

**Method and device for transcoding bit streams with video data**

The invention relates to a method and a device for transcoding bit streams which contain video data with motion
5 information.

Prior art

The coding or decoding of video data with the associated
10 audio and/or other data can be performed, for example, on the basis of the standards ISO/IEC 11172 (MPEG1) or ISO/IEC 13818 (MPEG2). In some cases, it is wished to convert a bit stream coded on the basis of such standards into a bit stream with a different data rate. It is known from the standard ISO/IEC
15 13818-2, subclause 7.8, "SNR scalability" to generate for this purpose a data stream with two layers, a corresponding decoder processing either only one layer with low resolution or both layers with an increased resolution. The second layer in this case additionally contains DCT coefficients to represent the
20 increased spacial resolution.

However, the coding must in this case already generate a spacial layer and there is obtained a bit stream to be decoded which has only two possible, fixed data rates or resolutions.

To permit other data rates as well, during the
25 transcoding of the digital video bit stream a processing of the primary bit stream should take place in such a way that a lower data rate of the secondary bit stream is possible along with high picture quality at the same time. The best picture quality is achieved by a decoding of the primary bit stream and
30 subsequent encoding into a secondary bit stream. However, extensive hardware is required for this purpose.

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The invention

The invention is based on the object of specifying a method for transcoding bit streams with video information, including motion information, in which the output data rate or resolution can be varied within broad limits and in which only a reduced amount of hardware is required. This object is achieved by the method specified in Claim 1.

The invention is based on the further object of specifying a device for the method according to the invention. This object is achieved by the device specified in Claim 5.

Data-reducing coding methods for video signals often use a motion prediction in conjunction with a corresponding motion interpolation. For this purpose, motion vectors are determined for picture-element blocks or macroblocks respectively comprising a plurality of picture-element blocks. Depending on the type (for example frame, field, I, P, B) of these blocks or video data, numerous prediction modes are possible. For achieving an optimum coding, all these modes are taken into consideration.

The method according to the invention is based on the reuse of motion-compensating prediction vectors of the primary bit stream in the secondary bit stream. Since the information content of the motion vectors from the primary bit stream retains its validity also in the secondary bit stream, it is not necessary to recalculate motion vectors for transcoding. Instead, an encoding of the secondary bit stream is performed with the aid of the motion vectors from the primary bit stream.

In this case, the encoding of the secondary bit stream is carried out in a restricted prediction mode, i.e. in the secondary bit stream only prediction modes which are described by the respective block type or the motion information of the primary bit stream are authorized. The postprocessing of the prediction error, for example the quantization, which on account of the altered data rate is likewise altered, is adjusted adaptively to the desired target data rate. Consequently, a lower data rate can also actually be ensured.

The delay of the overall signal by the required processing time for the bit stream transcoding is also



advantageously reduced by the invention in comparison with a complete decoding/encoding.

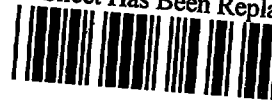
The video signals may comprise luminance and/or chrominance signals.

5 In principle, the method according to the invention for transcoding a bit stream with video data, to which motion information and video data type information are assigned, from a first data rate into a second data rate consists in that the incoming video data, corresponding to the first data rate, are
10 at least partially decoded with the aid of the motion information and video data type information obtained therefrom and are encoded using the same motion information and video data type information into the video data corresponding to the second data rate, a motion prediction and interpolation, in which the
15 number of possible prediction modes is restricted to the prediction modes allowed for the respective video data type, being used for the encoding.

 Advantageous further developments of the method according to the invention emerge from the associated dependent
20 claims.

 In principle, the device according to the invention for transcoding a bit stream with video data, to which motion information and video data type information are assigned, from a first data rate into a second data rate, is provided with:
25 - buffer-storing means and analysing means, which obtain the motion and video data type information from the video data;
- followed by video data decoding means, assigned to the first data rate, which include motion prediction and motion interpolation means controlled by the motion and video data type information;
30 - followed by video data encoding means, assigned to the second data rate, which include motion prediction and motion interpolation means controlled by the same motion and video data type information and in which the number of
35 possible prediction modes is restricted to the prediction modes allowed for the respective video data type.

