

EXHIBIT A-2
WO 01/11891 A1 (“KARCZEWICZ”)
ANTICIPATES / RENDERS OBVIOUS U.S. PATENT NO. 7,532,808

As described in the following claim chart, claims 1-2, 6-7, 9-11, 15-16, 20-25, 28-30, 32, 34, 36, 39-41, 43-44, 47-49, 51-54, 58-60, 62-65 of U.S. Patent No. 7,535,280 (the “’808 patent”) are invalid in view of International Publication Number WO 01/11891 A1 (“Karczewicz”) (RESPNOKIA_00000885), entitled “Apparatus and Method for Compression a Motion Vector Field,” published on February 15, 2001, Karczewicz is prior art under at least 35 U.S.C. § 102(b).

To the extent that these Invalidity Contentions rely on or otherwise embody particular constructions of terms or phrases in the Asserted Claims, Respondents are not proposing any such constructions as proper constructions of those terms or phrases. Various positions put forth in this document are predicated on Complainants’ incorrect and overly broad interpretation of its claims. Those positions are not intended to and do not necessarily reflect Respondents’ interpretation of the true and proper scope of Complainants’ claims, and Respondents reserve the right to adopt claim construction positions that differ from or even conflict with various positions put forth in this document.

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>1[preamble] A method of encoding a video sequence, the method comprising:</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious a method of encoding a video sequence.</p> <p><i>See, e.g.,</i></p> <p>Abstract.</p> <p>Apparatus, and an associated method, motion compensates coding of video sequences. Motion compensated prediction is utilized in the representation of motion vector fields. Reduced numbers of bits are required to represent the motion vector field while maintaining a low prediction error, thereby facilitating improved communication of, and recreation of, video frames forming a video sequence.</p> <p>1:6-13.</p> <p>More particularly, the present invention relates to apparatus, and an associated method, for encoding, and decoding, a video sequence utilizing motion compensated prediction. Motion fields of a segment are predicted from adjacent segments of a video frame and by using orthogonal affine motion vector field models. Through operation of an embodiment of the present invention, motion vector fields are formed with a reduced number of bits while still maintaining a low prediction error.</p> <p>13:11-16.</p> <p>The new manner of motion predictive video coding of an embodiment of the present invention report further reduces the amount of data to be transferred from encoder to decoder in a low bit-rate video coding system, while maintaining good image quality. The manner includes a new way of further predicting the pixel values of segments in the current frame using already coded segments of that same frame.</p>

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<p>1[a] assigning a skip coding mode to a first segment of a first frame of the sequence;</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious assigning a skip coding mode to a first segment of a first frame of the sequence.</p> <p><i>See, e.g.,</i></p> <p>14:27-15:6.</p> <p>The second segment has one previously coded neighboring segment (i.e. the first segment). The encoder now considers whether it is “more efficient” to model the second segment in terms of the affine motion model previously determined for the first segment, rather than according to the newly determined affine motion coefficients for the second segment itself. The rationale is as follows: Since the motion coefficients for the first segment have already been determined and transmitted to the decoder, it may be possible to reduce the amount of information that must be transmitted to the decoder while encoding the second segment. Hence an improvement in coding efficiency may be obtained.</p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some “refinement” information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost"</p>

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	<p>of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>15:27-16:3.</p> <p>However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second segment can be predicted purely on the basis of motion coefficients already stored in the decoder.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the “rate-distortion” considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>17:23-18:2.</p> <p>Whenever a segment is coded using a prediction field, whether there is an associated refinement field or not, it is necessary to provide information about the neighboring segment(s) used in the prediction. It is not necessary to transmit any motion coefficient data because the motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in)</p>

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	<p>the decoder. Extra information may also be required if, for example, prediction is based on more than one neighboring segment, or neighboring segments have been divided into sub-segments and the motion field model of one or more of the sub-segments is used to form the prediction field.</p> <p>18:29-19:9.</p> <p>As stated above, when the method according to the invention is applied in practice, it is often found that very little refinement information is required and the motion model of a general segment can be predicted with quite high precision from the motion field models of its neighbors. The invention includes a further feature, whereby individual coefficients of the refinement field or the entire refinement field may be set to zero, if that is efficient in a “rate-distortion sense.” In other words, the refinement field may be set to zero if the image distortion introduced in doing that is acceptable when considering the reduction in the amount of data to be transmitted. This additional feature further reduces the amount of data that must be transmitted from encoder to decoder.</p> <p>20:22-26.</p> <p>Difference values formed by the subtractor 24 are provided to a prediction error coder 42. The prediction error coder determines the differences in pixel value between the current input video frame and the MC predicted version of the frame in order to produce an indication of the prediction error.</p> <p>31:14-25.</p> <p>Therefore, with respect to motion vector fields, a given segment S_i can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a</p>

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	<p>zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p> <p>Claims 61, 64-65:</p> <p>61. In a method of encoding a video sequence, said video sequence being formed of at least a current video frame and a reference video frame, the current video frame comprising at least a first neighboring segment and a second neighboring segment, an improvement of a method for motion compensated prediction of the current video frame comprising:</p> <p>defining a set of coding modes for said second neighboring segment;</p> <p>calculating a set of cost functions, each one of said cost functions being associated with one of said set of coding modes;</p> <p>choosing that one of said set of cost functions with a smallest absolute value;</p> <p>defining that one of said set of coding modes associated with said smallest absolute value as a chosen coding mode for said second neighboring segment;</p> <p>encoding information about said second neighboring segment according to said chosen coding mode.</p> <p>64. A method according to claim 61 wherein said set of coding modes comprises:</p> <p>A first coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a prediction motion field model and said second neighboring segment is represented by said prediction motion field model;</p> <p>a second coding mode wherein said second neighboring segment is represented by a motion field model derived from said reference frame;</p> <p>a third coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a projection field model and said second neighboring segment is represented by said prediction motion field model and a refinement motion field model.</p>

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	<p>65. A method according to claim 64 wherein said set of coding modes further comprises:</p> <p>A fourth coding mode wherein said second neighboring segment is encoded using pixel values from said reference frame;</p> <p>a fifth coding mode wherein said second neighboring segment is encoded using pixel values from said current frame.</p>
<p>1[b] assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment; and</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment.</p> <p><i>See, e.g.,</i></p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some “refinement” information. When making its choice of what information to transmit, the</p>

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	<p>encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost" of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the "rate-distortion" considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>25:13-24.</p> <p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to</p>

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	<p>the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p>26:13-20.</p> <p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on the motion vector field of the “winning” candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>30:20-27.</p> <p>The output of the motion analyzer 64 forms the input to the motion coefficient remover 66. The operations performed by the remover 66 when setting some of the refinement motion field coefficients to zero include, for instance, removing those elements that correspond to coefficients that can be removed from R, with z 1. The result is a modified matrix R and vector z. Various manners can be utilized to specify, or imply by default, the segment or the set of neighboring segments from which the prediction motion field is derived.</p> <p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And,</p>

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	for example, the segment can be coded using intra coding in which no motion vector field is utilized.
1[c] forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector; and	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector.</p> <p><i>See, e.g.,</i></p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some "refinement" information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost"</p>

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	<p>of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>15:27-16:3.</p> <p>However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second segment can be predicted purely on the basis of motion coefficients already stored in the decoder.</p> <p>16:14-18.</p> <p>Thus, when considering a general segment in a frame to be coded, there are several possibilities for the prediction of motion coefficients. In a general case, the encoder can try to predict the motion coefficients for a given segment using the motion field model for the segment above it or to the left.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the “rate-distortion” considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference</p>

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	<p>frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>21:6-21.</p> <p>The motion estimator 22 calculates motion vectors ($\Delta x(x, y)$, $\Delta y(x, y)$) of pixels between the frame being coded, referred to as the current frame $I_n(x, y)$, and the reference frame $R_{ref}(x, y)$. The reference frame is one of the previously coded and transmitted frames which at a given instant is available in the frame memory 26 of the encoder and also of the decoder.</p> <p>$\Delta x(x, y)$ and $\Delta y(x, y)$ are the values of the horizontal and vertical displacements, respectively. The set of motion vectors of all pixels in the current frame, referred to as a motion vector field, is compressed by the motion field coder 28 and thereafter, as noted above, sent to the decoder. To indicate that the compression of the motion vector field is typically lossy, the compressed motion vectors are denoted as $Ax(x, y)$, $Ay(x, y)$. In the motion compensated predictor 36, the compressed motion vectors and the reference frame are used to construct a prediction frame, $P_n(x, y)$. The prediction frame is a coded version of the current frame $I_n(x, y)$ calculated using the motion vector field determined by the motion estimator 22 and the motion field coder 28 and the pixel values of the reference frame $R_{ref}(x, y)$.</p> <p>25:13-24.</p> <p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p>26:13-20.</p>

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	<p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on the motion vector field of the "winning" candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p> <p>33:18-34:6.</p> <p>Once the neighboring segment has been selected for the prediction of the current segment, the prediction motion vector field is simply the extrapolation of the motion vector field of the segment inside the pixel domain covered by the current segment as follows:</p>

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	<p style="text-align: center;">EQUATION 20</p> $\Delta x_{prd}(x,y) = \beta_1^k + \beta_2^k \cdot (y - y_o^k) + \beta_3^k \cdot (x - x_o^k)$ $\Delta y_{prd}(x,y) = \beta_4^k + \beta_5^k \cdot (y - y_o^k) + \beta_6^k \cdot (x - x_o^k)$ <p>where x_o^k, y_o^k are coordinates of the upper left-most pixel in the neighboring segment S_k and $\beta_1^k, \dots, \beta_6^k$ are integer-valued coefficients corresponding to the motion field of segment S_k. In equation 20, the superscript k indicates that the coefficients are associated with the neighboring segment S_k.</p> <p>Analysis of equations 19 and 20 indicates that the motion vector field of the neighboring segment S_k has become the prediction motion vector field of the segment S_i by simply extrapolating it to the pixels inside the current segment S_i.</p>
<p>1[d] providing in an encoded bitstream an indication of the skip coding mode, wherein no further motion vector information for the first segment is coded in the encoded bitstream.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious providing in an encoded bitstream an indication of the skip coding mode, wherein no further motion vector information for the first segment is coded in the encoded bitstream.</p> <p><i>See, e.g.,</i></p> <p>17:8-18.</p> <p>The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the</p>

