

Video record systems

This invention relates to video record systems.

It has been proposed in the prior art to divide a television picture into an array of points to sample the values of the Y, I, and Q signals, and to store this information on a video disk as a sequence of marks and intervening spaces that are modulated in length to represent the digital values. For example, the length of the recording mark can be varied according to the amplitude of the luminance signal at a corresponding point on the television screen. The amplitude of the luminance signal and the length of the mark can both be thought of as analog signals in this introductory explanation, but there are advantages in digitizing the amplitude of the luminance signal and correspondingly, it is convenient to think of the marks as at least approximately varying in discrete increments that correspond to successive digital values.

One of the reasons for digitizing the luminance values is that the digitized values can be compressed by a matrix operation that may be for example a Hadamard Transform. For example, the video picture can be organized as a number of eight by eight matrices of sixty-four points on the face of a picture tube. (This matrix is called the X matrix.) Each of these points would be represented initially by a digital code of say six bits that would represent sixty-four gray levels at the corresponding point on the television raster. A matrix multiplication produces another matrix, called the G matrix, in which some of the elements or coefficients have relatively large, significant, numerical values and other elements have small values. Data compression is possible because it is not necessary to actually store the small values on the disk and because some of the other terms of the G matrix can be satisfactorily represented by truncated or shortened binary codes. The compression matrix that is stored on the disk is called the G* matrix. In the player, there is a matrix multiplication that produces the original X matrix with only a slight difference in picture quality that is generally not detectable.

A characteristic of this data compression technique that is significant is that more bits are assigned to storing the more significant coefficients than are assigned to storing the less significant coefficients. (The assignment is either standard so that the sequence of bits read from the record can be assigned to the proper coefficients of the G* matrix or the disk carries this information and it is loaded into a control section of the player.) To understand how the longer code blocks of the player/recorder system are represented by the shorter codes of the modulated marks, it will be helpful to first review some of the features of this modulation technique.

Suppose that the marks that are to be

recorded on a video disk are to be modulated in length to represent a code of three bits. There are eight of these code blocks and they can be presented in the binary counting sequence 000, 001, 010...111. A mark has a minimum length that is necessary in order for the mark to be detected by the read apparatus of the player, and this minimum length represents zero, or 000 in the format of the three bit code block. The longest mark length represents the highest code value, 111 (or decimal 7) and intermediate increments of length represent the intermediate values of the code, 001 through 110.

It has been proposed to modulate the length of the mark and to maintain a constant space from the beginning of one mark to the beginning of the next mark or to modulate the length of the mark and maintain a constant space between marks or to modulate both the length of a mark and the length of the space. The invention is applicable to any of these techniques and for simplicity the techniques will all be described generally in terms of modulating the length of a mark without limitation as to any data significance of the intervening space.

A further question of terminology concerning this data representation technique can now be explained. Commonly, video disks are intended to be rotated at a constant angular velocity that permits one television frame to be stored on each track revolution. In such a system, a mark on an inner track is shorter than the equivalent mark on an outer track but equivalent marks have the same angular length and the timing for equivalent marks is the same whether they are on an outer track circle or an inner track circle. In electronic circuits that generate the data signals for the video write apparatus, it is customary to refer to this modulation technique as pulse width modulation since only the timing of the pulses is significant and the variation in mark length that occurs according to the radius of the write operation is not apparent. It has also been proposed in the prior art to maintain equal data density along each data track without regard to the radius of the track and to slow the record as the read or write operation proceeds radially inward in order to compensate for the change in track radius. In such a system, the timing for the marks and the physical length of the marks is constant across the radius of the record. The invention is applicable to either of these recording techniques and it will ordinarily be helpful to refer to the length of a pulse or the length of a mark interchangeably as though the operation was along a constant radius track of a constant speed record or at any point on a variable speed record.