 Advantageous further developments of the device according to the invention emerge from the associated dependent claims.

Drawing

Exemplary embodiments of the invention are described with reference to the drawing, in which:

- 5 Fig. 1 shows a transcoder according to the invention.

Exemplary embodiments

10 The transcoder in Fig. 1 receives a primary bit stream PBS with a first data rate and emits a secondary bit stream SBS with a second, preferably lower data rate. The bit stream PBS is separated in a demultiplexer DMX into system data SYD, audio data AUD and video data VID. The inverse operation takes place at the output in a multiplexer MX. SYD and/or AUD can, if need
15 be, likewise be adapted to the second data rate in a corresponding system data processor SDP or an audio data processor ADP, respectively. The primary bit stream PBS is partially decoded and subsequently re-encoded. The video data VID are fed for partial decoding to a buffering and analysing
20 circuit BUPAR, which separates motion information - for example motion vectors - and block type information MV&MBT and quantization parameters QP_D , and passes on the buffer-stored video data via a variable length decoder VLD, an inverse quantizer Q_D^{-1} , controlled by QP_D , an inverse DCT transformer circuit DCT_D^{-1} , an adder A_D and via frame-storing means FRM_D to
25 the encoder part of the transcoder.

With a motion predictor and interpolator $MCPI_D$, the picture signals stored in FRM_D are picked off and, in the case of interframe-coded or interfield-coded picture-element
30 blocks/macroblocks, are added in adder A_D to the picture data coming in there. The decoded input video signal IDV is available at the output of A_D . The motion predictor and interpolator $MCPI_D$ is controlled by the motion and block type information MV&MBT. The input signal of the encoder part is fed via a subtractor S,
35 a DCT transformer circuit DCT, a quantizer Q, a variable length coder VLC and a buffering and packet-forming circuit BUPAC to the multiplexer MX, together with the output signals of SDP and ADP. The circuit BUPAC controls the quantizer Q and inserts the



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motion and block type information MV&MBT into the video bit stream.

- The output signal of the quantizer Q runs via an inverse quantizer Q_E^{-1} , an inverse DCT transformer circuit DCT_E^{-1} , an adder A_E , frame-storing means FRM_E and a motion predictor and interpolator $MCPI_E$ to the inverting input of subtractor S . The output signal of $MCPI_E$ is additionally fed to the second input of adder A_E . The motion predictor and interpolator $MCPI_E$ is also controlled by the motion and block type information MV&MBT. The motion-estimating hardware which is actually required in the case of complete encoding is not needed. The decoded output video signal ODV is available at the output of A_E . According to the invention, in the motion prediction in $MCPI_E$ only prediction modes which are described by the respective block type or the motion information MV&MBT of the primary bit stream are allowed. The prediction error, altered as a matter of principle on account of the altered data rate, is adapted by a correspondingly altered quantization characteristic in Q and Q_E^{-1} to the desired target data rate.
- If MPEG2 coding has been used, the following relationships apply, for example, between MV&MBT and prediction mode (for the definition of P, I and B pictures, see ISO/IEC 13818-2, subclauses I.4.1.1 and 6.1.2.4; for the definition of picture types or block types and prediction modes, see ISO/IEC 13818-2, subclause 7.6):
- field picture:
frame prediction not allowed;
 - frame picture:
16*8 prediction not allowed;
 - I pictures and B pictures:
dual prime prediction not allowed;
 - P pictures, skipped macroblocks:
no prediction (motion vector is set to 0)
 - B pictures, skipped macroblocks:
prediction remains unchanged (corresponding existing motion vectors continue to be used)

The decoder part may be constructed, for example, similarly to in Martin Bolton, "Chip, Chip hurra", Funkschau 24/1993, pp. 76-81, using the MPEG decoder chip STi3240 and the



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DCT processor STV3208, both from SGS-Thomson. The MPEG/H.261 decoder STi3400 or the MPEG2/CCIR601 video decoder STi3500 may also be used as the decoder chip.

The MPEG/H.261 encoders STi3230 or STi3400 may be used for the
5 encoder part.

The invention can be used, for example, in digital picture reproduction equipment or picture recording equipment, in video telephone systems, in television studios, in television signal feeding systems, for distribution in cable networks or
10 for satellite transmission systems.



