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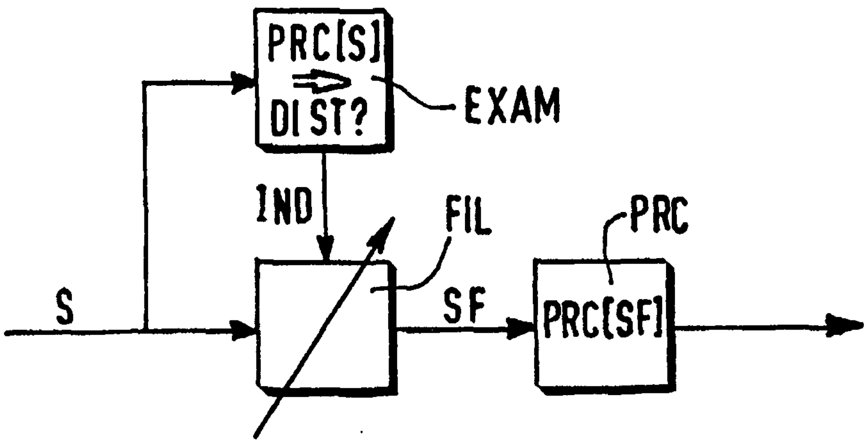

(57) Abstract

A signal-processing arrangement comprising an examining circuit (EXAM), and adjustable filter (FIL), and a signal processor (PRC). The signal processor (PRC) may be, for example, a video encoder for encoding a sequence of pictures in accordance with an MPEG standard. The examining circuit (EXAM) examines a signal (S) to be processed so as to obtain a distortion indication (IND) the distortion indication (IND) indicates to which extent distortion (DIST) would be introduced if the signal (S) were processed (PRC[S]) by means of the processor (PRC). An adjustable filter (FIL) filters the signal (S) in dependence on the distrotion indication (IND) so as to obtain a filtered signal (SF). The signal processor (PRC) processes the filtered signal (SF). Thus, the signal-processing arrangement filters the signal to be processed in a pro-active manner so as to counter distortion which might otherwise be introduced by processing the signal. Accordingly, a satisfactory signal quality can be obtained. For example, in a video-encoding application, the filter can reduce details contained in a series of pictures. This allows the series of pictures to be coded with a sufficient precision without introducing block effects which might otherwise occur if the pictures were not filtered. Moreover, since the filter is pro-actively adjusted, it filters the series of pictures more evenly than if the filter were retro-actively adjusted. Accordingly, there will be relatively little variation in resolution from one picture to another, which contributes to a satisfactory overall picture quality.

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SIGNAL PROCESSING APPARATUS AND METHOD

FIELD OF THE INVENTION

The invention relates to signal processing such as, for example, coding a sequence of pictures in accordance with a standard defined by the Moving Pictures Experts Group (MPEG).

BACKGROUND ART

The document JP-A-09,009,260 describes a dynamic image encoding device. What follows is a literal citation of the English abstract. For AD converted image picture data, the low frequency components are passed through by a two-dimensional block unit in a variable low-pass spatial filter, a high frequency encoding processing is performed in a compressor 13, they are tentatively stored in a FIFO memory and a compressed data storage amount in the FIFO memory is monitored by a FIFO monitoring device. FIFO storage information which is the monitoring data and block activity information for each block unit from the compressor are inputted to a band controller and a cut-off frequency for each block is set and instructed to the variable low-pass spatial filter from the band controller.

SUMMARY OF THE INVENTION

It is an object of the invention to provide signal processing which allows a better quality.

The invention takes the following aspects into consideration. Processing of a signal may cause distortion. For example, coding a sequence of pictures is a form of signal processing which may cause distortion. In order not to exceed a certain limit in terms of amount of coded data obtained, it may be necessary to code certain pictures with a relatively low precision. If a picture is coded with a relatively low precision, the picture may be distorted in the sense that block effects occur in the picture at a decoding end.

It is possible to counter distortion caused by processing a signal, by filtering the signal before it is processed. However, if a signal is filtered, it is distorted too in the sense that certain signal components are attenuated or even removed. Thus, if a signal is filtered before it is processed, in effect, a compromise is made between distortion caused by the filtering and distortion caused by the processing. For example, if a picture is filtered, the filtered picture thus obtained will comprise fewer details than the original picture. As a result, the filtered picture can be coded with a higher precision than the original picture while respecting a certain limit in terms of amount of coded data obtained. However, the filtered picture will have a lower resolution than the original picture. Thus, filtering a picture before it is coded entails a compromise between coding precision and picture resolution because both affect the overall quality of the picture.