Mark length modulation is an efficient data storage technique because relatively inex-

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pensive optical systems can distinguish very small increments of length beyond a minimum length that is required for detection. The marks can be modulated to represent code blocks of a selected number of bits (the codes are not efficient for very long code blocks) and code blocks of three or four bits will be used in most of the examples in this specification. A feature of these codes that is significant is that a three-bit code is a subset of a four-bit code, and mixed block lengths can be used in the record writing apparatus without any change in the read apparatus.

As the explanation has proceeded so far, it can be seen that a digital code block of eight bits (for example) in the player system can be represented by two marks on the data track and that each of these marks can be interpreted as a four-bit code. Next it will be explained how errors occur in writing or reading the length of a mark as an introduction to a later description of how application of the invention can reduce the effects of these errors.

Reading these marks is a kind of analog-to-digital conversion and there are a number of techniques for reading the marks. If the marks and the increments are made small in order to increase the storage density, there is a statistical chance of misreading or miswriting a mark length and thereby signaling a wrong code block. The errors in the recording are further increased by the fact that the marks may be somewhat irregular in shape as the result of imperfections in the recording process and the beginning and end of the mark may be somewhat rounded and non-uniform in shape. For example, consider the operation of reading a mark representing a three-bit code. If the mark length is half-way between the length for a four and five (100 and 101) there is no way of evaluating the mark, and whether the system reads the mark as a four or five depends on the particular analog-to-digital conversion technique that is used in the circuit.

Conversely, considering errors from the standpoint of a write operation, when a mark is to be recorded in a length to signify a 101 (decimal 5) an error in the write operation might cause the mark to be recorded shorter in the range of length for a 100 (decimal 4) or to be recorded longer in the range of length for a 110 (decimal 6).

The invention seeks to overcome the aforementioned problems arising due to errors in recording and reading length modulated marks.

The invention provides a video record system in which data is recorded using marks the lengths of which represent values of storage code blocks of n bits related to system code blocks of m bits, where m is greater than n , characterised in that the bits of each system code block are assigned to individual bit positions in a plurality of storage code blocks with the high order bits of each system code block assigned to high order bit positions in

each of the plurality of storage code blocks.

One of the characteristics of mark length coding is that normally an error in mark length is only between two adjacent numbers. For example an intended four would sometimes be recorded or read in error as a five or a three, but only much more rarely would a four be read as a two or a six.

When two marks are used to represent a multi-bit code block, we have found that it is advantageous to assign bits of the system code to bits of the code that is represented by the two storage code marks in a way that takes this ambiguity into account. As one example, if a six-bit code is represented as ABCDEF, where A is a high order bit and F is a low order bit, it is advantageous to code the two marks as ACE and BDF. (Other examples will be explained later.) Any ambiguity about the length of one or both of the code marks will tend to affect the low order bits of the system code. By contrast, if the two marks are coded ABC and DEF, an ambiguity about the length of the first mark would have a substantially larger effect on the system code.

When the longer code blocks of the system are assigned to two (or more) shorter codes that are represented in storage by pulse length modulated marks, some ambiguities in mark length affect only the low order bit position or the next to the low order bit position of the system code. For example, if the code BDF is read as a four instead of a five (or vice versa) and the storage code ACE is read correctly, the system code ABCDEF is incorrect only in the low order bit position for an error of one part in sixty-four for a six-bit system code or one part in two hundred fifty-six in an eight-bit system code. Similarly, some errors affect the second bit position of the storage code, for example when a five (101) is read as a six (110). The most significant error causes a change in the high order bit position of the storage code. In a three-bit code this error occurs when there is an error between a three (011) and a four (100). In a four-bit code, an error in the third bit position occurs between three and four and also between eleven (1011) and twelve (1100), and the high order bit of a four-bit code is affected by an ambiguity between a seven (0111) and an eight (1000).

In a preferred system embodying the invention, the increment between these mark lengths is made larger than the other increments to reduce the actual likelihood that this ambiguity will occur. It is not necessary to make the other increments shorter, but if the other increments are made proportionately shorter to preserve the overall data recording density, the decreased likelihood of ambiguity between the selected increment lengths more than offsets the increased likelihood of ambiguity at the other mark lengths and a substantial improvement in the error rate is achieved. A non-linear read apparatus is provided for detecting these

marks.