Patent claims



1. Method for transcoding a bit stream (PBS) with video data (VID), to which motion information and video data type information (MV&MBT) are assigned, from a first data rate into a second data rate, characterized in that the incoming video data (VID), corresponding to the first data rate, are at least partially decoded (VLD , Q_D^{-1} , DCT_D^{-1} , A_D , FRM_D , $MCPI_D$) with the aid of the motion information and video data type information (MV&MBT) obtained therefrom (BUPAR) and are encoded (S , DCT , Q , VLC , Q_E^{-1} , DCT_E^{-1} , A_E , FRM_E) using the same motion information and video data type information into the video data corresponding to the second data rate, a motion prediction and interpolation ($MCPI_E$), in which the number of possible prediction modes is restricted to the prediction modes allowed for the respective video data type (MV&MBT), being used for the encoding.
2. Method according to Claim 1, characterized in that the incoming video data (VID) and the generated video data are based on coded picture-element blocks, to which the corresponding motion and video data type information (MV&MBT) is assigned.
3. Method according to Claim 2, characterized in that at least the coding of the incoming video data (VID) corresponds to the standard ISO/IEC 11172 or ISO/IEC 13818, a plurality of such picture-element blocks respectively forming a macroblock, to which the corresponding motion and video data type information (MV&MBT) is assigned.
4. Method according to one or more of Claims 1 to 3, characterized in that the bit stream (PBS) to be transcoded likewise contains audio (AUD) and/or system data (SYD), which are likewise adapted to the second data rate.
5. Device for a method according to one or more of Claims 1 to 5, for transcoding a bit stream (PBS) with video data (VID), to which motion information and video data type information (MV&MBT) are assigned, from a first data rate into a second data rate, is provided with:



- buffer-storing means and analysing means (BUPAR), which obtain the motion and video data type information (MV&MBT) from the video data;
- followed by video data decoding means (VLD , Q_D^{-1} , DCT_D^{-1} , A_D , FRM_D), assigned to the first data rate, which include motion prediction and motion interpolation means ($MCPI_D$) controlled by the motion and video data type information;
- followed by video data encoding means (S , DCT , Q , VLC , Q_E^{-1} , DCT_E^{-1} , A_E , FRM_E), assigned to the second data rate, which include motion prediction and motion interpolation means ($MCPI_E$) controlled by the same motion and video data type information and in which the number of possible prediction modes is restricted to the prediction modes allowed for the respective video data type (MV&MBT).

6. Device according to Claim 5, characterized in that, in the case of the encoding, following buffer-storing means and inserting means (BUPAC) are provided, which add the motion and video data type information (MV&MBT) to the encoded video data.

7. Device according to Claim 5 or 6, characterized in that the video data decoding means include means (DCT_D^{-1}) for inverse DCT transformation and in that the video data encoding means include means (DCT) for DCT transformation and means (DCT_E^{-1}) for inverse DCT transformation.

8. Device according to one or more of Claims 5 to 7, characterized in that the video data (VID) are obtained together with audio (AUD) and/or system data (SYD) from the incoming bit stream (PBS) by demultiplexer means (DMX) and, after encoding, are combined in multiplexer means (MX) to give the outgoing data stream, the audio and/or system data likewise being adapted from the first data rate to the second data rate (ADP, SDP).