In the background art, the spatial low-pass filter, which filters picture data before it is coded, appears to be adjusted as a function of the amount of coded data contained in the FIFO output buffer. Consequently, it does not initially prevent that a relatively large amount of coded data is produced. If a relatively large amount of coded data is indeed produced, the picture data yet to be coded will be distorted to a relatively large extent. This is because this picture data either has to be filtered to a relatively large extent, or has to be coded with a relatively low precision, or both, in order to prevent that a limit in terms of amount of coded data obtained is exceeded. Thus, the picture data yet to be coded will have a relatively poor quality, either because the resolution is low or because there are so..e block effects, or both.

In accordance with the invention, an examining circuit examines a signal to be processed by means of a signal processor so as to obtain a distortion indication. The distortion indication indicates to which extent distortion would be introduced if the signal as such were processed by the signal processor. An adjustable filter filters the signal in dependence on the distortion indication so as to obtain a filtered signal. The signal processor processes the filtered signal.

Thus, in the invention, the adjustable filter is adjusted in a pro-active manner, whereas in the background art, the spatial low-pass filter is adjusted in a retro-active manner. Accordingly, in the invention, there is not any substantial delay in making a compromise between distortion caused by processing and distortion caused by filtering, whereas in the background art, there is inherently some delay in making such a compromise. Thus, the invention allows a better compromise between the two aforementioned types of distortion. As a result, the invention allows a better quality.

For example, the invention may be applied for coding a sequence of pictures. Let it be assumed that the examining circuit examines a picture to be coded or a portion thereof. By doing so, it can indicate that if the picture as such were coded, a relatively large amount of coded data would be obtained. As explained hereinbefore, this potentially causes distortion of one or more pictures subsequently to be coded. Since the invention allows the picture to be filtered in dependence on this indication, it can be prevented that the coding of the picture actually produces a large amount of coded data. Accordingly, this contributes to the quality of the one or more subsequent pictures. Thus, in effect, the invention allows a quality trade, off between the picture examined and the one or more subsequent pictures. Accordingly, the invention allows a satisfactory and homogeneous picture quality.

The invention and additional features, which may be optionally used to implement the invention to advantage, are apparent from and will be elucidated with reference to the drawings described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a conceptual diagram illustrating basic features of the invention as claimed in claim 1.

Fig. 2 is a block diagram illustrating an example of a video encoder;

Fig. 3 is a block diagram illustrating a video-coding arrangement in accordance with the invention;

Fig. 4 is a graph illustrating a first filter control-characteristic for the video coding arrangement illustrated in Fig. 3.

Fig. 5 is a graph illustrating a second filter control-characteristic for the video coding arrangement illustrated in Fig. 3.

DETAILED DESCRIPTION OF THE DRAWINGS

First, some remarks will be made on the use of reference signs. Similar entities are denoted by an identical letter code throughout the drawings. Various similar entities may be shown in a single drawing. In that case, a numeral is added to the letter code so as to distinguish similar entities from each other. The numeral will be between parentheses if the number of similar entities is a running parameter. In the description and the claims, any numeral in a reference sign may be omitted if this is appropriate.

Fig. 1 illustrates basic features of the invention in solid lines. A signal processing arrangement comprises an examining circuit EXAM, a pre-processor FIL, and a signal processor PRC. The examining circuit EXAM examines a signal S to be processed so as to obtain a distortion indication IND. The distortion indication IND indicates to which extent distortion DIST would be introduced if the signal S were processed PRC[S] by means of the processor PRC. The pre-processor FIL pre-processes the signal S in dependence on the distortion indication IND so as to obtain a pre-processed signal SF. The signal processor PRC processes the pre-processed signal SF.

The features illustrated in Fig. 1 may be applied, for example, for coding a sequence of pictures. In such an application, the signal S is a data stream representing the sequence of pictures to be coded. The signal processor PRC is a video encoder which may distort one or more pictures to a relatively large extent. This will be explained in greater detail hereinafter.