The invention will now be explained by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 represents a video player/recorder system including apparatus for writing and reading non-linear mark lengths;

Fig. 2 is a graph explaining the characteristics of the non-linear circuits of Fig. 1;

Fig. 3 represents a suitable circuit arrangement for translating a system code block into two disk code blocks.

A Video Record System (Fig. 1) comprises a video disc 12, a television set 14, and components for writing on the disk 12 according to a signal on a line 15 and for reading from the disk and producing a video signal on a line 16 for the television set 14. A motor 17 drives the video disk 12 at a uniform angular velocity that corresponds to one television frame per revolution. A read/write head 19 optically scans a representative track 20 with a laser beam represented by dashed line 22. For a write operation, the laser beam selectively alters the material of the disk between reflective and non-reflective state (or between transparent and non-transparent states). As a specific example, the disk may comprise a thin layer of tellurium on a glass substrate and the laser may burn holes in the tellurium to form marks that are transparent on a non-transparent background.

For a write operation, the laser beam is modulated according to a pulse length signal that is produced by a digital to analog converter 26 in response to the signal to be recorded and supplied to the read/write head 19 on a line 25. The apparatus for recording on the disk 12 that has been described so far is conventional except for the fact that the digital to analog converter 26 is nonlinear as will be explained later.

During a read operation, the record is illuminated from the read/write head and reflected (or transmitted) light travels from the track being read along dashed line 22 to the read/write head which produces an analog signal on a line 28. The analog signal is of fixed amplitude and is up (arbitrarily) when a mark passes under the read/write head and is down when a space travels under the read/write head. A non-linear analog to digital converter 30 receives the signal on line 28 and produces a multi-bit digital data output on line 31. This digital signal is operated on by digital signal processor 32 to produce a video signal on line 16. In a simple application of the invention, the multi-bit data blocks on line 31 represent the Y, Q, and I signals at a point on the television raster and the audio signal and these values are used directly to modulate a video carrier signal. However, part of the digital data on line 31 may represent coefficients of a Hadamard Transform that is used for data compression. Except for the fact that the analog to digital converter 30 is non-linear, the features of the player that have

been described are conventional.

System Code to Disk Code Conversion — Fig. 3

In Fig. 3, the system associated with a disk supplies on line 15 a six-bit code block that is to be written on the disk as two marks, and the apparatus of Fig. 3 produces on a line 33 two code blocks of three-bits each that represent these marks in subsequent operations of the digital to analog converter 26. The six bits in the system format are designated A (the highest order bit) through F (the lowest order bit). A six-bit register 34 initially stores the system code block. The contents of register 34 are transferred to two registers 35, 36 of three bits each on lines that are connected to produce the sequence ACE in register 35 and the sequence BDF in register 36. Gating circuits that are conventional for register to register transfers are not shown in the drawing. A set of gates 37 transfers the contents of registers 35, 36 in sequence to a three-bit output bus 37 under control of suitable timing signals, time 1 and time 2, on lines 38, 39. The registers 34, 35, 36 are presented in Fig. 3 to better show the flow of data; register 34 may be an existing register of the system and registers 35, 36 may be replaced by one register of the analog to digital converter with sequentially operated gating circuits or by the equivalent of two registers 35, 36 in the converter. Fig. 3 is representative of a variety of well known techniques for assembling bits into particular formats, and similar circuits for transferring between four-bit code blocks and eight-bit code blocks and circuits for reforming two codes from the disk to a single longer code for the associated system will be readily apparent.

The Non-Linear Converters, 26 and 30 — Fig. 2

In the graph of Fig. 2, the horizontal axis H shows the increments in the length of a recorded mark and the vertical axis V shows the numerical value of the mark. For the analog to digital converter 30 the horizontal axis represents the input and the vertical axis represents the output and for the digital to analog converter 26 the vertical axis represents the input and the horizontal axis represents the output.