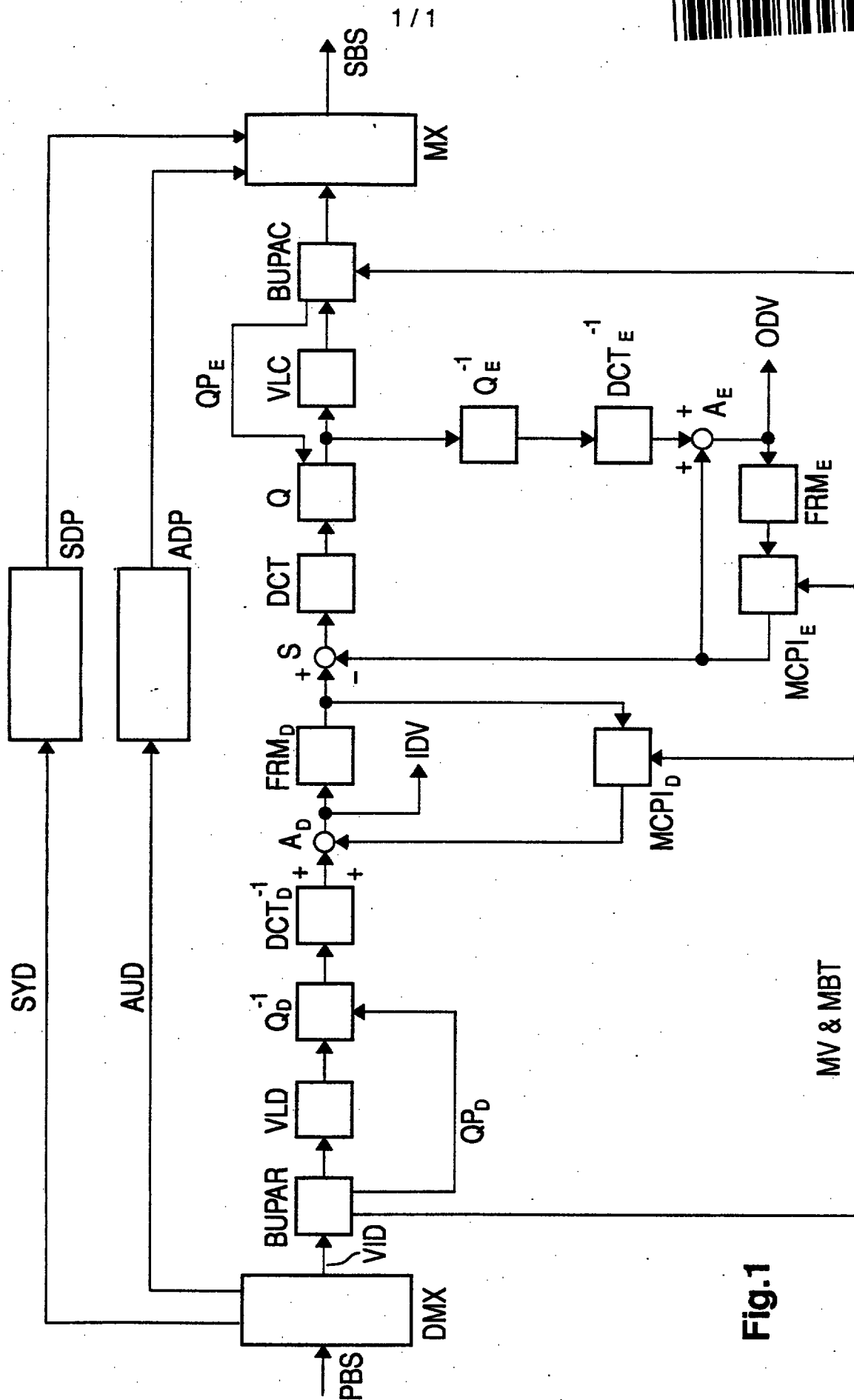
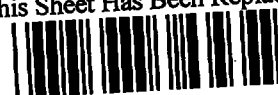
9. Use of the device according to one or more of Claims 5 to 8 in digital picture reproduction equipment, digital picture recording equipment, video telephone systems, television studios, television signal feeding systems, for distribution in cable networks or for satellite transmission systems.

**Abstract**

The coding or decoding of video data with the associated audio and/or other data can be performed, for example, on the basis of the standards ISO/IEC 11172 (MPEG1) or ISO/IEC 13818 (MPEG2). In some cases, it is wished to convert a bit stream coded on the basis of such standards into a bit stream with a different data rate. The best picture quality is in this case achieved by a decoding of the primary bit stream and subsequent encoding into a secondary bit stream. However, extensive hardware is required for this purpose.

The invention is based on the reuse of motion-compensating prediction vectors of the primary bit stream in the secondary bit stream. Since the information content of the motion vectors from the primary bit stream retains its validity also in the secondary bit stream, it is not necessary to recalculate motion vectors for transcoding. Instead, an encoding of the secondary bit stream is performed with the aid of the motion vectors from the primary bit stream. In this case, the encoding of the secondary bit stream is carried out in a restricted prediction mode, i.e. only those prediction modes which are described by the respective block type or the motion information of the primary bit stream are allowed in the secondary bit stream.

