of time and a higher index is allocated to reference field far from the current field in view of time while sequentially visiting the reference frames in an order of the reference picture indexes of the picture (or slice) level.

In other words, the reference field indexes can be given by an equation below.

Reference field index close to the current field = 2 × picture index of reference frame

Reference field index far from the current field = 2 × picture index of reference frame + 1

In FIG. 12, there are shown reference picture indexes for field macroblock of P frame and B frame.

While the present invention has been described and illustrated herein with reference to the preferred embodiments thereof, it will be apparent to those skilled in the art that various modifications and variations can be made therein without departing from the spirit and scope of the invention. Thus, it is intended that the present invention covers the modifications and variations of this invention that come within the scope of the appended claims and their equivalents.

Industrial Applicability

According to a coding a moving picture method of the present invention, when a moving picture coding system using multiple reference pictures codes an interlaced moving picture into a frame picture having frame/field macroblock, the moving picture coding system efficiently provides reference picture information used for motion compensation by differently determining reference picture index according to coding modes of macroblocks.

Claims

1. In a moving picture coding system using multiple reference picture, a method for setting a reference index when an interlaced moving picture is coded into a frame picture having frame/field macroblock, comprising:

(a) determining reference picture index of frame unit at a picture (or slice) level; and

(b) determining reference picture index according to a coding mode of the macroblock on the basis of the reference picture index of frame unit at a macroblock level.

2. The method according to claim 1, wherein in the step (a), all reference pictures are considered in unit of frame.

3. The method according to claim 1, wherein in the step (a), reference picture index for P frame is determined by sorting the reference frames in an order reverse to a coding order and allocating index values to the sorted reference frames while sequentially visiting the sorted reference frames.

4. The method according to claim 1, wherein in the step (a), reference picture index for B frame is determined based on a display order of the reference frame.

5. The method according to claim 1, wherein in the step (a), in case of a reference frame list 0 for B frame, indexes are allocated in a reverse order to reference frames whose display orders are lower than the B frame and the remaining indexes are allocated in a display order to reference frames whose display orders are higher than the B frame; and

in case of a reference frame list 1 for B frame, indexes are allocated in the display order to reference

frames whose display orders are higher than the B frame and the remaining indexes are allocated in the reverse order to reference frames whose display orders are lower than the B frame.

6. The method according to claim 1, wherein in the step (b), the reference picture index is determined according to the coding mode of the macroblock while coding macroblock pair with respect to the reference picture index of frame unit.

7. The method according to claim 1, wherein in the step (b), the frame macroblocks use the reference picture indexes of frame unit.

8. The method according to claim 1, wherein in the step (b), the reference frame stored in a reference buffer is configured with field pair having parities opposite to each other.

9. The method according to claim 1, wherein in the step (b), regardless of top and bottom field macroblocks of a current field macroblock, a lower index is allocated to the top reference field and a higher index is allocated to the bottom reference field while sequentially visiting the reference frames in an order of the reference picture indexes, the top and bottom reference field indexes being given by an equation:

top reference field index = 2 × picture index of reference frame; and

bottom reference field index = 2 × picture index of reference frame + 1.

10. The method according to claim 1, wherein in the step (b), regardless of top and bottom field macroblocks of a current field macroblock, a lower index is allocated to the

bottom reference field and a higher index is allocated to the top reference field while sequentially visiting the reference frames in an order of the reference picture indexes, the top and bottom reference field indexes being given by an equation:

top reference field index = 2 × picture index of reference frame + 1; and

bottom reference field index = 2 × picture index of reference frame

11. The method according to claim 1, wherein in the step (b), indexes that are increased by one are alternately allocated to reference fields, starting from the reference field having a parity equal to the current field to the reference field having a parity different from the current field, while sequentially visiting the reference frames according to a reference picture index order of the picture (or slice) level.

12. The method according to claim 1, wherein in the step (b), regardless of the top and bottom field macroblocks of a current field macroblock, a lower index is allocated to reference field close to the current field in view of time and a higher index is allocated to reference field far from the current field in view of time while sequentially visiting the reference frames in an order of the reference picture indexes, the reference field indexes being given by an equation:

reference field index close to the current field = 2 × picture index of reference frame; and

reference field index far from the current field = 2 × picture index of reference frame + 1.

13. In a moving picture coding system using multiple reference picture, a method for coding an interlaced moving picture into a frame picture having frame/field macroblock,

wherein a reference picture index of the frame macroblock is determined at a macroblock level by determining the reference picture index of frame unit at a picture (or slice) level and the reference picture index of frame unit is used.

14. In a moving picture coding system using multiple reference picture, a method for coding an interlaced moving picture into a frame picture having frame/field macroblock, wherein a reference picture index of the frame macroblock is determined at a macroblock level by determining the reference picture index of frame unit at a picture (or slice) level and respectively allocating a lower index and a higher index to a top reference field and a bottom reference field while sequentially visiting the reference frames according to an order of reference picture index of frame unit, the top and bottom field indexes being giving by an equation:

top reference field index = 2 × picture index of reference frame; and

bottom reference field index = 2 × picture index of reference frame + 1.

15. In a moving picture coding system using multiple reference picture, a method for coding an interlaced moving picture into a frame picture having frame/field macroblock, wherein a reference picture index of the frame macroblock is determined at a macroblock level by determining the reference picture index of frame unit at a picture (or slice) level and respectively allocating a lower index and a higher index to a bottom reference field and a top reference field while sequentially visiting the reference frames according to an order of reference picture index of frame unit, the top and bottom reference field indexes being given by an equation:

top reference field index = 2 × picture index of reference frame + 1; and

bottom reference field index = 2 × picture index of reference frame.

16. In a moving picture coding system using multiple reference picture, a method for coding an interlaced moving picture into a frame picture having frame/field macroblock, wherein a reference picture index of the frame macroblock is determined at a macroblock level by determining the reference picture index of frame unit at a picture (or slice) level and alternately allocating indexes, which are increased by one, to reference fields, starting from a reference field having parity equal to a current field to reference field having parity different from the current field while sequentially visiting the reference frames according to an order of reference picture index of frame unit in the field macroblock.

17. In a moving picture coding system using multiple reference picture, a method for coding an interlaced moving picture into a frame picture having frame/field macroblock, wherein a reference picture index of the frame macroblock is determined at a macroblock level by determining the reference picture index of frame unit at a picture (or slice) level allocating a lower index to a reference field close to a current field in view of time and allocating higher index to a reference field far from the current field in view of time while sequentially visiting the reference frames according to an order of reference picture index of frame unit, the indexes of the reference fields being given by an equation:

index of the reference field close to the current field = 2 × picture index of reference frame; and

index of the reference field far from the current field = 2 × picture index of reference frame + 1.