It will be helpful to consider Fig. 2 first in relation to a conventional, linear, converter. In one well known conversion technique, an oscillator supplies clock signals at intervals that correspond to the increments of length of the recorded marks. In a conventional, linear, converter for analog to a four-bit digital code, a counter is reset and gated to begin counting clock pulses at the beginning of the analog mark and to stop counting at the end of the mark. The value in the counter at the end of this time, minus the count for a zero signifying mark is the digital value of the analog signal. For linear digital to analog conversion, the counter is

gated on to start the analog mark and is gated off to terminate the mark when the count equals the digital code plus the fixed count for the zero length mark. There are many variations of this general design; for example, the counting function is often provided by ramp generating circuits.

In the non-linear converter of Fig. 2, the break in the horizontal axis shows that any desired count can be assigned to the mark for the zero code (0000). The next three digital codes, 0001, 0010, and 0011 are represented by successive increments of length, as is conventional. The code for four (0100) however is given one additional increment so that in the conventional linear converter that has been described a four would be read as a five and a four would be represented by the intermediate increment which is not assigned a code value.

Similarly, there are two increments of mark length between seven and eight (0111 and 1000) and between eleven and twelve (1011 and 1100).

An analysis has been made of the frequency of errors with the assumptions (1) that a mark that is in error is equally likely to be too long or too short, (2) that the marks for all numerical values are equally likely to be in error, and (3) that the error rate is a function of increment length. We have found that in these circumstances errors in the system codes are significantly reduced by the non-linear mark length assignments and that the improvement is also significant when the intervals of mark length are shortened to maintain the storage density, even though there will be an increase in the error rate for the codes that are represented by a shortened increment of length (including an increase in double errors such as a change from length 0 to length 2). (Increments are shortened by shortening the period of the clock oscillator.)

The conventional linear converter that has been referred to in this description can be modified in several ways to give the non-linear relationship of Fig. 2. As an example of a four-bit non-linear digital to analog converter, a read-only store of sixteen words is addressed by the four-bit code that is to be stored on the disk. The word that is fetched from the read-only store is applied to the conventional digital to analog converter. The read-only store has the following entries.

Address	Storage Contents
0000 (0)	00000 (0)
0001 (1)	00001 (1)
0010 (2)	00010 (2)
0011 (3)	00011 (3)
0100 (4)	00101 (5)
0101 (5)	00110 (6)
0110 (6)	00111 (7)
0111 (7)	01000 (8)
1000 (8)	01010 (10)
1001 (9)	01011 (11)
1010 (10)	01100 (12)
1011 (11)	01101 (13)
1100 (12)	01111 (15)
1101 (13)	10000 (16)
1110 (14)	10001 (17)
1111 (15)	10010 (18)

Conversely, the non-linear analog to digital converter may comprise a conventional, linear, analog to digital converter and the output of the converter is a five-bit code in the set that is shown under the heading "Storage Contents" in the listing for the non-linear digital to analog converter. The read-only store may have thirty-two storage locations with the sequence 0000 through 1111 stored at the sixteen locations that are addressed by the sixteen possible outputs of the conventional analog to digital converter.

System Code Bit Assignment

Notice that the three-bit code is a sub-set of the four-bit code and that the analog to digital and digital to analog converters for four-bit codes will operate without change with three-

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bit codes. That is, the system for either the video recorder or the video player will operate with a mix of three and four-bit storage codes. The bit assignment apparatus of Fig. 3 can be constructed to use this capability advantageously in a system in which video data is compressed by Hadamard transform or other matrix multiplication technique. Suppose that the transform is based on an eight by eight matrix and that by data compression, the number of bits can be reduced from three hundred twenty-four for the G matrix (the transform of the picture matrix) to 92 bits for the G* matrix (the matrix which is stored on the disk as marks of modulated length). These 92 bits are distributed among a few elements of the G* matrix with eight bits for the most significant elements, seven bits for the next most significant elements, and so on. Thus, the compactor of a recorder produces (and the decompactor of a player receives) a sequence of bits in groups of 92 bits in which each bit has a specific position in a specific multi-bit element of the G* matrix, but the boundaries between these units do not in general fall on boundaries of eight bits. The eight-bit units are coded as two storage codes of four bits each and the six-bit system codes are stored as two storage codes of three bits each, as has already been explained. The seven-bit units of the G* matrix are stored as a three-bit and a four-bit code. Alternatively, a five-bit system code can be stored as a five-bit storage code in a single mark. Similarly, three and four-bit system codes can be stored directly as three and four-bit storage codes. Shorter system codes that are adjacent in the bit sequence can be handled as longer system codes to be represented by two or more storage codes.