Fig. 1



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Method and device for transcoding bit streams with video data

The invention relates to a method and a device for transcoding bit streams which contain video data with motion information.

Prior art

The coding or decoding of video data with the associated audio and/or other data can be performed, for example, on the basis of the standards ISO/IEC 11172 (MPEG1) or ISO/IEC 13818 (MPEG2). In some cases, it is wished to convert a bit stream coded on the basis of such standards into a bit stream with a different data rate. It is known from the standard ISO/IEC 13818-2, subclause 7.8, "SNR scalability" to generate for this purpose a data stream with two layers, a corresponding decoder processing either only one layer with low resolution or both layers with an increased resolution. The second layer in this case additionally contains DCT coefficients to represent the increased spacial resolution.

However, the coding must in this case already generate a spacial layer and there is obtained a bit stream to be decoded which has only two possible, fixed data rates or resolutions.

To permit other data rates as well, during the transcoding of the digital video bit stream a processing of the primary bit stream should take place in such a way that a lower data rate of the secondary bit stream is possible along with high picture quality at the same time. The best picture quality is achieved by a decoding of the primary bit stream and subsequent encoding into a secondary bit stream. However, extensive hardware is required for this purpose.

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The invention

The invention is based on the object of specifying a method for transcoding bit streams with video information, including motion information, in which the output data rate or resolution can be varied within broad limits and in which only a reduced amount of hardware is required. This object is achieved by the method specified in Claim 1.

The invention is based on the further object of specifying a device for the method according to the invention. This object is achieved by the device specified in Claim 5.

Data-reducing coding methods for video signals often use a motion prediction in conjunction with a corresponding motion interpolation. For this purpose, motion vectors are determined for picture-element blocks or macroblocks respectively comprising a plurality of picture-element blocks. Depending on the type (for example frame, field, I, P, B) of these blocks or video data, numerous prediction modes are possible. For achieving an optimum coding, all these modes are taken into consideration.

The method according to the invention is based on the reuse of motion-compensating prediction vectors of the primary bit stream in the secondary bit stream. Since the information content of the motion vectors from the primary bit stream retains its validity also in the secondary bit stream, it is not necessary to recalculate motion vectors for transcoding. Instead, an encoding of the secondary bit stream is performed with the aid of the motion vectors from the primary bit stream.

In this case, the encoding of the secondary bit stream is carried out in a restricted prediction mode, i.e. in the secondary bit stream only prediction modes which are described by the respective block type or the motion information of the primary bit stream are authorized. The postprocessing of the prediction error, for example the quantization, which on account of the altered data rate is likewise altered, is adjusted adaptively to the desired target data rate. Consequently, a lower data rate can also actually be ensured.

The delay of the overall signal by the required processing time for the bit stream transcoding is also

advantageously reduced by the invention in comparison with a complete decoding/encoding.

The video signals may comprise luminance and/or chrominance signals.

In principle, the method according to the invention for transcoding a bit stream with video data, to which motion information and video data type information are assigned, from a first data rate into a second data rate consists in that the incoming video data, corresponding to the first data rate, are at least partially decoded with the aid of the motion information and video data type information obtained therefrom and are encoded using the same motion information and video data type information into the video data corresponding to the second data rate, a motion prediction and interpolation, in which the number of possible prediction modes is restricted to the prediction modes allowed for the respective video data type, being used for the encoding.

Advantageous further developments of the method according to the invention emerge from the associated dependent claims.

In principle, the device according to the invention for transcoding a bit stream with video data, to which motion information and video data type information are assigned, from a first data rate into a second data rate, is provided with:

- buffer-storing means and analysing means, which obtain the motion and video data type information from the video data;
- followed by video data decoding means, assigned to the first data rate, which include motion prediction and motion interpolation means controlled by the motion and video data type information;
- followed by video data encoding means, assigned to the second data rate, which include motion prediction and motion interpolation means controlled by the same motion and video data type information and in which the number of possible prediction modes is restricted to the prediction modes allowed for the respective video data type.