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	<p>motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>32:18-22.</p> <p>In the exemplary implementation, one bit is sent to the decoder 14 to signal whether the prediction field of a neighbor is used or not, but only in the case when there is at least one prediction neighbor candidate.</p> <p>32:23-33:3.</p> <p>Also in the exemplary implementation, prediction is performed only from a nearest neighboring block at the left or just above the current segment. Therefore, the number of neighboring segments can be at most four, i.e., two eight by eight pixel blocks above and two eight by eight pixel blocks at the left. In this implementation, whenever the bit sent to the decoder indicates that prediction from a neighboring segment is used, the number and location of prediction candidates is calculated, in both the encoder and decoder. If there are, e.g., two, three, or four prediction candidates, then one or two selection bits are sent to the decoder 14 to indicate the candidate to be used. The selection information is made, e.g., of one prediction direction bit which may, or may not, exist, followed by one discrimination bit, which also may, or may not, exist.</p> <p>37:5-13.</p> <p>In the exemplary implementation, the presence of motion coefficients in the bitstream is signaled by one bit whenever refinement or nonrefinement motion coefficients can be expected. This bit is referred to as a motion coefficient indicator (MCI).</p> <p>Also in the exemplary implementation, when motion coefficients are transmitted for a segment S_i, a variable-length code, referred to as a motion coefficient pattern (MCP) is first sent to indicate which coefficients have nonzero values. An all-zero pattern is the only non-valid pattern, as this possibility can be signaled by the MCI bit alone.</p>

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	<p>Claim 2</p> <p>2. A method according to claim 1 further including: encoding information about said chosen motion field model.</p> <p>Claim 3</p> <p>3. A method according to claim 2 further including: transmitting said coded information to a decoder for decoding.</p>
<p>2. A method according to claim 1, wherein the second segment is a previously encoded segment neighboring the first segment.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that the second segment is a previously encoded segment neighboring the first segment.</p> <p><i>See, e.g.,</i></p> <p>14:27-15:6.</p> <p>The second segment has one previously coded neighboring segment (i.e. the first segment). The encoder now considers whether it is “more efficient” to model the second segment in terms of the affine motion model previously determined for the first segment, rather than according to the newly determined affine motion coefficients for the second segment itself. The rationale is as follows: Since the motion coefficients for the first segment have already been determined and transmitted to the decoder, it may be possible to reduce the amount of information that must be transmitted to the decoder while encoding the second segment. Hence an improvement in coding efficiency may be obtained.</p> <p>15:7-25.</p>

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	<p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some "refinement" information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost" of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>15:27-16:3.</p> <p>However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second segment can be predicted purely on the basis of motion coefficients already stored in the decoder.</p> <p>16:4-30.</p> <p>So far in this example, only the first and second segments of the frame have been considered. As explained above, according to the segmentation scheme used in the preferred embodiment of the invention, the second segment has only one neighbor that can be used to predict its motion coefficients. The same is true for all other segments on the first row of the frame. All such segments can only have previously coded neighbors immediately to their left. However, on the second and subsequent rows of the image, previously coded segments are also available above each segment. Thus, segments in subsequent rows have neighbors to the left and above. This is</p>