Fig. 2 illustrates an example of a video encoder. The video encoder provides an MPEG data stream OUT having a certain bit rate R in response to a picture data stream IN representing a sequence of pictures. The picture data stream IN may be obtained, for example, by converting an analog video signal to a digital video signal. The video encoder comprises the following functional blocks: an input buffer IBUF, a subtractor SUB, a memory MEM, a motion estimator and compensator MEC, a discrete cosine transformer DCT, an inverse discrete cosine transformer IDCT, a quantizer Q, an inverse quantizer IQ, an adder ADD, a variable-length encoder VLC, an output buffer OBUF, and a controller CON.

The video encoder illustrated in Fig. 2 codes most pictures in the following manner. The input buffer IBUF temporarily stores a picture to be coded. The picture to be coded is, in effect, subdivided into macroblocks of 16-by-16 pixels. It is assumed that the memory MEM contains a decoded version of a previously coded picture which will hereinafter be referred to as the previous picture. For each macroblock in the picture to be coded, the motion estimator and compensator MEC searches a similar macroblock of 16-by-16 pixels in the previous picture. The motion estimator and compensator MEC supplies the similar macroblock which it has found to the subtractor SUB. The subtractor SUB provides a differential macroblock by subtracting, from the macroblock to be coded, the similar macroblock provided by the motion estimator and compensator MEC. The discrete cosine transformer DCT transforms the differential macroblock into a block of frequency coefficients.

The quantizer Q divides each frequency coefficient by a value which is proportional to a quantization parameter QP and rounds off the result of this division to the nearest integer. Accordingly, the quantizer Q provides a block of quantized frequency coefficients. The inverse quantizer IQ and the inverse discrete cosine transformer ICDT provide a decoded version of the differential macroblock on the basis of the block of quantized frequency coefficients. The adder ADD adds the similar macroblock in the previous picture, which the motion estimator and compensator MEC has found, to the decoded version of the differential macroblock. Accordingly, the adder ADD provides a decoded version of the macroblock being coded, which decoded version is stored in the memory MEM. The memory MEM will thus comprise a decoded version of the picture currently being coded once all macroblocks comprised in this picture have been coded. Consequently, in this manner it is achieved that when a picture is coded, a decoded version of the preceding picture is contained in the memory MEM.

The variable-length encoder VLC transforms the block of quantized frequency coefficients into a series of variable-length codes. The block of quantized frequency coefficients will generally comprise a number of frequency coefficients having the value of zero, the number being higher as the quantization parameter QP has a higher value. As a result, the series of variable-length codes comprises relatively few bits if the quantization parameter QP has a high value, and vice versa. The variable-length codes are temporarily stored in the output buffer OBUF. The output buffer OBUF outputs variable-length codes belonging to macroblocks which have already been coded, at the bit rate R.

The controller CON controls the quantization parameter QP on the basis of the following criterion. The amount of coded data contained in the output buffer OBUF, which amount will hereinafter be referred to as output buffer fullness F, should be between a minimum and a maximum level. This implies that, if the output buffer OBUF is relatively full, the quantization parameter QP will generally have a relatively high value. If the output buffer OBUF is relatively empty, the quantization parameter QP will generally have a relatively low value.

In greater detail, the controller CON calculates a target amount of coded data for a picture to be coded, or a portion thereof. The target amount of coded data depends on the output buffer fullness F. That is, if the output buffer OBUF is relatively full, the target will be relatively low, and vice versa. The controller CON calculates a value for the quantization parameter QP on the basis of the target amount of coded data and recent coding experiences. These recent coding experiences include an amount data comprised in a recently coded portion of the picture, and the value of the quantization parameter QP which was applied in the coding of that portion. Let it be assumed that the recently coded portion of the picture comprises a relatively large amount of coded data. The controller CON deduces from this that the quantization parameter QP should have a value which is somewhat lower than the recent value, so as to prevent that the target amount of coded data is exceeded.

The video encoder illustrated in Fig. 2 may distort a picture to a relatively large extent if the picture, or a portion thereof, is coded with the quantization parameter QP having a relatively high value. If the quantization parameter QP has a relatively high value, the number of different values which a quantized frequency coefficient may have, is relatively low. Moreover, in practice, many frequency coefficients will be rounded off to zero value. As a result, at a decoding end, the picture will be distorted to a relatively large extent. For example, objects, or portions thereof, which comprise relatively many details will be represented by means of relatively large, uniform blocks. This phenomenon is hereinafter referred to as block effects.