Advantageous further developments of the device according to the invention emerge from the associated dependent claims.

Drawing

Exemplary embodiments of the invention are described with reference to the drawing, in which:

Fig. 1 shows a transcoder according to the invention.

Exemplary embodiments

The transcoder in Fig. 1 receives a primary bit stream PBS with a first data rate and emits a secondary bit stream SBS with a second, preferably lower data rate. The bit stream PBS is separated in a demultiplexer DMX into system data SYD, audio data AUD and video data VID. The inverse operation takes place at the output in a multiplexer MX. SYD and/or AUD can, if need be, likewise be adapted to the second data rate in a corresponding system data processor SDP or an audio data processor ADP, respectively. The primary bit stream PBS is partially decoded and subsequently re-encoded. The video data VID are fed for partial decoding to a buffering and analysing circuit BUPAR, which separates motion information - for example motion vectors - and block type information MV&MBT and quantization parameters QP_D , and passes on the buffer-stored video data via a variable length decoder VLD, an inverse quantizer Q_D^{-1} , controlled by QP_D , an inverse DCT transformer circuit DCT_D^{-1} , an adder A_D and via frame-storing means FRM_D to the encoder part of the transcoder.

With a motion predictor and interpolator $MCPI_D$, the picture signals stored in FRM_D are picked off and, in the case of interframe-coded or interfield-coded picture-element blocks/macroblocks, are added in adder A_D to the picture data coming in there. The decoded input video signal IDV is available at the output of A_D . The motion predictor and interpolator $MCPI_D$ is controlled by the motion and block type information MV&MBT.

The input signal of the encoder part is fed via a subtracter S, a DCT transformer circuit DCT, a quantizer Q, a variable length coder VLC and a buffering and packet-forming circuit BUPAC to the multiplexer MX, together with the output signals of SDP and ADP. The circuit BUPAC controls the quantizer Q and inserts the

motion and block type information MV&MBT into the video bit stream.

The output signal of the quantizer Q runs via an inverse quantizer Q_E^{-1} , an inverse DCT transformer circuit DCT_E^{-1} , an adder A_E , frame-storing means FRM_E and a motion predictor and interpolator $MCPI_E$ to the inverting input of subtractor S . The output signal of $MCPI_E$ is additionally fed to the second input of adder A_E . The motion predictor and interpolator $MCPI_E$ is also controlled by the motion and block type information MV&MBT. The motion-estimating hardware which is actually required in the case of complete encoding is not needed. The decoded output video signal ODV is available at the output of A_E . According to the invention, in the motion prediction in $MCPI_E$ only prediction modes which are described by the respective block type or the motion information MV&MBT of the primary bit stream are allowed. The prediction error, altered as a matter of principle on account of the altered data rate, is adapted by a correspondingly altered quantization characteristic in Q and Q_E^{-1} to the desired target data rate.

If MPEG2 coding has been used, the following relationships apply, for example, between MV&MBT and prediction mode (for the definition of P, I and B pictures, see ISO/IEC 13818-2, subclauses I.4.1.1 and 6.1.2.4; for the definition of picture types or block types and prediction modes, see ISO/IEC 13818-2, subclause 7.6):

- field picture:
frame prediction not allowed;
- frame picture:
16*8 prediction not allowed;
- I pictures and B pictures:
dual prime prediction not allowed;
- P pictures, skipped macroblocks:
no prediction (motion vector is set to 0)
- B pictures, skipped macroblocks:
prediction remains unchanged (corresponding existing motion vectors continue to be used)

The decoder part may be constructed, for example, similarly to in Martin Bolton, "Chip, Chip hurra", Funkschau 24/1993, pp. 76-81, using the MPEG decoder chip ST13240 and the

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DCT processor STV3208, both from SGS-Thomson. The MPEG/H.261 decoder STi3400 or the MPEG2/CCIR601 video decoder STi3500 may also be used as the decoder chip.

The MPEG/H.261 encoders STi3230 or STi3400 may be used for the encoder part.

The invention can be used, for example, in digital picture reproduction equipment or picture recording equipment, in video telephone systems, in television studios, in television signal feeding systems, for distribution in cable networks or for satellite transmission systems.