A circuit for assigning bits in a long bit stream to the storage code bits can have a long (e.g. 92 bits) register like register 34 with a corresponding number of gates. Functionally equivalent circuits adapted to a particular player/recorder will be readily apparent.

As the system has been described so far, the length of a recording track will vary with the data content. However, the information for a frame of video information or a sub unit of a frame must occupy a substantially fixed portion of the recording track to keep the data synchronized with the television display or signal source. One technique for maintaining suitably equal track lengths is to modulate only the length of the mark and use the space to maintain synchronous recording. A preferable technique is to modulate both the mark and the space and to record either the original data (e.g. 1111, 1110...) or the complement (e.g. 0000, 0001) to maintain the data length within the length of the track. A bit in the header for the data segment identifies to the player whether the data that is read from the disk is to be complemented.

Claims

1. A video record system in which data is recorded using marks the length of which represent values of storage code blocks of n bits related to system code blocks of m bits, where m is greater than n, characterised in that the bits of each system code block are assigned to individual bit positions in a plurality of storage code blocks with the high order bits of each system code block assigned to high order bit positions in each of the plurality of storage code blocks.

2. A video record system as claimed in claim 1, in which the bits of each system code block are assigned to a pair of storage code blocks, the bits in successive bit positions of the system code block being assigned alternately to one and the other of the pair of storage code blocks.

3. A video record system as claimed in claim 2, in which each system code block has 8 bits and each storage code block has 4 bits.

4. A video record system as claimed in any preceding claim, in which the marks are modulated in increments of length to represent the storage code blocks, the increment of length being greater between two codes for which there is a transition in a high order bit position than between two codes for which there is a transition only in the low order bit positions.

5. A video record system as claimed in any preceding claim, which comprises a recorder including writing means for writing on a storage medium marks modulated in increments of length to represent an aforesaid storage code block of n bits and means for supplying a sequence of the aforesaid storage code blocks to the writing means.

6. A video record system as claimed in claim 5, including means supplying such aforesaid system code blocks as a substantially continuous bit stream, and means for assigning bits of said bit stream to bit positions of the storage code blocks according to the position of the bits in the system code blocks.

7. A video record system as claimed in claim 5 or claim 6, in which the writing means includes means for modulating the length of such an aforesaid mark to represent such an aforesaid storage code block of n bits in which the increment of length is greater between two binary codes for which there is a transition in a high order bit position than between two binary codes in which there is a transition only in the low order bit positions.

8. A video record system as claimed in any of claims 1 to 4, which comprises a player including means for determining the length of a mark in a record track, storage code block producing means for producing a storage code block corresponding to the length of the mark, means for converting storage code blocks into system code blocks and means for processing the system code blocks to form a video signal