Block effects may occur, for example, when there is a scene change in the sequence of pictures. In general, the first picture of a new scene will differ from the last picture of the preceding scene to a relatively large extent. Consequently, if the first picture of the new scene is coded, many blocks of frequency coefficients will comprise many frequency coefficients having a substantial value. If these blocks were quantized with the quantization parameter QP having a nominal value, a relatively large amount of coded data would be obtained. In order to prevent this, the controller CON will give the quantization parameter QP a high value. As explained hereinbefore, this might cause block effects.

Fig. 3 illustrates an example of a video-encoding arrangement in accordance with the invention. The video-encoding arrangement recaptures the features illustrated in Fig. 1. It provides an MPEG data stream MDS in response to a picture data stream PDS representing a sequence of pictures. The video-encoding arrangement comprises a pseudo video-encoder PENC, a filter controller FCON, a delay circuit DEL, an adjustable filter FIL and a video encoder ENC. The video encoder ENC and the pseudo video-encoder PENC are similar to the video encoder illustrated in Fig. 2 and discussed hereinbefore. However, the controller CON comprised in the pseudo video-encoder does not control the quantization parameter QP in the same manner as described hereinbefore with reference to Fig. 2. This will be explained in greater detail hereinafter.

The video-encoding arrangement illustrated in Fig. 3 basically operates in the following manner. The pseudo-video-encoder PENC codes a picture so as to derive a complexity indication CI indicating, as it were, how difficult it is to code the picture. The filter controller FCON controls the adjustable filter FIL in dependence on the complexity indication CI. The delay circuit DEL compensates for the time which the pseudo video-encoder PENC spends to code the picture as well as the time which the filter controller FCON spends to control the adjustable filter FIL. The adjustable filter FIL filters the picture to be coded with a cut-off frequency FC determined by the complexity indication CI. The video encoder ENC codes the filtered picture.

There are various manners in which the pseudo video-encoder PENC may provide the complexity indication CI. For example, the pseudo video-encoder may code the picture with the quantization parameter QP having a certain fixed value. If the amount of coded data is relatively large, it can be said that the picture is difficult to code, and vice versa. Thus, the amount of coded data obtained by coding the picture may constitute the complexity indication CI. The pseudo video-encoder PENC may also encode the picture with the quantization parameter QP being controlled on the basis of a target amount of coded data established in the encoder ENC. If the quantization parameter QP is given a relatively high value, so as to meet the target, it can be said that the picture is difficult to code, and vice versa. Thus, the quantization parameter QP may constitute the complexity indication CI. It is also possible to use the product of the quantization parameter QP and the amount of coded data obtained as a complexity indication. In that case, it does not matter how the pseudo video-encoder PENC establishes a value for the quantization parameter QP.

The complexity indication CI is, in effect, a distortion indication. If the complexity indication CI has a high value, which means that the picture is difficult to code, the following may occur. The video encoder ENC may give the quantization parameter QP a relatively high value, so as to prevent that a relatively large amount of coded data is produced. In that case, block effects may occur in the picture at a decoding end, as explained hereinbefore. The video encoder ENC may also give the quantization parameter QP a value which is sufficiently low to prevent such block effects. However, in that case, a relatively large amount of coded data will be produced, which will affect the quality of one or more subsequent pictures as explained hereinbefore. Thus, if the complexity indication CI has a high value, either the picture itself will be distorted, or one or more subsequent pictures, or both, if the encoder ENC were to code the picture as such.

Fig. 4 illustrates a filter control characteristic which may be applied by the filter controller FCON. Fig. 4 is a graph having a horizontal axis representing the complexity indication CI and a vertical axis representing the cut-off frequency FC of the adjustable filter FIL. The graph illustrates that, if the complexity indication CI is below a threshold value Cth, the cut-off frequency has a relatively high value which does not substantially vary as a function of the complexity indication CI. Accordingly, if a picture is relatively easy to code, it will be filtered to a relatively small extent only and, consequently, details of the picture will substantially be preserved. However, if the complexity indication CI is above the threshold value, the cut-off frequency decreases as the complexity indication CI increases in value. Accordingly, if a picture is relatively difficult to code, it will be filtered to an extent which depends on how difficult the picture is to code. That is, if a picture is relatively difficult to code, details of the picture will be removed to an extent which depends on how difficult the picture is to code. This allows the video encoder ENC to code the thus filtered picture with the quantization parameter QP having a value which is sufficiently low to prevent block effects in the picture itself, while the amount of coded data obtained is sufficiently low to allow a satisfactory quality of subsequent pictures.