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	<p>true for all segments except the first in each row, which only has a previously coded neighbor directly above it. Thus, when considering a general segment in a frame to be coded, there are several possibilities for the prediction of motion coefficients. In a general case, the encoder can try to predict the motion coefficients for a given segment using the motion field model for the segment above it or to the left. Alternatively, it can form some kind of average, using the motion field model for both neighbors. In each case, the motion field model predicted from the neighboring segment(s) is referred to as the "prediction field" and the difference between the prediction field and the motion field model determined specifically for the segment itself is termed the "refinement field." In the preferred embodiment, both the prediction and refinement fields are affine motion field models. The sum of the prediction field and the refinement field should thus be equivalent to the motion field model determined by applying the affine motion model to the segment itself. In a situation where it is not possible to predict the motion field model for a given segment from any of its neighbors, the prediction field is set to zero and the refinement field becomes equal to the motion field model determined specifically for the segment itself.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the "rate-distortion" considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>17:23-18:2.</p> <p>Whenever a segment is coded using a prediction field, whether there is an associated refinement field or not, it is necessary to provide information about the neighboring segment(s) used in the prediction. It is not necessary to transmit any motion coefficient data because the motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in) the decoder. Extra information may also be required if, for example, prediction is based on more than one neighboring segment, or neighboring segments have been divided into sub-segments and the motion field model of one or more of the sub-segments is used to form the prediction field.</p> <p>18:29-19:9.</p> <p>As stated above, when the method according to the invention is applied in practice, it is often found that very little refinement information is required and the motion model of a general segment can be predicted with quite high precision from the motion field models of its neighbors. The invention includes a further feature, whereby individual coefficients of the refinement field or the entire refinement field may be set to zero, if that is efficient in a “rate-distortion sense.” In other words, the refinement field may be set to zero if the image distortion introduced in doing that is acceptable when considering the reduction in the amount of data to be transmitted. This additional feature further reduces the amount of data that must be transmitted from encoder to decoder.</p> <p>20:22-26.</p> <p>Difference values formed by the subtractor 24 are provided to a prediction error coder 42. The prediction error coder determines the differences in pixel value between the current input video frame and the MC predicted version of the frame in order to produce an indication of the prediction error.</p> <p>31:8:10.</p> <p>The coding of a frame is performed by scanning from left-to-right and top-to-bottom, macroblock by macroblock.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>31:14-25.</p> <p>Therefore, with respect to motion vector fields, a given segment S_i can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p> <p>Claims 61, 64-65:</p> <p>61. In a method of encoding a video sequence, said video sequence being formed of at least a current video frame and a reference video frame, the current video frame comprising at least a first neighboring segment and a second neighboring segment, an improvement of a method for motion compensated prediction of the current video frame comprising:</p> <p>defining a set of coding modes for said second neighboring segment;</p> <p>calculating a set of cost functions, each one of said cost functions being associated with one of said set of coding modes;</p> <p>choosing that one of said set of cost functions with a smallest absolute value;</p> <p>defining that one of said set of coding modes associated with said smallest absolute value as a chosen coding mode for said second neighboring segment;</p> <p>encoding information about said second neighboring segment according to said chosen coding mode.</p> <p>64. A method according to claim 61 wherein said set of coding modes comprises:</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>A first coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a prediction motion field model and said second neighboring segment is represented by said prediction motion field model;</p> <p>a second coding mode wherein said second neighboring segment is represented by a motion field model derived from said reference frame;</p> <p>a third coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a projection field model and said second neighboring segment is represented by said prediction motion field model and a refinement motion field model.</p> <p>65. A method according to claim 64 wherein said set of coding modes further comprises:</p> <p>A fourth coding mode wherein said second neighboring segment is encoded using pixel values from said reference frame;</p> <p>a fifth coding mode wherein said second neighboring segment is encoded using pixel values from said current frame.</p>
<p>6. A method according to claim 1, wherein if the second segment has zero motion vector, the zero motion vector is assigned for skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that if the second segment has zero motion vector, the zero motion vector is assigned for skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p> <p><i>See, e.g.,</i></p> <p>14:27-15:6.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
frame associated with the zero motion vector.	<p>The second segment has one previously coded neighboring segment (i.e. the first segment). The encoder now considers whether it is “more efficient” to model the second segment in terms of the affine motion model previously determined for the first segment, rather than according to the newly determined affine motion coefficients for the second segment itself. The rationale is as follows: Since the motion coefficients for the first segment have already been determined and transmitted to the decoder, it may be possible to reduce the amount of information that must be transmitted to the decoder while encoding the second segment. Hence an improvement in coding efficiency may be obtained.</p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some “refinement” information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost" of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>15:27-16:3.</p> <p>However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>segment can be predicted purely on the basis of motion coefficients already stored in the decoder.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the “rate-distortion” considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>17:23-18:2.</p> <p>Whenever a segment is coded using a prediction field, whether there is an associated refinement field or not, it is necessary to provide information about the neighboring segment(s) used in the prediction. It is not necessary to transmit any motion coefficient data because the motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in) the decoder. Extra information may also be required if, for example, prediction is based on more than one neighboring segment, or neighboring segments have been divided into sub-segments and the motion field model of one or more of the sub-segments is used to form the prediction field.</p> <p>18:29-19:9.</p> <p>As stated above, when the method according to the invention is applied in practice, it is often found that very little refinement information is required and the motion model of a general</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>segment can be predicted with quite high precision from the motion field models of its neighbors. The invention includes a further feature, whereby individual coefficients of the refinement field or the entire refinement field may be set to zero, if that is efficient in a “rate-distortion sense.” In other words, the refinement field may be set to zero if the image distortion introduced in doing that is acceptable when considering the reduction in the amount of data to be transmitted. This additional feature further reduces the amount of data that must be transmitted from encoder to decoder.</p> <p>20:22-26.</p> <p>Difference values formed by the subtractor 24 are provided to a prediction error coder 42. The prediction error coder determines the differences in pixel value between the current input video frame and the MC predicted version of the frame in order to produce an indication of the prediction error.</p> <p>25:13-24.</p> <p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p>26:13-20.</p> <p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on the motion vector field of the “winning” candidate, or candidates, the prediction motion field is</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>30:20-27.</p> <p>The output of the motion analyzer 64 forms the input to the motion coefficient remover 66. The operations performed by the remover 66 when setting some of the refinement motion field coefficients to zero include, for instance, removing those elements that correspond to coefficients that can be removed from R, with z 1. The result is a modified matrix R and vector z. Various manners can be utilized to specify, or imply by default, the segment or the set of neighboring segments from which the prediction motion field is derived.</p> <p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p> <p>Claims 61, 64-65:</p> <p>61. In a method of encoding a video sequence, said video sequence being formed of at least a current video frame and a reference video frame, the current video frame comprising at least a first neighboring segment and a second neighboring segment, an improvement of a method for motion compensated prediction of the current video frame comprising:</p> <p>defining a set of coding modes for said second neighboring segment;</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>calculating a set of cost functions, each one of said cost functions being associated with one of said set of coding modes;</p> <p>choosing that one of said set of cost functions with a smallest absolute value;</p> <p>defining that one of said set of coding modes associated with said smallest absolute value as a chosen coding mode for said second neighboring segment;</p> <p>encoding information about said second neighboring segment according to said chosen coding mode.</p> <p>64. A method according to claim 61 wherein said set of coding modes comprises:</p> <p>A first coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a prediction motion field model and said second neighboring segment is represented by said prediction motion field model;</p> <p>a second coding mode wherein said second neighboring segment is represented by a motion field model derived from said reference frame;</p> <p>a third coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a projection field model and said second neighboring segment is represented by said prediction motion field model and a refinement motion field model.</p> <p>65. A method according to claim 64 wherein said set of coding modes further comprises:</p> <p>A fourth coding mode wherein said second neighboring segment is encoded using pixel values from said reference frame;</p> <p>a fifth coding mode wherein said second neighboring segment is encoded using pixel values from said current frame.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>7[preamble] A method of decoding an encoded video sequence, the method comprising:</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious a method of decoding an encoded video sequence.</p> <p><i>See, e.g.,</i></p> <p>Abstract.</p> <p>Apparatus, and an associated method, motion compensates coding of video sequences. Motion compensated prediction is utilized in the representation of motion vector fields. Reduced numbers of bits are required to represent the motion vector field while maintaining a low prediction error, thereby facilitating improved communication of, and recreation of, video frames forming a video sequence.</p> <p>1:6-13.</p> <p>More particularly, the present invention relates to apparatus, and an associated method, for encoding, and decoding, a video sequence utilizing motion compensated prediction. Motion fields of a segment are predicted from adjacent segments of a video frame and by using orthogonal affine motion vector field models. Through operation of an embodiment of the present invention, motion vector fields are formed with a reduced number of bits while still maintaining a low prediction error.</p> <p>13:11-16.</p> <p>The new manner of motion predictive video coding of an embodiment of the present invention report further reduces the amount of data to be transferred from encoder to decoder in a low bit-rate video coding system, while maintaining good image quality. The manner includes a new way of further predicting the pixel values of segments in the current frame using already coded segments of that same frame.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>7[a] receiving an indication of a skip coding mode for a first segment;</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious receiving an indication of a skip coding mode for a first segment.</p> <p><i>See, e.g.,</i></p> <p>14:27-30.</p> <p>The second segment has one previously coded neighboring segment (i.e. the first segment). The encoder now considers whether it is “more efficient” to model the second segment in terms of the affine motion model previously determined for the first segment, rather than according to the newly determined affine motion coefficients for the second segment itself. The rationale is as follows: Since the motion coefficients for the first segment have already been determined and transmitted to the decoder, it may be possible to reduce the amount of information that must be transmitted to the decoder while encoding the second segment. Hence an improvement in coding efficiency may be obtained.</p> <p>15:7-15.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image.</p> <p>15:27-16:3.</p> <p>However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>segment can be predicted purely on the basis of motion coefficients already stored in the decoder.</p> <p>17:8-18.</p> <p>The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>17:23-18:2.</p> <p>Whenever a segment is coded using a prediction field, whether there is an associated refinement field or not, it is necessary to provide information about the neighboring segment(s) used in the prediction. It is not necessary to transmit any motion coefficient data because the motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in) the decoder. Extra information may also be required if, for example, prediction is based on more than one neighboring segment, or neighboring segments have been divided into sub-segments and the motion field model of one or more of the sub-segments is used to form the prediction field.</p> <p>18:29-19:9.</p> <p>As stated above, when the method according to the invention is applied in practice, it is often found that very little refinement information is required and the motion model of a general segment can be predicted with quite high precision from the motion field models of its neighbors. The invention includes a further feature, whereby individual coefficients of the refinement field or the entire refinement field may be set to zero, if that is efficient in a “rate-distortion sense.” In other words, the refinement field may be set to zero if the image distortion introduced in doing that is acceptable when considering the reduction in the amount of data to be</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>transmitted. This additional feature further reduces the amount of data that must be transmitted from encoder to decoder.</p> <p>32:18-22.</p> <p>In the exemplary implementation, one bit is sent to the decoder 14 to signal whether the prediction field of a neighbor is used or not, but only in the case when there is at least one prediction neighbor candidate.</p> <p>32:23-33:3.</p> <p>Also in the exemplary implementation, prediction is performed only from a nearest neighboring block at the left or just above the current segment. Therefore, the number of neighboring segments can be at most four, i.e., two eight by eight pixel blocks above and two eight by eight pixel blocks at the left. In this implementation, whenever the bit sent to the decoder indicates that prediction from a neighboring segment is used, the number and location of prediction candidates is calculated, in both the encoder and decoder. If there are, e.g., two, three, or four prediction candidates, then one or two selection bits are sent to the decoder 14 to indicate the candidate to be used. The selection information is made, e.g., of one prediction direction bit which may, or may not, exist, followed by one discrimination bit, which also may, or may not, exist.</p> <p>37:5-13.</p> <p>In the exemplary implementation, the presence of motion coefficients in the bitstream is signaled by one bit whenever refinement or nonrefinement motion coefficients can be expected. This bit is referred to as a motion coefficient indicator (MCI).</p> <p>Also in the exemplary implementation, when motion coefficients are transmitted for a segment S_i, a variable-length code, referred to as a motion coefficient pattern (MCP) is first sent to indicate which coefficients have nonzero values. An all-zero pattern is the only non-valid pattern, as this possibility can be signaled by the MCI bit alone.</p> <p>Claim 2</p> <p>2. A method according to claim 1 further including: encoding information about said chosen motion field model.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>Claim 3</p> <p>3. A method according to claim 2 further including: transmitting said coded information to a decoder for decoding.</p>
<p>7[b] assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment; and</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment.</p> <p><i>See, e.g.,</i></p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some "refinement" information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost"</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the “rate-distortion” considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>25:13-24.</p> <p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p>26:13-20.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on the motion vector field of the “winning” candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p> <p>30:20-27.</p> <p>The output of the motion analyzer 64 forms the input to the motion coefficient remover 66. The operations performed by the remover 66 when setting some of the refinement motion field coefficients to zero include, for instance, removing those elements that correspond to coefficients that can be removed from R, with z 1. The result is a modified matrix R and vector z. Various manners can be utilized to specify, or imply by default, the segment or the set of neighboring segments from which the prediction motion field is derived.</p> <p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p>
<p>7[c] forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector.</p> <p><i>See, e.g.,</i></p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some "refinement" information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost"</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>15:27-16:3.</p> <p>However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second segment can be predicted purely on the basis of motion coefficients already stored in the decoder.</p> <p>16:14-18.</p> <p>Thus, when considering a general segment in a frame to be coded, there are several possibilities for the prediction of motion coefficients. In a general case, the encoder can try to predict the motion coefficients for a given segment using the motion field model for the segment above it or to the left.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the “rate-distortion” considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>21:6-21.</p> <p>The motion estimator 22 calculates motion vectors ($\Delta x(x, y)$, $\Delta y(x, y)$) of pixels between the frame being coded, referred to as the current frame $I_n(x, y)$, and the reference frame $R_{ref}(x, y)$. The reference frame is one of the previously coded and transmitted frames which at a given instant is available in the frame memory 26 of the encoder and also of the decoder.</p> <p>$\Delta x(x, y)$ and $\Delta y(x, y)$ are the values of the horizontal and vertical displacements, respectively. The set of motion vectors of all pixels in the current frame, referred to as a motion vector field, is compressed by the motion field coder 28 and thereafter, as noted above, sent to the decoder. To indicate that the compression of the motion vector field is typically lossy, the compressed motion vectors are denoted as $Ax(x, y)$, $Ay(x, y)$. In the motion compensated predictor 36, the compressed motion vectors and the reference frame are used to construct a prediction frame, $P_n(x, y)$. The prediction frame is a coded version of the current frame $I_n(x, y)$ calculated using the motion vector field determined by the motion estimator 22 and the motion field coder 28 and the pixel values of the reference frame $R_{ref}(x, y)$.</p> <p>25:13-24.</p> <p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p>26:13-20.</p>

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	<p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on the motion vector field of the "winning" candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p> <p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p> <p>33:18-34:6.</p>

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	<p>Once the neighboring segment has been selected for the prediction of the current segment, the prediction motion vector field is simply the extrapolation of the motion vector field of the segment inside the pixel domain covered by the current segment as follows:</p> <p style="text-align: center;">EQUATION 20</p> $\Delta x_{prd}(x,y) = \beta_1^k + \beta_2^k \cdot (y - y_o^k) + \beta_3^k \cdot (x - x_o^k)$ $\Delta y_{prd}(x,y) = \beta_4^k + \beta_5^k \cdot (y - y_o^k) + \beta_6^k \cdot (x - x_o^k)$ <p>where x_o^k, y_o^k are coordinates of the upper left-most pixel in the neighboring segment S_k and $\beta_1^k, \dots, \beta_6^k$ are integer-valued coefficients corresponding to the motion field of segment S_k. In equation 20, the superscript k indicates that the coefficients are associated with the neighboring segment S_k.</p> <p>Analysis of equations 19 and 20 indicates that the motion vector field of the neighboring segment S_k has become the prediction motion vector field of the segment S_i by simply extrapolating it to the pixels inside the current segment S_i.</p>
<p>9. A method according to claim 7, wherein if a segment in a previously decoded region surrounding the first segment has zero motion vector, the zero-motion vector is assigned to the skip coding</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that if a segment in a previously decoded region surrounding the first segment has zero motion vector, the zero-motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>

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<p>mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>	<p><i>See, e.g.,</i></p> <p><i>See claim 6.</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p>
<p>10[preamble] A video encoder for encoding a video sequence, the encoder comprises:</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious a video encoder for encoding a video sequence.</p> <p><i>See, e.g.,</i></p> <p>Abstract.</p> <p>Apparatus, and an associated method, motion compensates coding of video sequences. Motion compensated prediction is utilized in the representation of motion vector fields. Reduced numbers of bits are required to represent the motion vector field while maintaining a low</p>