Patent claims

1. Method for transcoding a bit stream (PBS) with video data (VID), to which motion information and video data type information (MV&MBT) are assigned, from a first data rate into a second data rate, characterized in that the incoming video data (VID), corresponding to the first data rate, are at least partially decoded (VLD , Q_D^{-1} , DCT_D^{-1} , A_D , FRM_D , $MCPI_D$) with the aid of the motion information and video data type information (MV&MBT) obtained therefrom (BUPAR) and are encoded (S , DCT , Q , VLC , Q_E^{-1} , DCT_E^{-1} , A_E , FRM_E) using the same motion information and video data type information into the video data corresponding to the second data rate, a motion prediction and interpolation ($MCPI_E$), in which the number of possible prediction modes is restricted to the prediction modes allowed for the respective video data type (MV&MBT), being used for the encoding.
2. Method according to Claim 1, characterized in that the incoming video data (VID) and the generated video data are based on coded picture-element blocks, to which the corresponding motion and video data type information (MV&MBT) is assigned.
3. Method according to Claim 2, characterized in that at least the coding of the incoming video data (VID) corresponds to the standard ISO/IEC 11172 or ISO/IEC 13818, a plurality of such picture-element blocks respectively forming a macroblock, to which the corresponding motion and video data type information (MV&MBT) is assigned.
4. Method according to one or more of Claims 1 to 3, characterized in that the bit stream (PBS) to be transcoded likewise contains audio (AUD) and/or system data (SYD), which are likewise adapted to the second data rate.
5. Device for a method according to one or more of Claims 1 to 5, for transcoding a bit stream (PBS) with video data (VID), to which motion information and video data type information (MV&MBT) are assigned, from a first data rate into a second data rate, is provided with:



- buffer-storing means and analysing means (BUPAR), which obtain the motion and video data type information (MV&MBT) from the video data;
- followed by video data decoding means (VLD , Q_D^{-1} , DCT_D^{-1} , A_D , FRM_D), assigned to the first data rate, which include motion prediction and motion interpolation means ($MCPI_D$) controlled by the motion and video data type information;
- followed by video data encoding means (S , DCT , Q , VLC , Q_E^{-1} , DCT_E^{-1} , A_E , FRM_E), assigned to the second data rate, which include motion prediction and motion interpolation means ($MCPI_E$) controlled by the same motion and video data type information and in which the number of possible prediction modes is restricted to the prediction modes allowed for the respective video data type (MV&MBT).

6. Device according to Claim 5, characterized in that, in the case of the encoding, following buffer-storing means and inserting means (BUPAC) are provided, which add the motion and video data type information (MV&MBT) to the encoded video data.

7. Device according to Claim 5 or 6, characterized in that the video data decoding means include means (DCT_D^{-1}) for inverse DCT transformation and in that the video data encoding means include means (DCT) for DCT transformation and means (DCT_E^{-1}) for inverse DCT transformation.

8. Device according to one or more of Claims 5 to 7, characterized in that the video data (VID) are obtained together with audio (AUD) and/or system data (SYD) from the incoming bit stream (PBS) by demultiplexer means (DMX) and, after encoding, are combined in multiplexer means (MX) to give the outgoing data stream, the audio and/or system data likewise being adapted from the first data rate to the second data rate (ADP, SDP).

9. Use of the device according to one or more of Claims 5 to 8 in digital picture reproduction equipment, digital picture recording equipment, video telephone systems, television studios, television signal feeding systems, for distribution in cable networks or for satellite transmission systems.