Fig. 5 illustrates another filter control characteristic which may be optionally applied in combination with the control characteristic illustrated in Fig. 4. Fig. 5 is a graph having a horizontal axis representing a picture number and a vertical axis representing the cut-off frequency FC. The picture number N represents the picture for which the complexity indication CI has been established as described hereinbefore. It is assumed that the complexity indication CI of this picture has a relatively high value, which means that the picture is difficult to code. As a result, the spatial filter FIL has a relatively low cut-off frequency FClow when the picture number N is filtered. Fig. 5 illustrates that, as a consequence, subsequent pictures having numbers N+1, N+2, N+3, are also filtered with the cut-off frequency which gradually increases as the picture number increases.

The filter control characteristic illustrated in Fig. 5 is advantageous, for example, when a scene change occurs. Let it be assumed that the picture number N is the first picture of a new scene. Since the first picture of the new scene is filtered with the relatively low cut-off frequency FClow, relatively many details will be removed. That is, at a decoding end, the first picture of the new scene will have a relatively low resolution. Since the cut-off frequency FC gradually increases with the picture number in the new scene, the resolution will gradually become better with each subsequent picture. This evolution in resolution matches properties of human vision. Human beings tend to first pay attention to the basic shape and color of new objects and only later pay attention to the details of the new objects. Thus, in the case of a scene change, the filter control characteristic illustrated in Fig. 5 will affect the perceived resolution to a relatively small extent only. What is more, the control characteristic allows the first pictures of a new scene to be coded with the quantization parameter QP having a value which is sufficiently high to avoid block effects, without producing a relatively large amount of coded data. Thus, the control characteristic illustrated in Fig. 5 contributes to a satisfactory overall quality.

The drawings and their description hereinbefore illustrate rather than limit the invention. It will be evident that there are numerous alternatives which fall within the scope of the appended claims. In this respect, the following closing remarks are made.

There are numerous ways of physically spreading functions or functional elements over various units. In this respect, the drawings are very diagrammatic, each representing only one possible embodiment of the invention. Thus, although a drawing shows different functional elements as different blocks, this by no means excludes that some functional elements, or all functional elements, may be implemented as a single physical unit.

Although, the video-coding arrangement illustrated in Fig. 3 uses a pseudo video-encoder PENC to provide a distortion indication in the form of the complexity indication CI, other circuits may be used to provide a distortion indication. For example, a circuit may be used, which establishes a sum of absolute differences between the pixels of a picture to be coded and corresponding pixels of a previous picture. If the sum of absolute differences is high, the picture is difficult to code and, consequently, the picture itself may be distorted or one or more subsequent pictures, or both. Thus, the sum of absolute differences is a distortion indication.

Although in the video-encoding arrangement illustrated in Fig. 3, the adjustable filter FIL filters pictures and is controlled on a picture-by-picture basis, it may also filter portions of pictures and be adjusted on a picture portion-by-portion basis.

With respect to the adjustable filter FIL shown in Fig. 5, the following is also noted. In principle, any type of filter may be used. For example, the adjustable filter FIL may be a spatial filter or a horizontal filter. That is, it may be a two-dimensional filter or a one-dimensional filter. The adjustable filter FIL may be implemented, for example, as a mean filter, a gauss filter or a median filter

The adjustable filter FIL may also be implemented as a wavelet domain filter. The wavelet domain filter can be based on a de-blocking algorithm for JPEG compressed images. In that case, the filter carries out edge detection and smoothing so as to preserve detected edges in the wavelet domain. The edge detection may be based on a threshold which is determined in the pseudo video-encoder PENC shown in Fig. 3. Accordingly, the threshold is adapted to the complexity of the current picture to be encoded.

The wavelet domain filter counters block effects by filtering only those areas of a picture in which these effects may occur. Thus, a wavelet domain filter will reduce the resolution of a picture to a lesser extent than a low-pass filter. As the wavelet domain filtering is preferably applied picture-by-picture, or rather field-by-field, a JPEG algorithm can further be useful to counter block effects. Such an algorithm provides a satisfactory de-blocking performance and is relatively simple.

In view of the remarks made hereinbefore, it will be clear that the term "filter" is not limited to signal processing characterized by a certain frequency response. The term "filter" should be broadly construed so as to include various types of pre-processing which will diminish the distortion that would otherwise be introduced by a processor.