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	<p data-bbox="678 386 1923 451">prediction error, thereby facilitating improved communication of, and recreation of, video frames forming a video sequence.</p> <p data-bbox="625 467 716 500">1:6-13.</p> <p data-bbox="678 516 1850 711">More particularly, the present invention relates to apparatus, and an associated method, for encoding, and decoding, a video sequence utilizing motion compensated prediction. Motion fields of a segment are predicted from adjacent segments of a video frame and by using orthogonal affine motion vector field models. Through operation of an embodiment of the present invention, motion vector fields are formed with a reduced number of bits while still maintaining a low prediction error.</p> <p data-bbox="625 727 747 760">13:11-16.</p> <p data-bbox="678 776 1902 930">The new manner of motion predictive video coding of an embodiment of the present invention report further reduces the amount of data to be transferred from encoder to decoder in a low bit-rate video coding system, while maintaining good image quality. The manner includes a new way of further predicting the pixel values of segments in the current frame using already coded segments of that same frame.</p> <p data-bbox="625 946 709 979">Fig. 1.</p>

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	<p>The diagram illustrates a video coding system 10 and its corresponding decoder 14. The encoder 10 (enclosed in a dashed box) processes a video input $I_n(x,y)$ at 18. It subtracts a prediction $P_n(x,y)$ at 24 to produce a prediction error $E_n(x,y)$ at 42. This error is then coded at 46 and sent to a multiplexer 34. The prediction $P_n(x,y)$ is also sent to the multiplexer. The multiplexer outputs a stream 16 to the decoder 14. The decoder 14 (also in a dashed box) demultiplexes at 52 to recover the prediction error $E_n(x,y)$ at 54 and the prediction $P_n(x,y)$ at 56. The prediction error is decoded at 54 and added to the prediction at 56 to produce the decoded video $T_n(x,y)$ at 56. The decoded video is stored in a frame memory 26. The frame memory 26 provides a reference $R_{ref}(x,y)$ at 32 to the motion estimation 22 and motion field coding 28. The motion estimation 22 provides motion information to the MC Prediction 36, which then provides the prediction $P_n(x,y)$ at 24 back to the encoder. The system is labeled 10 and 14.</p>
<p>10[a] a coding controller for assigning a skip coding mode to a first segment;</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious a coding controller for assigning a skip coding mode to a first segment.</p> <p><i>See, e.g.,</i></p>

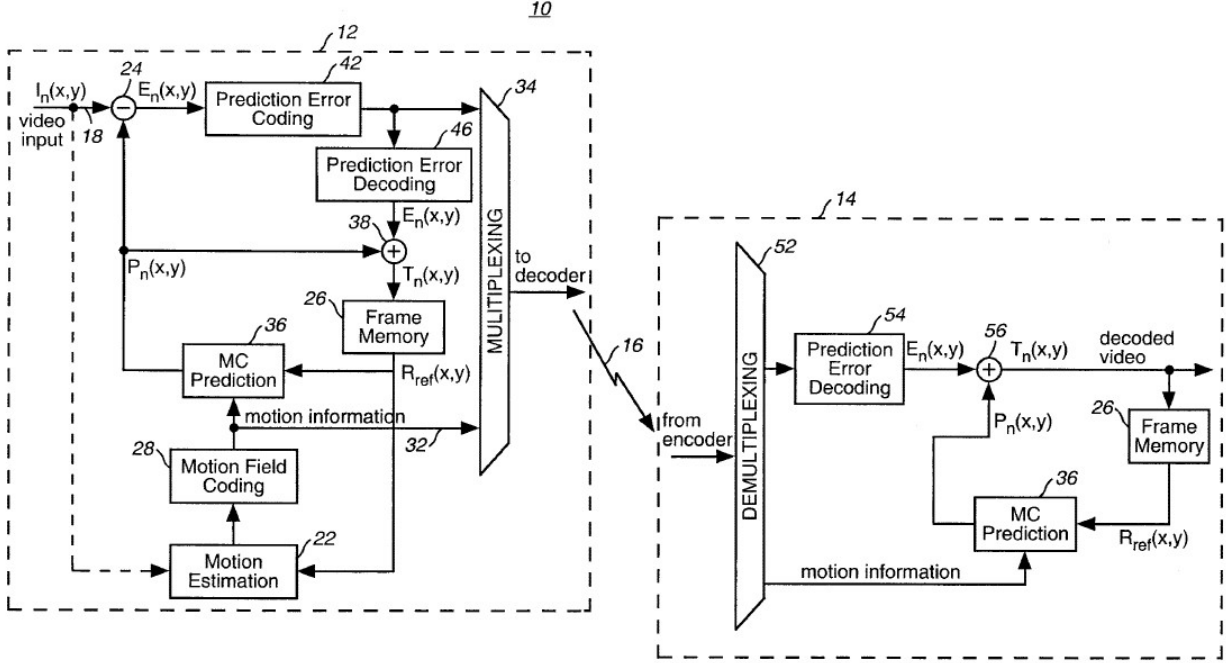
ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>11:19-23.</p> <p>In one aspect of the present invention, a motion field coder is provided for a video encoder. The motion field coder is operable to form a compressed motion vector field which is formed of a set of motion vectors of all pixels of a current frame. The motion vector field is formed of a prediction motion vector field and a refinement motion vector field.</p> <p>14:27-15:6.</p> <p>The second segment has one previously coded neighboring segment (i.e. the first segment). The encoder now considers whether it is “more efficient” to model the second segment in terms of the affine motion model previously determined for the first segment, rather than according to the newly determined affine motion coefficients for the second segment itself. The rationale is as follows: Since the motion coefficients for the first segment have already been determined and transmitted to the decoder, it may be possible to reduce the amount of information that must be transmitted to the decoder while encoding the second segment. Hence an improvement in coding efficiency may be obtained.</p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some “refinement” information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost"</p>

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	<p>of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>15:27-16:3.</p> <p>However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second segment can be predicted purely on the basis of motion coefficients already stored in the decoder.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the “rate-distortion” considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>17:23-18:2.</p> <p>Whenever a segment is coded using a prediction field, whether there is an associated refinement field or not, it is necessary to provide information about the neighboring segment(s) used in the prediction. It is not necessary to transmit any motion coefficient data because the motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in)</p>

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	<p>the decoder. Extra information may also be required if, for example, prediction is based on more than one neighboring segment, or neighboring segments have been divided into sub-segments and the motion field model of one or more of the sub-segments is used to form the prediction field.</p> <p>18:29-19:9.</p> <p>As stated above, when the method according to the invention is applied in practice, it is often found that very little refinement information is required and the motion model of a general segment can be predicted with quite high precision from the motion field models of its neighbors. The invention includes a further feature, whereby individual coefficients of the refinement field or the entire refinement field may be set to zero, if that is efficient in a “rate-distortion sense.” In other words, the refinement field may be set to zero if the image distortion introduced in doing that is acceptable when considering the reduction in the amount of data to be transmitted. This additional feature further reduces the amount of data that must be transmitted from encoder to decoder.</p> <p>20:11-16.</p> <p>The motion estimator 22 is coupled to a motion field coder 28. The motion field coder 28 is operable to form a motion vector field which is a set of motion vectors of all pixels of the current frame. The field generated by the motion field coder is provided by way of the line 32 to a multiplexor 34 thereafter to be communicated upon the communication path 16 to the video sequence receiver and the decoder 14 thereof.</p> <p>20:22-26.</p> <p>Difference values formed by the subtractor 24 are provided to a prediction error coder 42. The prediction error coder determines the differences in pixel value between the current input video frame and the MC predicted version of the frame in order to produce an indication of the prediction error.</p> <p>31:14-25.</p> <p>Therefore, with respect to motion vector fields, a given segment S_i can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p> <p>Claims 61, 64-65:</p> <p>61. In a method of encoding a video sequence, said video sequence being formed of at least a current video frame and a reference video frame, the current video frame comprising at least a first neighboring segment and a second neighboring segment, an improvement of a method for motion compensated prediction of the current video frame comprising:</p> <p>defining a set of coding modes for said second neighboring segment;</p> <p>calculating a set of cost functions, each one of said cost functions being associated with one of said set of coding modes;</p> <p>choosing that one of said set of cost functions with a smallest absolute value;</p> <p>defining that one of said set of coding modes associated with said smallest absolute value as a chosen coding mode for said second neighboring segment;</p> <p>encoding information about said second neighboring segment according to said chosen coding mode.</p> <p>64. A method according to claim 61 wherein said set of coding modes comprises:</p> <p>A first coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a prediction motion field model and said second neighboring segment is represented by said prediction motion field model;</p> <p>a second coding mode wherein said second neighboring segment is represented by a motion field model derived from said reference frame;</p>

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	<p>a third coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a projection field model and said second neighboring segment is represented by said prediction motion field model and a refinement motion field model.</p> <p>65. A method according to claim 64 wherein said set of coding modes further comprises:</p> <p>A fourth coding mode wherein said second neighboring segment is encoded using pixel values from said reference frame;</p> <p>a fifth coding mode wherein said second neighboring segment is encoded using pixel values from said current frame.</p> <p>Fig. 1.</p>

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	 <p>The diagram illustrates a video encoding and decoding system. The encoder (10) processes a video input $I_n(x,y)$ (18) by subtracting a prediction $P_n(x,y)$ (24) to produce a prediction error $E_n(x,y)$ (24). This error is then coded by a Prediction Error Coding block (42) to produce a coded error $E_n(x,y)$ (46). The coded error is multiplexed (34) with motion information (32) and a reference frame $R_{ref}(x,y)$ (26) to produce a multiplexed stream (16) sent to the decoder. The decoder (14) demultiplexes (52) the stream to extract the coded error and motion information. The coded error is decoded by a Prediction Error Decoding block (54) to produce a decoded error $E_n(x,y)$ (56). The motion information is used by a Motion Field Coding block (28) and a Motion Estimation block (22) to produce a prediction $P_n(x,y)$ (36). The decoded error is then added to the prediction to produce the decoded video $T_n(x,y)$ (56). The decoded video is stored in a Frame Memory (26) and used as a reference frame $R_{ref}(x,y)$ (26) for the next frame.</p>
<p>10[b] a motion estimation block for assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious a motion estimation block for assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment.</p>