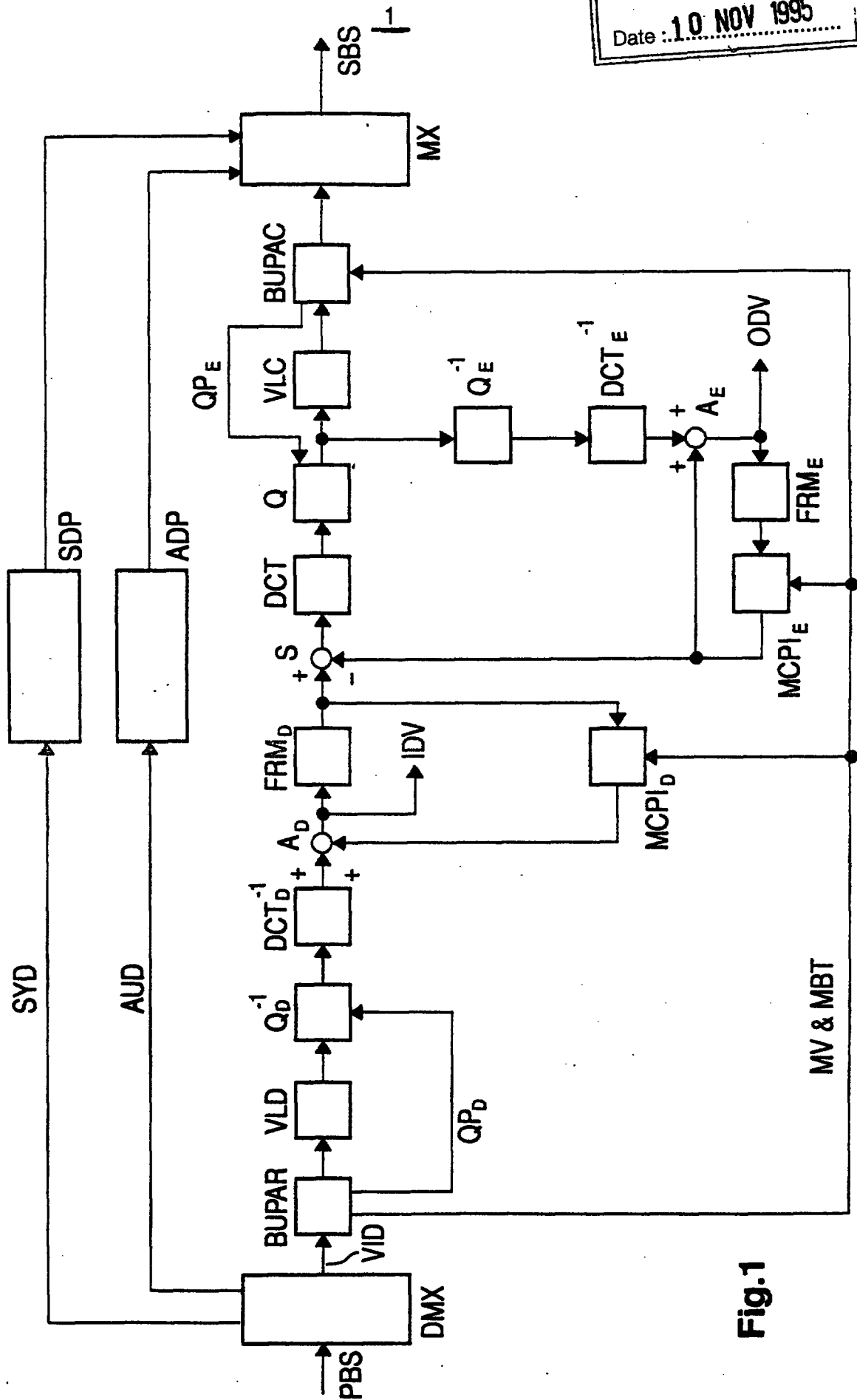


Fig.1

ABSTRACT**METHOD AND DEVICE FOR TRANSCODING BIT STREAMS WITH VIDEO
DATA**

The invention deals with a method and device for transcoding of a bit stream (PBS) with video data (VID). Transcoding means in this case the conversion of a coded bit stream transmitted with a given data rate into a coded bit stream with a different data rate. The invention proposes the reuse of motion-compensating prediction vectors (MV&MBT) of the primary bit stream (PBS) in the secondary bit-stream (SBS) with different data rate. Thereby the recalculation of motion vectors (MV&MBT) for the transcoding operation is not necessary. It is also proposed that the encoding operation for generation of the secondary bit stream (SBS) is carried out in a restricted prediction mode, i.e., only those prediction modes which are described by the respective block type or motion information of the primary bit stream (PBS) are allowed for the secondary bit stream.

(Fig. 1)