Any reference sign in a claim should not be construed as limiting the claim concerned.

CLAIMS:

1. A method of processing a signal (S) by means of a signal processor (PRC), the method comprising the steps of :

- examining (EXAM) the signal (S) to be processed so as to obtain a distortion indication (IND) indicating to which extent distortion (DIST) would be introduced if the signal (S) were processed (PRC[S]) by means of the processor (PRC);
- pre-processing (FIL) the signal (S) in dependence on the distortion indication (IND) so as to obtain a pre-processed signal (SF); and
- processing (PRC[SF]) the pre-processed signal (SF) by means of the processor (PRC).

2. A signal-processing arrangement comprising a signal processor (PRC), characterized in that the signal-processing arrangement further comprises:

- an examining circuit (EXAM) for examining a signal (S) to be processed so as to obtain a distortion indication (IND) indicating to which extent distortion (DIST) would be introduced if the signal (S) were processed (PRC[S]) by means of the processor (PRC);
- a pre-processor (FIL) for pre-processor the signal (S) in dependence on the distortion indication (IND) so as to obtain a pre-processed signal (SF), the signal processor (PRC) being coupled to the pre-processor (FIL) for processing (PRC[SF]) the pre-processed signal (SF).

3. A signal-processing arrangement as claimed in claim 2 characterized in that the pre-processor (FIL) comprises an adjustable filter whose filter characteristics are adjusted in dependence on the distortion indication (IND).

4. A method of video encoding comprising the steps of:

- examining (PENC) video data to be encoded so as to obtain a complexity indication (CI) indicating how difficult it is to encode the video data;
- filtering (FIL) the video data in dependence on the complexity indication (CI)

so as to obtain filtered video data; and

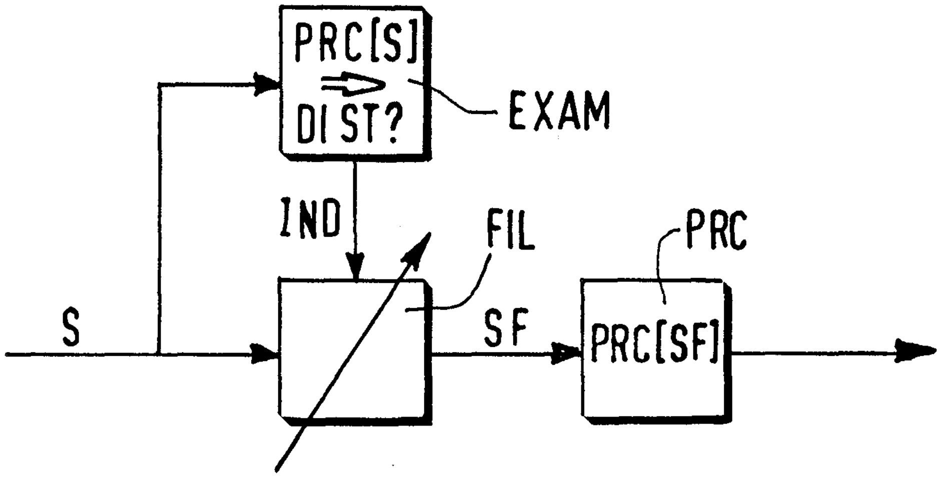
- encoding (ENC) the filtered video data.

5. A video-encoding arrangement comprising:

- an examining circuit (FIL) for examining video data to be encoded so as to obtain a complexity indication (CI) indicating how difficult it is to encode the video data;

- an adjustable filter (FIL) for filtering the video data in dependence on the complexity indication (CI) so as to obtain filtered video data; and