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<p>based at least in part on the motion information of a second segment neighboring the first segment; and</p>	<p><i>See, e.g.,</i></p> <p>20:11-16.</p> <p>The motion estimator 22 is coupled to a motion field coder 28. The motion field coder 28 is operable to form a motion vector field which is a set of motion vectors of all pixels of the current frame. The field generated by the motion field coder is provided by way of the line 32 to a multiplexor 34 thereafter to be communicated upon the communication path 16 to the video sequence receiver and the decoder 14 thereof.</p> <p>20:17-20.</p> <p>The encoder is further shown to include a motion compensated (MC) predictor 36. The predictor 36 is also coupled to the frame memory 26. The predictor 36 is operable to generate a prediction frame which is supplied to the subtractor 24 and also to a summer 38.</p> <p>21:15-21.</p> <p>To indicate that the compression of the motion vector field is typically lossy, the compressed motion vectors are denoted as $Ax(x,y), Ay(x,y)$. In the motion compensated predictor 36, the compressed motion vectors and the reference frame are used to construct a prediction frame, $P_n(x, y)$. The prediction frame is a coded version of the current frame $I_n(x, y)$ calculated using the motion vector field determined by the motion estimator 22 and the motion field coder 28 and the pixel values of the reference frame $R_{ref}(x, y)$.</p> <p>26:9-25.</p> <p>Figure 2 illustrates the motion field coder 28 in greater detail. The coder 28 is here shown to include a selector and builder of prediction motion fields 62, a motion analyzer 64, a motion coefficient remover 66, and a quantizer 68.</p> <p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on</p>

ASSERTED CLAIMS	<p style="text-align: center;">PRIOR ART REFERENCE:</p> <p style="text-align: center;">Karczewicz</p>
	<p>the motion vector field of the "winning" candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>The motion analyzer 64 is operable to find a new representation of a refinement motion vector field. That is to say, a mathematically efficient representation is made. The new representation is later used at the motion coefficient remover 66 for a quick and flexible determination of refinement motion coefficients.</p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some "refinement" information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost" of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the "rate-distortion" considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment</p>

ASSERTED CLAIMS	<p style="text-align: center;">PRIOR ART REFERENCE:</p> <p style="text-align: center;">Karczewicz</p>
	<p>can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>25:13-24.</p> <p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p>30:20-27.</p> <p>The output of the motion analyzer 64 forms the input to the motion coefficient remover 66. The operations performed by the remover 66 when setting some of the refinement motion field coefficients to zero include, for instance, removing those elements that correspond to coefficients that can be removed from R, with z 1. The result is a modified matrix R and vector z. Various manners can be utilized to specify, or imply by default, the segment or the set of neighboring segments from which the prediction motion field is derived.</p> <p>31:11-25.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p> <p>Fig. 1.</p> <pre> graph LR subgraph Encoder [Encoder] Input[Video Input I_n(x,y)] --> Sum1((+)) RefMem[Frame Memory R_ref(x,y)] --> Sum1 Sum1 --> OutE[E_n(x,y)] OutE --> MFC[Motion Field Coding] MFC --> ME[Motion Estimation] ME --> MP[MC Prediction] MP --> Sum2((+)) RefMem --> Sum2 Sum2 --> OutP[P_n(x,y)] OutP --> PEM[Prediction Error Decoding] PEM --> Sum1 OutE --> Multiplexing[MULTIPLEXING] OutP --> Multiplexing Multiplexing --> Output[to decoder] end subgraph Decoder [Decoder] InputD[from encoder] --> Demultiplexing[DEMULTIPLEXING] Demultiplexing --> PEMD[Prediction Error Decoding] Demultiplexing --> OutT[T_n(x,y)] Demultiplexing --> OutPn[P_n(x,y)] OutT --> Sum3((+)) OutPn --> Sum3 RefMemD[Frame Memory R_ref(x,y)] --> Sum3 Sum3 --> MPD[MC Prediction] MPD --> MI[motion information] MI --> OutMI[output] end </pre> <p style="text-align: center;">FIG. 1</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>10[c] forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector; and</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 10[b].</i></p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some "refinement" information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost" of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>15:27-16:3.</p>

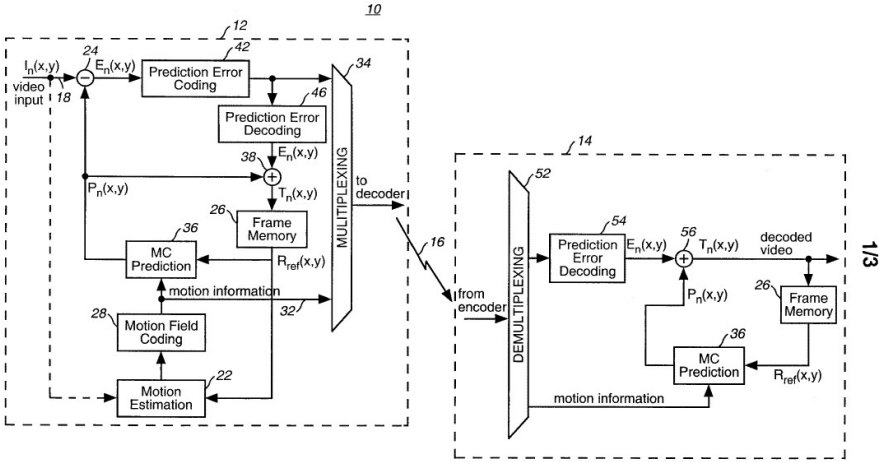
ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second segment can be predicted purely on the basis of motion coefficients already stored in the decoder.</p> <p>16:14-18.</p> <p>Thus, when considering a general segment in a frame to be coded, there are several possibilities for the prediction of motion coefficients. In a general case, the encoder can try to predict the motion coefficients for a given segment using the motion field model for the segment above it or to the left.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the “rate-distortion” considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>20:11-16.</p> <p>The motion estimator 22 is coupled to a motion field coder 28. The motion field coder 28 is operable to form a motion vector field which is a set of motion vectors of all pixels of the current</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>frame. The field generated by the motion field coder is provided by way of the line 32 to a multiplexor 34 thereafter to be communicated upon the communication path 16 to the video sequence receiver and the decoder 14 thereof.</p> <p>20:17-20.</p> <p>The encoder is further shown to include a motion compensated (MC) predictor 36. The predictor 36 is also coupled to the frame memory 26. The predictor 36 is operable to generate a prediction frame which is supplied to the subtractor 24 and also to a summer 38.</p> <p>21:6-21.</p> <p>The motion estimator 22 calculates motion vectors ($\Delta x(x, y)$, $\Delta y(x, y)$) of pixels between the frame being coded, referred to as the current frame $I_n(x, y)$, and the reference frame $R_{ref}(x, y)$. The reference frame is one of the previously coded and transmitted frames which at a given instant is available in the frame memory 26 of the encoder and also of the decoder.</p> <p>$\Delta x(x, y)$ and $\Delta y(x, y)$ are the values of the horizontal and vertical displacements, respectively. The set of motion vectors of all pixels in the current frame, referred to as a motion vector field, is compressed by the motion field coder 28 and thereafter, as noted above, sent to the decoder. To indicate that the compression of the motion vector field is typically lossy, the compressed motion vectors are denoted as $Ax(x, y), Ay(x, y)$. In the motion compensated predictor 36, the compressed motion vectors and the reference frame are used to construct a prediction frame, $P_n(x, y)$. The prediction frame is a coded version of the current frame $I_n(x, y)$ calculated using the motion vector field determined by the motion estimator 22 and the motion field coder 28 and the pixel values of the reference frame $R_{ref}(x, y)$.</p> <p>25:13-24.</p> <p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p>26:9-25.</p> <p>Figure 2 illustrates the motion field coder 28 in greater detail. The coder 28 is here shown to include a selector and builder of prediction motion fields 62, a motion analyzer 64, a motion coefficient remover 66, and a quantizer 68.</p> <p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on the motion vector field of the "winning" candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>The motion analyzer 64 is operable to find a new representation of a refinement motion vector field. That is to say, a mathematically efficient representation is made. The new representation is later used at the motion coefficient remover 66 for a quick and flexible determination of refinement motion coefficients.</p> <p>30:20-27.</p> <p>The output of the motion analyzer 64 forms the input to the motion coefficient remover 66. The operations performed by the remover 66 when setting some of the refinement motion field coefficients to zero include, for instance, removing those elements that correspond to coefficients that can be removed from R, with z 1. The result is a modified matrix R and vector z. Various manners can be utilized to specify, or imply by default, the segment or the set of neighboring segments from which the prediction motion field is derived.</p> <p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or</p>