bit codes. That is, the system for either the video recorder or the video player will operate with a mix of three and four-bit storage codes. The bit assignment apparatus of Fig. 3 can be constructed to use this capability advantageously in a system in which video data is compressed by Hadamard transform or other matrix multiplication technique. Suppose that the transform is based on an eight by eight matrix and that by data compression, the number of bits can be reduced from three hundred twenty-four for the G matrix (the transform of the picture matrix) to 92 bits for the G* matrix (the matrix which is stored on the disk as marks of modulated length). These 92 bits are distributed among a few elements of the G* matrix with eight bits for the most significant elements, seven bits for the next most significant elements, and so on. Thus, the compressor of a recorder produces (and the decompressor of a player receives) a sequence of bits in groups of 92 bits in which each bit has a specific position in a specific multi-bit element of the G* matrix, but the boundaries between these units do not in general fall on boundaries of eight bits. The eight-bit units are coded as two storage codes of four bits each and the six-bit system codes are stored as two storage codes of three bits each, as has already been explained. The seven-bit units of the G* matrix are stored as a three-bit and a four-bit code. Alternatively, a five-bit system code can be stored as a five-bit storage code in a single mark. Similarly, three and four-bit system codes can be stored directly as three and four-bit storage codes. Shorter system codes that are adjacent in the bit sequence can be handled as longer system codes to be represented by two or more storage codes.

A circuit for assigning bits in a long bit stream to the storage code bits can have a long (e.g. 92 bits) register like register 34 with a corresponding number of gates. Functionally equivalent circuits adapted to a particular player/recorder will be readily apparent.

As the system has been described so far, the length of a recording track will vary with the data content. However, the information for a frame of video information or a sub unit of a frame must occupy a substantially fixed portion of the recording track to keep the data synchronized with the television display or signal source. One technique for maintaining suitably equal track lengths is to modulate only the length of the mark and use the space to maintain synchronous recording. A preferable technique is to modulate both the mark and the space and to record either the original data (e.g. 1111, 1110...) or the complement (e.g. 0000, 0001) to maintain the data length within the length of the track. A bit in the header for the data segment identifies to the player whether the data that is read from the disk is to be complemented.

Claims

1. A video record system in which data is recorded using marks the length of which represent values of storage code blocks of n bits related to system code blocks of m bits, where m is greater than n , characterised in that the bits of each system code block are assigned to individual bit positions in a plurality of storage code blocks with the high order bits of each system code block assigned to high order bit positions in each of the plurality of storage code blocks.

2. A video record system as claimed in claim 1, in which the bits of each system code block are assigned to a pair of storage code blocks, the bits in successive bit positions of the system code block being assigned alternately to one and the other of the pair of storage code blocks.

3. A video record system as claimed in claim 2, in which each system code block has 8 bits and each storage code block has 4 bits.

4. A video record system as claimed in any preceding claim, in which the marks are modulated in increments of length to represent the storage code blocks, the increment of length being greater between two codes for which there is a transition in a high order bit position than between two codes for which there is a transition only in the low order bit positions.

5. A video record system as claimed in any preceding claim, which comprises a recorder including writing means for writing on a storage medium marks modulated in increments of length to represent an aforesaid storage code block of n bits and means for supplying a sequence of the aforesaid storage code blocks to the writing means.

6. A video record system as claimed in claim 5, including means supplying such aforesaid system code blocks as a substantially continuous bit stream, and means for assigning bits of said bit stream to bit positions of the storage code blocks according to the position of the bits in the system code blocks.

7. A video record system as claimed in claim 5 or claim 6, in which the writing means includes means for modulating the length of such an aforesaid mark to represent such an aforesaid storage code block of n bits in which the increment of length is greater between two binary codes for which there is a transition in a high order bit position than between two binary codes in which there is a transition only in the low order bit positions.

8. A video record system as claimed in any of claims 1 to 4, which comprises a player including means for determining the length of a mark in a record track, storage code block producing means for producing a storage code block corresponding to the length of the mark, means for converting storage code blocks into system code blocks and means for processing the system code blocks to form a video signal



for a television set.

9. A video record system as claimed in claim 8 when appendant to claim 4, in which the storage code block producing means effects a non-constant conversion of length to binary code.

10. A video record system as claimed in claim 9, in which the storage codes are four-bit codes and the storage code block producing means effects a non-constant conversion of length to binary code in accordance with there being greater increments of length between mark lengths representing codes 0011 and 0100, 0111 and 1000, and 1011 and 1100.

