SIGNAL COMPRESSING SYSTEM

DESCRIPTION

The present invention relates to a signal compressing system. A system according to the present invention is particularly suited to compressing image signals.

Image signals may be compressed by motion-compensated interframe discrete cosine transform (DCT) coding such as is defined by a MPEG (Moving Picture Expert Group) international standard. This form of signal compression has attracted much attention in the field of high definition television (HDTV).

Figure 1 is a block diagram of such a conventional motion-compensated interframe DCT coder. In the shown coder, an image signal is divided into a plurality of sub-blocks. The sub-blocks are all of the same size, for example 8x8, 16x16, ... A motion estimator 40 produces a motion vector, defined by the difference

between the current image signal and a one-frame delayed image signal, output by a frame memory 30. The motion vector is supplied to a motion compensator 50 which compensates the delayed image signal from the frame memory 30 on the basis of the motion vector. A first adder 8a serves to produce the difference between the present frame and the delayed, motion compensated frame. A discrete cosine transform portion 10 processes the difference signal, output by the first adder 8a, for a sub-block. The motion estimator 40 determines the motion vector by using a block matching algorithm.

The discrete cosine transformed signal is quantized by a quantizer 20. The image signal is scanned in a zig-zag manner to produce a runlength coded version thereof. The runlength coded signal comprises a plurality of strings which include a series of "0"s, representing the run length, and an amplitude value of any value except "0".

The runlength coded signal is dequantized by a dequantizer 21, inversely zig-zag scanned and inversely discrete cosine transformed by an inverse discrete cosine transforming portion 11. The transformed image signal is added to the motion-compensated estimate error signal by a second adder 8b. As a result the image signal is decoded into a signal corresponding to the original image signal.

Refresh switches RSW1 , RSW2 are arranged between the adders 8a, 8b and the motion compensator 40 so as to provide the original image signal free from externally induced errors.

The runlength coded signal is also supplied to a variable length coder 60 which applies a variable length coding to the runlength coded image signal. The variable length coded signal is then output through a FIFO transfer buffer 70 as a coded image signal.

In motion-compensated adaptive DCT coding, the interframe signal can be easily estimated or coded by way of motion compensation, thereby obtaining a high

coding efficiency, since the image signal has a relatively high correlation along the time axis. That is, according to the afore-mentioned method, the coding efficiency is high because most of the energy of a discrete cosine transformed signal is compressed at the lower end of its spectrum, resulting in long runs of "0"s in the runlength coded signal.

However, the scanning regime of the afore-mentioned method does not take account of differences in the spectrum of the motion-compensated interframe DCT signal with time.

A method is known wherein one of a plurality of reference modes is previously selected on the basis of the difference between the present block and that of a previous frame and the image signal is scanned by way of a scanning pattern under the selected mode and suitably quantized. With such a method, however, three modes are employed to compute the energies of the intermediate and high frequency components of the image signal in accordance with the interframe or the intraframe modes in order to determine the appropriate

mode. This mode determining procedure is undesirably complicated.

According to the present invention, there is provided a video signal compression system, comprising discrete cosine transformer means arranged to perform motion-compensated interframe adaptive discrete cosine transformation of an input video signal to produce a set of coefficients, scanning means arranged to scan said set of coefficients according to a plurality of different scanning patterns to produce a plurality of sets of reordered coefficients, runlength coding means arranged to runlength encode each of said sets of reordered coefficients, selection means arranged to select the runlength encoded set of reordered coefficients which produces the most efficient coding according to a predetermined criterion and to produce a pattern signal indicating the scanning pattern corresponding to the selected runlength encoded set of reordered coefficients, a variable length coder arranged to variable length encode the selected runlength encoded set of reordered coefficients, and a multiplexer arranged to multiplex the signal output by the variable length coder and said pattern signal.

An embodiment of the present invention will now be described, by way of example, with reference to Figures 2

and 3 of the accompanying drawings, in which:

Figure 1 is a block diagram of a conventional adaptive interframe DCT coding system employing a motion compensating technique;

Figure 2 is a block diagram of a compression system embodying the present invention; and

Figure 3 shows various possible scanning patterns in accordance with the present invention.

Referring to Figure 2, an input image signal is divided into equal-sized sub-blocks, for example 8x8, 16x16, ... A motion estimator 40 determines a motion

vector by comparing the current frame and a one frame delayed signal from a frame memory 30.

The motion vector is supplied to a motion compensator 60 which, in turn, compensates the delayed frame signal for movement. A first adder 8a produces a difference signal representing the difference between the present frame and the delayed, motion-compensated frame. A DCT coder 10 DCT-codes the difference signal. The DCT coded image signal is quantized by a quantizer 20 and then dequantized by a dequantizer 21. The dequantized signal is supplied to a second adder 8b, which adds it to the output of the motion compensator 50, via an inverse discrete cosine transformer 11. This produces a signal corresponding to the original image signal.

The output of the motion compensator 50 is applied to the adders 8a, 8b by refresh switches RSW1, RSW2.

The quantized image signal is also supplied to a multi-scanner 80 which scans it according to a plurality of predetermined patterns.

A scanning pattern selector 90 selects the scanning pattern which produces the minimum number of bits to represent the current sub-block. The scanning pattern selector also produces selection data which identifies the selected scanning pattern.

The image signal output by the scanning pattern selector 90 is variable length coded by a variable length coder 60. The variable length coder 60 compresses the image signal output by the scanning pattern selector 90. The variable length coder 60 operates such that a large proportion of the data samples are each represented by a small number of bits whilst a small proportion of the data samples are each represented by a large number of bits.

When a discrete cosine transformed image signal is quantized and runlength coded, the number of "0"s is increased over all while the number of "0"s decreases as the magnitude of the signal increases. Accordingly, data compression is achieved because "0" can be represented by only a few bits and "255" can be represented by a relatively large number of bits.

Both the variable length coded signal and the selection data are supplied to a multiplexer MUX1 which multiplexes the variable length coded signal and the selection data, and optionally additional information such as teletext.

Since the variable length coded signal has data words of different lengths, a transfer buffer 70 is employed to temporarily store the multiplexed signal and output it at a constant rate.

The original image signal is reconstructed at a remote station by performing the appropriate inverse scanning of the runlength coded signal in accordance with the multiplexed scanning pattern selection data.

Figures 3A to 3H show possible scanning patterns employed by the multi-scanner 80. Additional scanning patterns will be apparent to the skilled man. However, if the number of patterns becomes too large, the coding efficiency is degraded as the selection data word becomes longer.

As described above, according to the present invention, the quantized image signal is scanned according to various scanning patterns. Then the most efficient pattern is selected. A suitable measure of efficiency is the number of bits required to runlength code the image signal.

CLAIMS

1. A video signal compression system, comprising discrete cosine transformer means arranged to perform motion-compensated interframe adaptive discrete cosine transformation of an input video signal to produce a set of coefficients, scanning means arranged to scan said set of coefficients according to a plurality of different scanning patterns to produce a plurality of sets of reordered coefficients, runlength coding means arranged to runlength encode each of said sets of reordered coefficients, selection means arranged to select the runlength encoded set of reordered coefficients which produces the most efficient coding according to a predetermined criterion and to produce a pattern signal indicating the scanning pattern corresponding to the selected runlength encoded set of reordered coefficients, a variable length coder arranged to variable length encode the selected runlength encoded set of reordered coefficients, and a multiplexer arranged to multiplex the signal output by the variable length coder and said pattern signal.

2. A video signal commpression system substantially as hereinbefore described with reference to Figures 2 and 3 of the accompanying drawings.

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