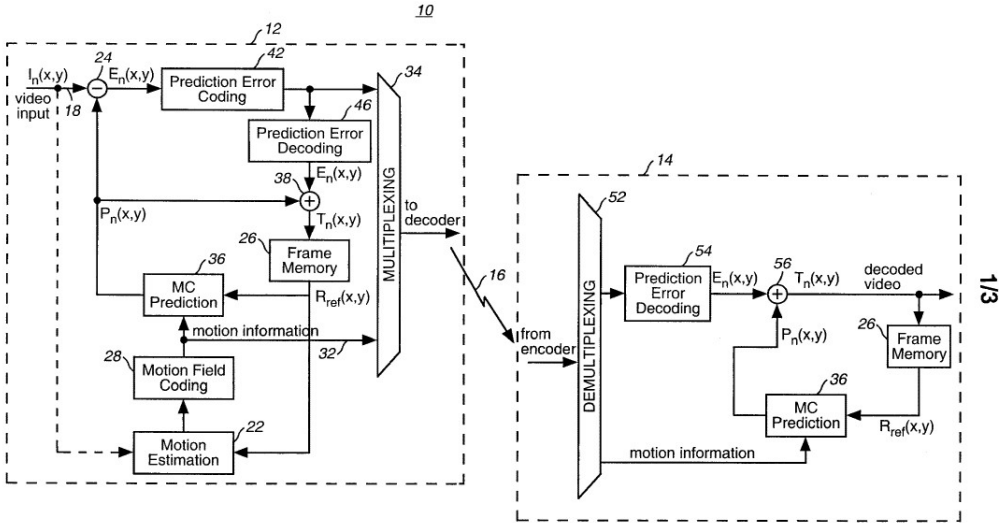
ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p> <p>33:18-34:6.</p> <p>Once the neighboring segment has been selected for the prediction of the current segment, the prediction motion vector field is simply the extrapolation of the motion vector field of the segment inside the pixel domain covered by the current segment as follows:</p> <p style="text-align: center;">EQUATION 20</p> $\Delta x_{prd}(x,y) = \beta_1^k + \beta_2^k \cdot (y - y_O^k) + \beta_3^k \cdot (x - x_O^k)$ $\Delta y_{prd}(x,y) = \beta_4^k + \beta_5^k \cdot (y - y_O^k) + \beta_6^k \cdot (x - x_O^k)$ <p>where x_O^k, y_O^k are coordinates of the upper left-most pixel in the neighboring segment S_k and $\beta_1^k, \dots, \beta_6^k$ are integer-valued coefficients corresponding to the motion field of segment S_k. In equation 20, the superscript k indicates that the coefficients are associated with the neighboring segment S_k.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>Analysis of equations 19 and 20 indicates that the motion vector field of the neighboring segment S_k has become the prediction motion vector field of the segment S_i by simply extrapolating it to the pixels inside the current segment S_i.</p> <p>20:17-20.</p> <p>The encoder is further shown to include a motion compensated (MC) predictor 36. The predictor 36 is also coupled to the frame memory 26. The predictor 36 is operable to generate a prediction frame which is supplied to the subtractor 24 and also to a summer 38.</p> <p>23:6-9.</p> <p>The motion compensated prediction frame $P_n(x, y)$, formed by the MC predictor 36 is constructed in such a way as to minimize the amount of reconstruction error, and at the same time, minimize the amount of information needed to represent the motion vector field.</p> <p>27:15-30.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients. In the exemplary implementation, the refinement motion vector fields are represented by their inverse quantized values. At the decoder 14 the prediction motion vector field is derived from one or several neighboring segments which have already been decoded. The refinement motion vector field coefficients are available at the decoder after the decoding and inverse quantization performed by the inverse quantizer 76. As illustrated, the MC predictor further includes a motion vector field builder, a segment predictor 80 and a prediction motion vector field builder 81.</p> <p>Fig. 1.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	 <p style="text-align: center;">FIG. 1</p>
<p>10[d] a multiplexer for providing in an encoded bitstream an indication of the skip coding mode, wherein no further motion vector information for the first segment is coded in the encoded bitstream.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious a multiplexer for providing in an encoded bitstream an indication of the skip coding mode, wherein no further motion vector information for the first segment is coded in the encoded bitstream.</p> <p><i>See, e.g.,</i></p> <p>17:8-18.</p> <p>The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>32:18-22.</p> <p>In the exemplary implementation, one bit is sent to the decoder 14 to signal whether the prediction field of a neighbor is used or not, but only in the case when there is at least one prediction neighbor candidate.</p> <p>32:23-33:3.</p> <p>Also in the exemplary implementation, prediction is performed only from a nearest neighboring block at the left or just above the current segment. Therefore, the number of neighboring segments can be at most four, i.e., two eight by eight pixel blocks above and two eight by eight pixel blocks at the left. In this implementation, whenever the bit sent to the decoder indicates that prediction from a neighboring segment is used, the number and location of prediction candidates is calculated, in both the encoder and decoder. If there are, e.g., two, three, or four prediction candidates, then one or two selection bits are sent to the decoder 14 to indicate the candidate to be used. The selection information is made, e.g., of one prediction direction bit which may, or may not, exist, followed by one discrimination bit, which also may, or may not, exist.</p> <p>37:5-13.</p> <p>In the exemplary implementation, the presence of motion coefficients in the bitstream is signaled by one bit whenever refinement or nonrefinement motion coefficients can be expected. This bit is referred to as a motion coefficient indicator (MCI).</p> <p>Also in the exemplary implementation, when motion coefficients are transmitted for a segment S_i, a variable-length code, referred to as a motion coefficient pattern (MCP) is first sent to indicate which coefficients have nonzero values. An all-zero pattern is the only non-valid</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>pattern, as this possibility can be signaled by the MCI bit alone.</p> <p>Claim 2</p> <p>2. A method according to claim 1 further including: encoding information about said chosen motion field model.</p> <p>Claim 3</p> <p>3. A method according to claim 2 further including: transmitting said coded information to a decoder for decoding.</p> <p>20:11-16.</p> <p>The motion estimator 22 is coupled to a motion field coder 28. The motion field coder 28 is operable to form a motion vector field which is a set of motion vectors of all pixels of the current frame. The field generated by the motion field coder is provided by way of the line 32 to a multiplexor 34 thereafter to be communicated upon the communication path 16 to the video sequence receiver and the decoder 14 thereof.</p> <p>Fig. 1.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p data-bbox="625 386 709 418">Fig. 1.</p>  <p data-bbox="1213 1003 1276 1027">FIG. 1</p>
<p data-bbox="205 1195 590 1414">15. An encoder according to claim 10, wherein if a segment in a region surrounding the first segment has zero motion vector, the encoder is arranged to assign the zero motion vector for the</p>	<p data-bbox="625 1195 1923 1349">Karczewicz, as evidenced by the example citations below, discloses or renders obvious that if a segment in a region surrounding the first segment has zero motion vector, the encoder is arranged to assign the zero motion vector for the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>	<p>See, e.g.,</p> <p>See claim 6.</p> <p>Fig. 1.</p> <p>The diagram illustrates a video encoding and decoding system. The encoder (10) processes video input $I_n(x,y)$ by subtracting a prediction $P_n(x,y)$ to produce a prediction error $E_n(x,y)$. This error is then coded (42) and decoded (46) to recover $E_n(x,y)$. The error is added back to the prediction to form the reconstructed frame $T_n(x,y)$, which is stored in Frame Memory (26). Motion Estimation (22) identifies a reference frame $R_{ref}(x,y)$ from the memory, and Motion Field Coding (28) generates motion information (32) for MC Prediction (36). The MC Prediction (36) uses this information to produce the prediction $P_n(x,y)$. The reconstructed frame $T_n(x,y)$ is multiplexed (34) with motion information (32) and transmitted to the decoder (14). The decoder (14) demultiplexes (52) the received signal to extract the reconstructed frame $T_n(x,y)$ and motion information. The motion information is used by MC Prediction (36) to generate $P_n(x,y)$. The prediction error $E_n(x,y)$ is decoded (54) and added to the prediction to produce the final decoded video.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>16[preamble] A video decoder for decoding an encoded video sequence, the decoder comprising:</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious a video decoder for decoding an encoded video sequence.</p> <p><i>See, e.g.,</i></p> <p>Abstract.</p> <p>Apparatus, and an associated method, motion compensates coding of video sequences. Motion compensated prediction is utilized in the representation of motion vector fields. Reduced numbers of bits are required to represent the motion vector field while maintaining a low prediction error, thereby facilitating improved communication of, and recreation of, video frames forming a video sequence.</p> <p>1:6-13.</p> <p>More particularly, the present invention relates to apparatus, and an associated method, for encoding, and decoding, a video sequence utilizing motion compensated prediction. Motion fields of a segment are predicted from adjacent segments of a video frame and by using orthogonal affine motion vector field models. Through operation of an embodiment of the present invention, motion vector fields are formed with a reduced number of bits while still maintaining a low prediction error.</p> <p>13:11-16.</p> <p>The new manner of motion predictive video coding of an embodiment of the present invention report further reduces the amount of data to be transferred from encoder to decoder in a low bit-rate video coding system, while maintaining good image quality. The manner includes a new way of further predicting the pixel values of segments in the current frame using already coded segments of that same frame.</p> <p>Fig. 1.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>The diagram illustrates a video coding system 10 and its corresponding decoder 14. The encoder 10 processes a video input 18 by subtracting a prediction $P_n(x,y)$ at block 24 to generate a prediction error $E_n(x,y)$. This error is then coded at block 42. Simultaneously, motion estimation 22 and motion field coding 28 are performed to produce motion information 32, which is used by the MC Prediction block 36 to generate the prediction $P_n(x,y)$. The coded error $E_n(x,y)$ is decoded at block 46 to produce $E_n(x,y)$ at block 38, which is then added to $P_n(x,y)$ at block 38 to produce the reconstructed frame $T_n(x,y)$. This frame is multiplexed at block 34 with the motion information 32 and sent to the decoder 14 via a channel 16. The decoder 14 demultiplexes at block 52 to retrieve $T_n(x,y)$ at block 56 and the motion information. The motion information is used by the MC Prediction block 36 to produce $P_n(x,y)$. The reconstructed frame $T_n(x,y)$ is then decoded at block 54 to produce the final decoded video. A Frame Memory 26 stores the reference frame $R_{ref}(x,y)$ and provides it to the MC Prediction block 36 and the motion estimation block 22.</p>
<p>16[a] a demultiplexer for receiving an indication of a skip coding mode assigned to a first segment;</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious a demultiplexer for receiving an indication of a skip coding mode assigned to a first segment.</p> <p><i>See, e.g.,</i></p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>14:27-30.</p> <p>The second segment has one previously coded neighboring segment (i.e. the first segment). The encoder now considers whether it is “more efficient” to model the second segment in terms of the affine motion model previously determined for the first segment, rather than according to the newly determined affine motion coefficients for the second segment itself. The rationale is as follows: Since the motion coefficients for the first segment have already been determined and transmitted to the decoder, it may be possible to reduce the amount of information that must be transmitted to the decoder while encoding the second segment. Hence an improvement in coding efficiency may be obtained.</p> <p>15:7-15.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image.</p> <p>15:27-16:3.</p> <p>However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second segment can be predicted purely on the basis of motion coefficients already stored in the decoder.</p> <p>17:8-18.</p> <p>The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p data-bbox="678 386 1915 574">motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p data-bbox="625 591 772 623">17:23-18:2.</p> <p data-bbox="678 639 1915 893">Whenever a segment is coded using a prediction field, whether there is an associated refinement field or not, it is necessary to provide information about the neighboring segment(s) used in the prediction. It is not necessary to transmit any motion coefficient data because the motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in) the decoder. Extra information may also be required if, for example, prediction is based on more than one neighboring segment, or neighboring segments have been divided into sub-segments and the motion field model of one or more of the sub-segments is used to form the prediction field.</p> <p data-bbox="625 909 772 941">18:29-19:9.</p> <p data-bbox="678 958 1915 1243">As stated above, when the method according to the invention is applied in practice, it is often found that very little refinement information is required and the motion model of a general segment can be predicted with quite high precision from the motion field models of its neighbors. The invention includes a further feature, whereby individual coefficients of the refinement field or the entire refinement field may be set to zero, if that is efficient in a “rate-distortion sense.” In other words, the refinement field may be set to zero if the image distortion introduced in doing that is acceptable when considering the reduction in the amount of data to be transmitted. This additional feature further reduces the amount of data that must be transmitted from encoder to decoder.</p> <p data-bbox="625 1260 751 1292">32:18-22.</p>