Revendications

1. Système d'enregistrement vidéo où la donnée est enregistrée en utilisant des marques dont les longueurs représentent des valeurs de blocs codés de stockage de n bits en rapport avec des blocs codés du système de m bits, où m est supérieur à n , caractérisé en ce que les bits de chaque bloc codé du système sont assignés à des positions individuelles de bit dans un certain nombre de blocs codés de stockage, les bits d'ordre supérieur de chaque bloc codé du système étant assignés à des positions de bit d'ordre supérieur dans chacun des divers blocs codés de stockage.

2. Système d'enregistrement vidéo selon la revendication, où les bits de chaque bloc codé du système sont assignés à une paire de blocs codés de stockage, les bits dans des positions successives de bit du bloc codé du système étant assignés alternativement à l'un et à l'autre des blocs codés de stockage de la paire.

3. Système d'enregistrement vidéo, selon la revendication 2, où chaque bloc codé du système à huit bits et chaque bloc codé de stockage a 4 bits.

4. Système d'enregistrement vidéo selon l'une quelconque des revendications précédentes, où les marques sont modulées en incréments de longueur pour représenter les blocs codés de stockage, l'incrément de longueur étant plus grand entre deux codes pour lesquels il y a une transition dans une position de bit d'ordre supérieur qu'entre deux codes pour lesquels il y a une transition uniquement dans les positions de bit d'ordre inférieur.

5. Système d'enregistrement vidéo selon l'une quelconque des revendications précédentes, qui comprend un enregistreur ayant un moyen d'écriture pour écrire sur un milieu de stockage, des marques modulées en incréments de longueur pour représenter un bloc codé de stockage précité de n bits et un moyen pour appliquer une séquence des blocs codés de stockage précités au moyen d'écriture.

6. Système d'enregistrement vidéo selon la revendication 5, comprenant un moyen appliquant les blocs codés du système précités sous forme d'un courant sensiblement continu de bits, et un moyen pour assigner les bits dudit

courant de bits à des positions de bit des blocs codés de stockage selon la position des bits dans les blocs codés du système.

7. Système d'enregistrement vidéo selon la revendication 5 ou la revendication 6, où la moyen d'écriture comprend un moyen pour moduler la longueur d'une marque précitée pour représenter un bloc codé de stockage précité de n bits où l'incrément de longueur est supérieur entre deux codes binaires pour lesquels il y a une transition dans une position d'un bit d'ordre supérieur qu'entre deux codes binaires où il y a une transition uniquement dans les positions des bits d'ordre inférieur.

8. Système d'enregistrement vidéo selon l'une quelconque des revendications 1 à 4, qui comprend un lecteur comportant un moyen pour déterminer la longueur d'une marque dans une piste d'enregistrement, un moyen produisant les blocs codés de stockage pour produire un bloc codé de stockage correspondant à la longueur de la marque, un moyen pour convertir les blocs codés de stockage en blocs codés de système, et un moyen pour traiter les blocs codés de système pour former un signal vidéo pour un téléviseur.

9. Système d'enregistrement vidéo selon la revendication 8 dépendant de la revendication 4, où le moyen produisant un bloc codé de stockage effectue une conversion non constante de longueur en code binaire.

10. Système d'enregistrement vidéo selon la revendication 9, où les codes de stockage sont des codes à quatre bits et le moyen producteur de bloc codé de stockage effectue une conversion non constante de longueur en code binaire en accord avec les plus grands incréments de longueur entre des longueurs de marque représentant les codes 0011 et 0100, 0111 et 1000 et 1011 et 1100.

Patentansprüche

1. Videoaufzeichnungssystem, bei dem die Daten unter Verwendung von Markierungen aufgezeichnet werden, deren Länge Werte von Speichercodeblöcken von n Bits darstellen, bezogen auf Systemcodeblöcke von m Bits, wobei $m > n$, dadurch gekennzeichnet, daß die Bits jedes Systemcodeblocks einzelnen Bitpositionen in einer Mehrzahl von Speichercodeblöcken zugeordnet sind, wobei die höherstelligen Bits jedes Systemcodeblocks höherstelligen Bitpositionen in jedem der Mehrzahl von Speichercodeblöcken zugeordnet sind.