- a video encoder (ENC) for encoding the filtered video data.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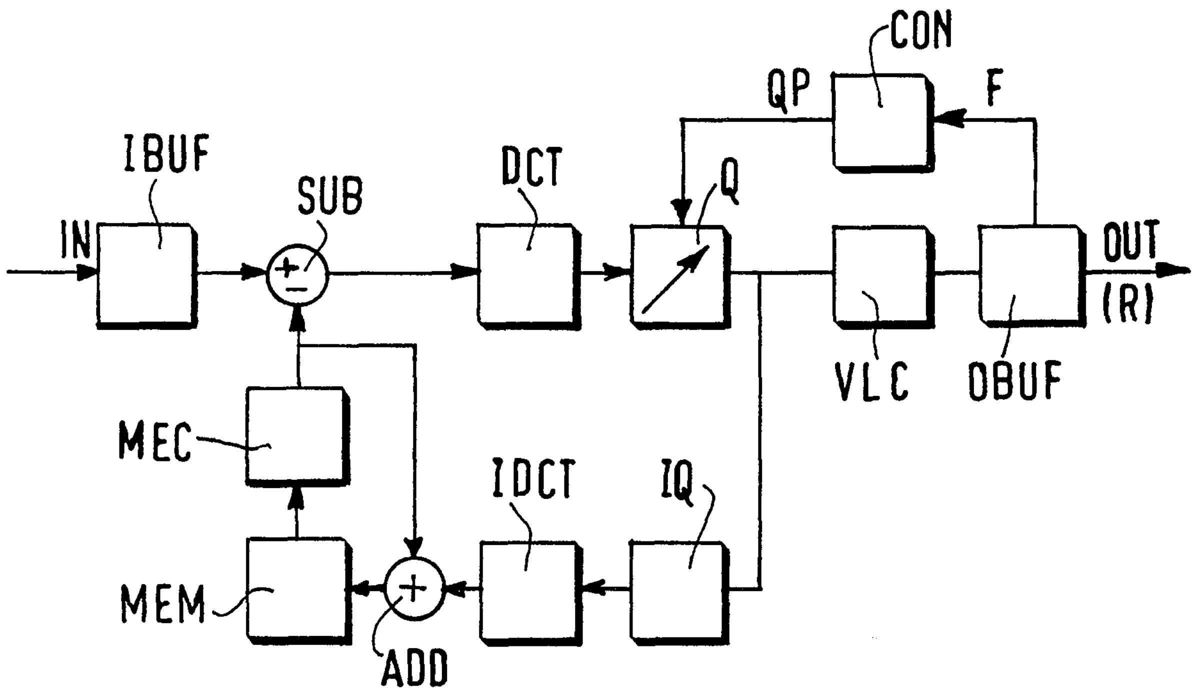
DIST?
EXAM
IND
FIL
PRC
S
SF
PRC[SF]