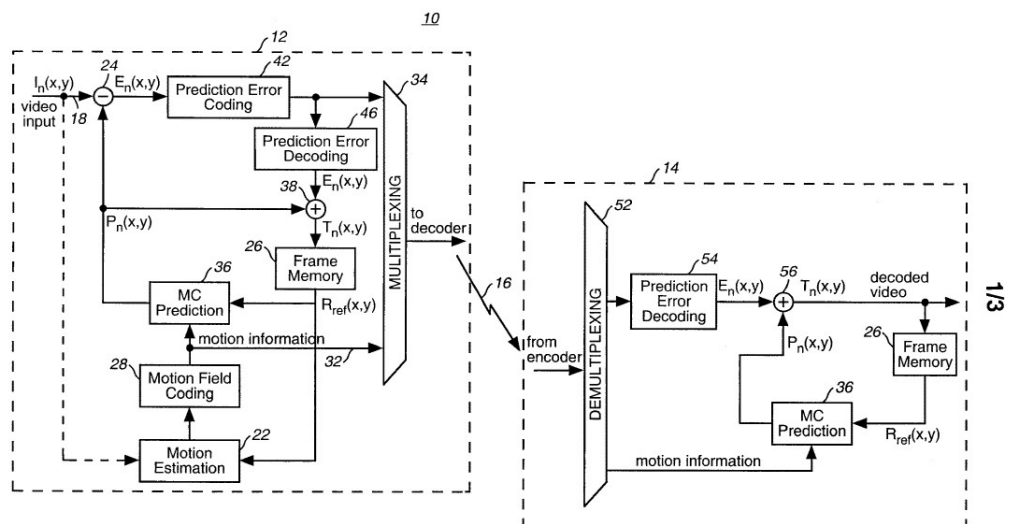
ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>In the exemplary implementation, one bit is sent to the decoder 14 to signal whether the prediction field of a neighbor is used or not, but only in the case when there is at least one prediction neighbor candidate.</p> <p>32:23-33:3.</p> <p>Also in the exemplary implementation, prediction is performed only from a nearest neighboring block at the left or just above the current segment. Therefore, the number of neighboring segments can be at most four, i.e., two eight by eight pixel blocks above and two eight by eight pixel blocks at the left. In this implementation, whenever the bit sent to the decoder indicates that prediction from a neighboring segment is used, the number and location of prediction candidates is calculated, in both the encoder and decoder. If there are, e.g., two, three, or four prediction candidates, then one or two selection bits are sent to the decoder 14 to indicate the candidate to be used. The selection information is made, e.g., of one prediction direction bit which may, or may not, exist, followed by one discrimination bit, which also may, or may not, exist.</p> <p>37:5-13.</p> <p>In the exemplary implementation, the presence of motion coefficients in the bitstream is signaled by one bit whenever refinement or nonrefinement motion coefficients can be expected. This bit is referred to as a motion coefficient indicator (MCI).</p> <p>Also in the exemplary implementation, when motion coefficients are transmitted for a segment S_i, a variable-length code, referred to as a motion coefficient pattern (MCP) is first sent to indicate which coefficients have nonzero values. An all-zero pattern is the only non-valid pattern, as this possibility can be signaled by the MCI bit alone.</p> <p>Claim 2</p> <p>2. A method according to claim 1 further including: encoding information about said chosen motion field model.</p> <p>Claim 3</p> <p>3. A method according to claim 2 further including: transmitting said coded information to a decoder for decoding.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>21:1-5.</p> <p>The decoder 14 is here shown to include a demultiplexer 52, a prediction error decoder 54, a motion compensated predictor 36, a summer 56, and a frame memory 26. The predictor 36 of the encoder and of the decoder are commonly numbered as are the frame memories 26 of the respective devices.</p> <p>Fig. 1.</p> <p>FIG. 1</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>16[b] a motion compensated prediction block for assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment; and</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious a motion compensated prediction block for assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment.</p> <p><i>See, e.g.,</i></p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some "refinement" information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost" of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the "rate-distortion" considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>25:13-24.</p> <p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p>26:13-20.</p> <p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on the motion vector field of the “winning” candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>27:15-22.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p> <p>30:20-27.</p> <p>The output of the motion analyzer 64 forms the input to the motion coefficient remover 66. The operations performed by the remover 66 when setting some of the refinement motion field coefficients to zero include, for instance, removing those elements that correspond to coefficients that can be removed from R, with z 1. The result is a modified matrix R and vector z. Various manners can be utilized to specify, or imply by default, the segment or the set of neighboring segments from which the prediction motion field is derived.</p> <p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p> <p>Fig. 1.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	 <p style="text-align: center;">FIG. 1</p>
<p>16[c] forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector.</p> <p><i>See, e.g.,</i></p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
the predicted non-zero motion vector.	<p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some "refinement" information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost" of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>15:27-16:3.</p> <p>However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second segment can be predicted purely on the basis of motion coefficients already stored in the decoder.</p> <p>16:14-18.</p> <p>Thus, when considering a general segment in a frame to be coded, there are several possibilities for the prediction of motion coefficients. In a general case, the encoder can try to predict the</p>

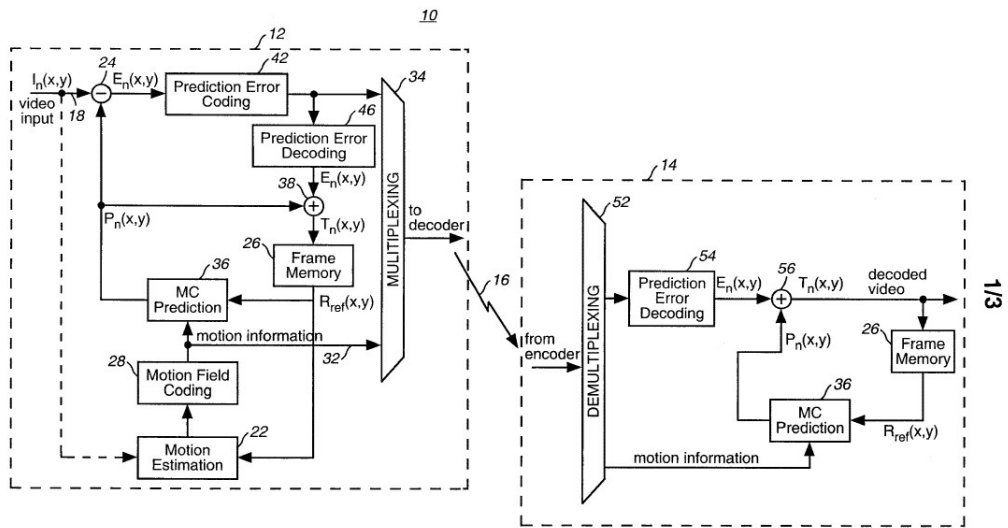
ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p data-bbox="678 386 1913 448">motion coefficients for a given segment using the motion field model for the segment above it or to the left.</p> <p data-bbox="627 464 735 493">17:1-18.</p> <p data-bbox="678 513 1923 958">As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the “rate-distortion” considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p data-bbox="627 974 735 1003">21:6-21.</p> <p data-bbox="678 1023 1885 1149">The motion estimator 22 calculates motion vectors ($\Delta x(x, y)$, $\Delta y(x, y)$) of pixels between the frame being coded, referred to as the current frame $I_n(x, y)$, and the reference frame $R_{ref}(x, y)$. The reference frame is one of the previously coded and transmitted frames which at a given instant is available in the frame memory 26 of the encoder and also of the decoder.</p> <p data-bbox="678 1166 1923 1386">$\Delta x(x, y)$ and $\Delta y(x, y)$ are the values of the horizontal and vertical displacements, respectively. The set of motion vectors of all pixels in the current frame, referred to as a motion vector field, is compressed by the motion field coder 28 and thereafter, as noted above, sent to the decoder. To indicate that the compression of the motion vector field is typically lossy, the compressed motion vectors are denoted as $Ax(x, y), Ay(x, y)J$. In the motion compensated predictor 36, the compressed motion vectors and the reference frame are used to construct a prediction frame, $P_n(x, y)$. The prediction frame is a coded version of the current frame $I_n(x, y)$ calculated using the</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p data-bbox="678 386 1913 451">motion vector field determined by the motion estimator 22 and the motion field coder 28 and the pixel values of the reference frame $R_{ref}(x, y)$.</p> <p data-bbox="625 467 747 496">25:13-24.</p> <p data-bbox="678 513 1923 829">The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p data-bbox="625 846 747 875">26:13-20.</p> <p data-bbox="678 891 1902 1086">The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on the motion vector field of the "winning" candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p data-bbox="625 1102 747 1131">27:15-22.</p> <p data-bbox="678 1148 1913 1367">Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{xprd}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p> <p>33:18-34:6.</p> <p>Once the neighboring segment has been selected for the prediction of the current segment, the prediction motion vector field is simply the extrapolation of the motion vector field of the segment inside the pixel domain covered by the current segment as follows:</p> <p style="text-align: center;">EQUATION 20</p> $\Delta x_{prd}(x,y) = \beta_1^k + \beta_2^k \cdot (y - y_o^k) + \beta_3^k \cdot (x - x_o^k)$ $\Delta y_{prd}(x,y) = \beta_4^k + \beta_5^k \cdot (y - y_o^k) + \beta_6^k \cdot (x - x_o^k)$ <p>where x_o^k, y_o^k are coordinates of the upper left-most pixel in the neighboring segment S_k and $\beta_1^k, \dots, \beta_6^k$ are integer-valued coefficients corresponding to the motion field of segment S_k. In</p>