2. Videoaufzeichnungssystem nach Anspruch 1, dadurch gekennzeichnet, daß die Bits jedes Systemcodeblocks einem Paar Speichercodeblöcken zugeordnet sind, wobei die Bits in aufeinanderfolgenden Bitpositionen des Systemcodeblocks abwechselnd dem einen oder dem anderen der beiden Speichercodeblöcke zugeordnet sind.

3. Videoaufzeichnungssystem nach Anspruch 2, dadurch gekennzeichnet, daß jeder



Systemcodeblock 8 Bits und jeder Speichercodeblock 4 Bits umfaßt.

4. Videoaufzeichnungssystem nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Markierungen in Längeninkrementen moduliert werden, um die Speichercodeblöcke wiederzugeben, wobei die Längeninkremente größer sind zwischen zwei Codes, für die ein Übergang in einer höherstelligen Bitposition stattfindet, als zwischen zwei Codes, für die ein Übergang nur in den niedrigstelligen Bitpositionen stattfindet.

5. Videoaufzeichnungssystem nach einem der vorhergehenden Ansprüche, gekennzeichnet durch ein Aufzeichnungsgerät mit einer Schreibeinrichtung zum Schreiben von Markierungen, die in Längeninkrementen moduliert sind, auf einen Datenträger, um einen vorerwähnten Speichercodeblock von n Bits darzustellen, und durch eine Einrichtung zum Zuführen einer Folge der vorerwähnten Speichercodeblöcke zu der Schreibeinrichtung.

6. Videoaufzeichnungssystem nach Anspruch 5, gekennzeichnet durch eine Einrichtung zum Zuführen von vorerwähnten Systemcodeblöcken in Form eines im wesentlichen fortlaufenden Bitstroms, und durch eine Einrichtung zum Zuordnen von Bits des Bitstroms zu Bitpositionen der Speichercodeblöcke entsprechend der Position der Bits in den Systemcodeblöcken.

7. Videoaufzeichnungssystem nach Anspruch 5 oder 6, dadurch gekennzeichnet, daß die Schreibeinrichtung eine Einrichtung zum Modulieren der Länge einer solchen vorerwähnten Markierung aufweist, um einen solchen vorer-

wähnten Speichercodeblock von n Bits darzustellen, in dem das Längeninkrement zwischen zwei Binärcodes, für die ein Übergang in einer höherstelligen Bitposition stattfindet, größer ist als zwischen zwei Binärcodes, in denen ein Übergang nur in den niedrigstelligen Bitpositionen stattfindet.

8. Videoaufzeichnungssystem nach einem der Ansprüche 1 bis 4, gekennzeichnet durch eine Abspielvorrichtung mit einer Einrichtung zum Bestimmen der Länge einer Markierung in einer Aufzeichnungsspur, durch eine Einrichtung zum Erzeugen eines Speichercodeblocks, die einen Speichercodeblock entsprechend der Länge der Markierung erzeugt, durch eine Einrichtung zum Umwandeln von Speichercodeblöcken in Systemcodeblöcke und durch eine Einrichtung zum Verarbeiten der Systemcodeblöcke, um ein Videosignal für eine Fernseh-anlage zu bilden.

9. Videoaufzeichnungssystem nach Anspruch 8 unter Rückbeziehung auf Anspruch 4, dadurch gekennzeichnet, daß die Einrichtung zum Herstellen der Speichercodeblöcke eine nicht-konstante Umwandlung von Länge in Binärcode bewirkt.

10. Videoaufzeichnungssystem nach Anspruch 9, dadurch gekennzeichnet, daß die Speichercode 4-Bit-Codes sind, und daß die Einrichtung zum Erzeugen von Speichercodeblöcken eine nichtkonstante Umwandlung von Länge in Binärcode in Übereinstimmung mit der Tatsache bewirkt, daß größere Längeninkremente zwischen den Markierungslängen auftreten, die die Codes 0011 und 0100, 0111 und 1000 bzw 1011 und 110 darstellen.