FIG.1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ADD

FIG.2

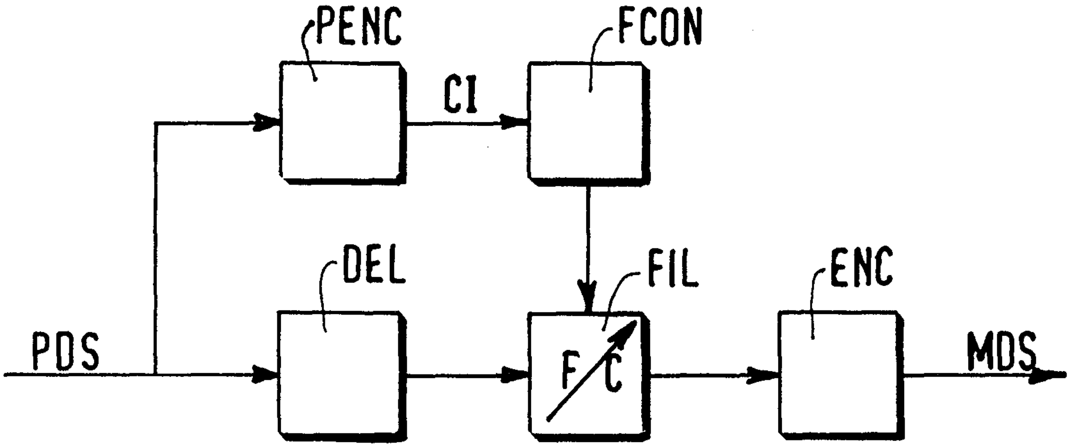

FIG.3

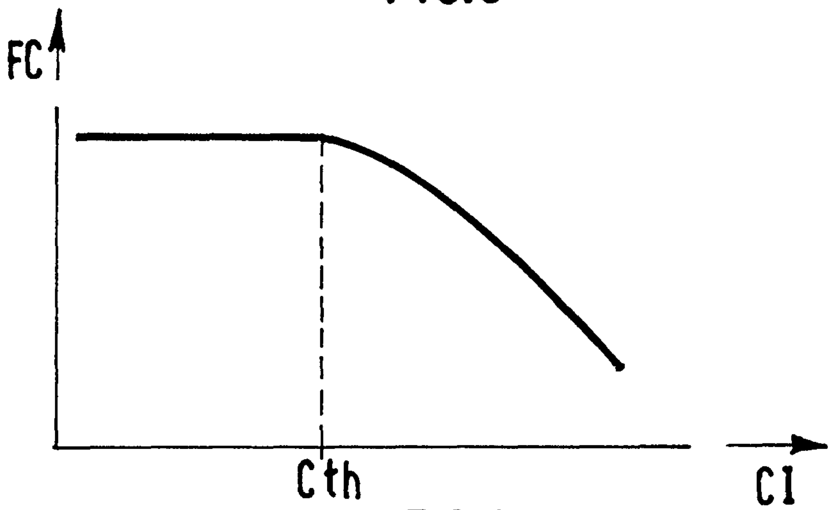

FIG.4

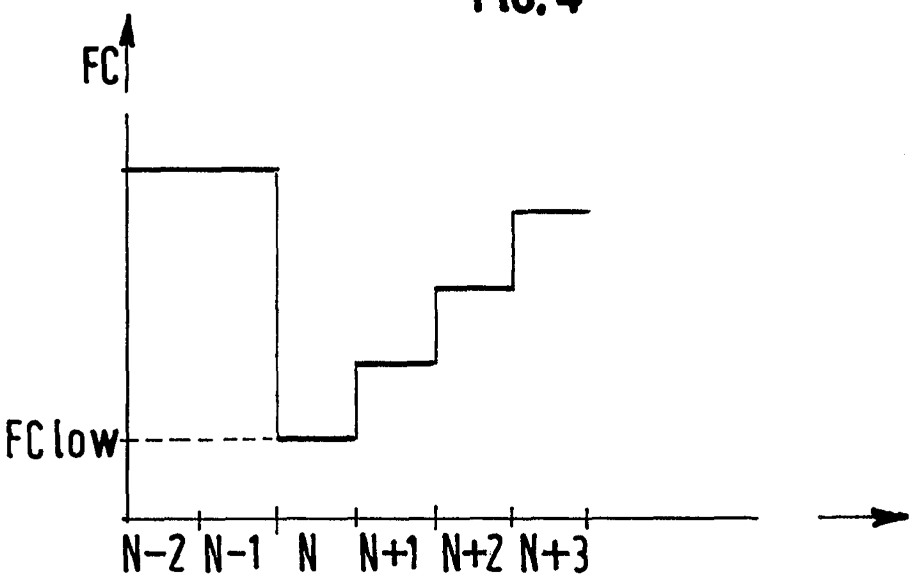

FIG.5

INTERNATIONAL SEARCH REPORT

Inter   onal Application No
PCT/EP 99/08937

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/50

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 579 121 A (OHTA MINEMASA ET AL) 26 November 1996 (1996-11-26) column 1, line 34-51 column 3, line 36 -column 7, line 44	1-3
X	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 05, 30 May 1997 (1997-05-30) & JP 09 009260 A (MATSUSHITA ELECTRIC IND CO LTD), 10 January 1997 (1997-01-10) cited in the application abstract	4,5
A	EP 0 493 130 A (CANON KK) 1 July 1992 (1992-07-01) page 5, line 18 -page 7, line 31	1-5

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
13 January 2000	31/01/2000

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Inter   onal Application No
PCT/EP 99/08937

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	NOBUMOTO YAMANE ET AL: "CHANNEL CODING PERFORMANCE OF AN ADAPTIVE DCT IMAGE CODING IN COMBINATION WITH M-TRANSFORM" ELECTRONICS & COMMUNICATIONS IN JAPAN, PART I - COMMUNICATIONS,US,SCRIPTA TECHNICA. NEW YORK, vol. 77, no. 9, page 52-61 XP000485733 ISSN: 8756-6621 paragraph '0002!; figure 1 -----	1-5

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte. .onal Application No
PCT/EP 99/08937

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5579121 A	26-11-1996	JP 7177464 A	14-07-1995
JP 09009260 A	10-01-1997	NONE	
EP 0493130 A	01-07-1992	JP 4315369 A	06-11-1992
		JP 4315370 A	06-11-1992
		JP 4317264 A	09-11-1992
		JP 4233373 A	21-08-1992
		DE 69126512 D	17-07-1997
		DE 69126512 T	06-11-1997
		EP 0763925 A	19-03-1997
		ES 2101730 T	16-07-1997
		US 5838826 A	17-11-1998