ASSERTED CLAIMS	<p style="text-align: center;">PRIOR ART REFERENCE:</p> <p style="text-align: center;">Karczewicz</p>
	<p>equation 20, the superscript k indicates that the coefficients are associated with the neighboring segment S_k.</p> <p>Analysis of equations 19 and 20 indicates that the motion vector field of the neighboring segment S_k has become the prediction motion vector field of the segment S_i by simply extrapolating it to the pixels inside the current segment S_i.</p> <p>Fig. 1.</p> <p style="text-align: center;">FIG. 1</p>
<p>20. A decoder according to claim 16, wherein if a</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that if a segment in a region surrounding the first segment has zero motion vector, the zero motion vector is</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>segment in a region surrounding the first segment has zero motion vector, the zero motion vector is assigned for the skip coding mode of the first segment, and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>	<p>assigned for the skip coding mode of the first segment, and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 6.</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p> <p>Fig. 1.</p>

ASSERTED CLAIMS	<p style="text-align: center;">PRIOR ART REFERENCE: Karczewicz</p>
	<p>For instance, communication systems have been proposed for the communication of digital video data capable of forming video frames. Video images utilized during video conferencing are exemplary of applications which can advantageously make use of digital video sequences.</p> <p>20:4-5.</p> <p>In videotelephony applications this has the advantage that end-to-end delay is kept to a minimum.</p> <p>Fig. 1.</p>  <p style="text-align: center;">FIG. 1</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>22. A multimedia terminal comprising a decoder according to claim 16.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious a multimedia terminal comprising a decoder according to claim 16.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 21.</i></p>
<p>23[preamble] A method according to claim 1, wherein if the second segment has a non-zero motion vector,</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that the second segment has a non-zero motion vector.</p> <p><i>See, e.g.,</i></p> <p>32:20-22.</p> <p>A neighboring segment S(k) is a candidate for prediction of motion vector field of a segment S(i) only if it has a nonzero motion vector field.</p>
<p>23[a] the method further comprising deriving the predicted non-zero motion vector based at least in part on</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.</p> <p><i>See, e.g.,</i></p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
the motion vector of the second segment; and	<p>14:27-15:6.</p> <p>The second segment has one previously coded neighboring segment (i.e. the first segment). The encoder now considers whether it is “more efficient” to model the second segment in terms of the affine motion model previously determined for the first segment, rather than according to the newly determined affine motion coefficients for the second segment itself. The rationale is as follows: Since the motion coefficients for the first segment have already been determined and transmitted to the decoder, it may be possible to reduce the amount of information that must be transmitted to the decoder while encoding the second segment. Hence an improvement in coding efficiency may be obtained.</p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some “refinement” information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost" of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>15:27-16:3.</p> <p>However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second segment can be predicted purely on the basis of motion coefficients already stored in the decoder.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the “rate-distortion” considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>17:23-18:2.</p> <p>Whenever a segment is coded using a prediction field, whether there is an associated refinement field or not, it is necessary to provide information about the neighboring segment(s) used in the prediction. It is not necessary to transmit any motion coefficient data because the motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in) the decoder. Extra information may also be required if, for example, prediction is based on more than one neighboring segment, or neighboring segments have been divided into sub-segments and the motion field model of one or more of the sub-segments is used to form the prediction field.</p> <p>18:29-19:9.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>As stated above, when the method according to the invention is applied in practice, it is often found that very little refinement information is required and the motion model of a general segment can be predicted with quite high precision from the motion field models of its neighbors. The invention includes a further feature, whereby individual coefficients of the refinement field or the entire refinement field may be set to zero, if that is efficient in a “rate-distortion sense.” In other words, the refinement field may be set to zero if the image distortion introduced in doing that is acceptable when considering the reduction in the amount of data to be transmitted. This additional feature further reduces the amount of data that must be transmitted from encoder to decoder.</p> <p>20:22-26.</p> <p>Difference values formed by the subtractor 24 are provided to a prediction error coder 42. The prediction error coder determines the differences in pixel value between the current input video frame and the MC predicted version of the frame in order to produce an indication of the prediction error.</p> <p>25:13-24.</p> <p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p>26:13-20.</p> <p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>the motion vector field of the “winning” candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>30:20-27.</p> <p>The output of the motion analyzer 64 forms the input to the motion coefficient remover 66. The operations performed by the remover 66 when setting some of the refinement motion field coefficients to zero include, for instance, removing those elements that correspond to coefficients that can be removed from R, with z 1. The result is a modified matrix R and vector z. Various manners can be utilized to specify, or imply by default, the segment or the set of neighboring segments from which the prediction motion field is derived.</p> <p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p> <p>Claims 61, 64-65:</p> <p>61. In a method of encoding a video sequence, said video sequence being formed of at least a current video frame and a reference video frame, the current video frame comprising at least a first neighboring segment and a second neighboring segment, an improvement of a method for motion compensated prediction of the current video frame comprising:</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>defining a set of coding modes for said second neighboring segment;</p> <p>calculating a set of cost functions, each one of said cost functions being associated with one of said set of coding modes;</p> <p>choosing that one of said set of cost functions with a smallest absolute value;</p> <p>defining that one of said set of coding modes associated with said smallest absolute value as a chosen coding mode for said second neighboring segment;</p> <p>encoding information about said second neighboring segment according to said chosen coding mode.</p> <p>64. A method according to claim 61 wherein said set of coding modes comprises:</p> <p>A first coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a prediction motion field model and said second neighboring segment is represented by said prediction motion field model;</p> <p>a second coding mode wherein said second neighboring segment is represented by a motion field model derived from said reference frame;</p> <p>a third coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a projection field model and said second neighboring segment is represented by said prediction motion field model and a refinement motion field model.</p> <p>65. A method according to claim 64 wherein said set of coding modes further comprises:</p> <p>A fourth coding mode wherein said second neighboring segment is encoded using pixel values from said reference frame;</p> <p>a fifth coding mode wherein said second neighboring segment is encoded using pixel values from said current frame.</p> <p>33:18-34:2.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>Once the neighboring segment has been selected for the prediction of the current segment, the prediction motion vector field is simply the extrapolation of the motion vector field of the segment inside the pixel domain covered by the current segment as follows:</p> <p style="text-align: center;">EQUATION 20</p> $\Delta x_{prd}(x,y) = \beta_1^k + \beta_2^k \cdot (y - y_o^k) + \beta_3^k \cdot (x - x_o^k)$ $\Delta y_{prd}(x,y) = \beta_4^k + \beta_5^k \cdot (y - y_o^k) + \beta_6^k \cdot (x - x_o^k)$ <p>where x_o^k, y_o^k are coordinates of the upper left-most pixel in the neighboring segment $S(k)$ and $\beta_1^k, \dots, \beta_6^k$ are integer-valued coefficients corresponding to the motion field of segment $S(k)$. In equation 20, the superscript k indicates that the coefficients are associated with the neighboring segment $S(k)$.</p>
<p>23[b] the predicted non-zero motion vector is assigned for the skip coding mode of the first segment; and</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious the predicted non-zero motion vector is assigned for the skip coding mode of the first segment.</p> <p><i>See, e.g.,</i></p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some "refinement" information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost" of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the "rate-distortion" considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>25:13-24.</p>

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	<p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p>26:13-20.</p> <p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on the motion vector field of the “winning” candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>30:20-27.</p> <p>The output of the motion analyzer 64 forms the input to the motion coefficient remover 66. The operations performed by the remover 66 when setting some of the refinement motion field coefficients to zero include, for instance, removing those elements that correspond to coefficients that can be removed from R, with z 1. The result is a modified matrix R and vector z. Various manners can be utilized to specify, or imply by default, the segment or the set of neighboring segments from which the prediction motion field is derived.</p> <p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using</p>

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	<p>only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p>
<p>23[c] the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector.</p> <p><i>See, e.g.,</i></p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's</p>

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	<p>motion vector field is determined from a projection of the motion model of the first segment plus some “refinement” information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost" of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>15:27-16:3.</p> <p>However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second segment can be predicted purely on the basis of motion coefficients already stored in the decoder.</p> <p>16:14-18.</p> <p>Thus, when considering a general segment in a frame to be coded, there are several possibilities for the prediction of motion coefficients. In a general case, the encoder can try to predict the motion coefficients for a given segment using the motion field model for the segment above it or to the left.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the “rate-distortion” considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the</p>

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	<p>encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>21:6-21.</p> <p>The motion estimator 22 calculates motion vectors ($\Delta x(x, y)$, $\Delta y(x, y)$) of pixels between the frame being coded, referred to as the current frame $I_n(x, y)$, and the reference frame $R_{ref}(x, y)$. The reference frame is one of the previously coded and transmitted frames which at a given instant is available in the frame memory 26 of the encoder and also of the decoder.</p> <p>$\Delta x(x, y)$ and $\Delta y(x, y)$ are the values of the horizontal and vertical displacements, respectively. The set of motion vectors of all pixels in the current frame, referred to as a motion vector field, is compressed by the motion field coder 28 and thereafter, as noted above, sent to the decoder. To indicate that the compression of the motion vector field is typically lossy, the compressed motion vectors are denoted as $Ax(x, y), Ay(x, y)J$. In the motion compensated predictor 36, the compressed motion vectors and the reference frame are used to construct a prediction frame, $P_n(x, y)$. The prediction frame is a coded version of the current frame $I_n(x, y)$ calculated using the motion vector field determined by the motion estimator 22 and the motion field coder 28 and the pixel values of the reference frame $R_{ref}(x, y)$.</p> <p>25:13-24.</p> <p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p>

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	<p>26:13-20.</p> <p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on the motion vector field of the "winning" candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p> <p>33:18-34:6.</p> <p>Once the neighboring segment has been selected for the prediction of the current segment, the prediction motion vector field is simply the extrapolation of the motion vector field of the segment inside the pixel domain covered by the current segment as follows:</p>

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	<p style="text-align: center;">EQUATION 20</p> $\Delta x_{prd}(x,y) = \beta_1^k + \beta_2^k \cdot (y - y_O^k) + \beta_3^k \cdot (x - x_O^k)$ $\Delta y_{prd}(x,y) = \beta_4^k + \beta_5^k \cdot (y - y_O^k) + \beta_6^k \cdot (x - x_O^k)$ <p>where x_O^k, y_O^k are coordinates of the upper left-most pixel in the neighboring segment S_k and $\beta_1^k, \dots, \beta_6^k$ are integer-valued coefficients corresponding to the motion field of segment S_k. In equation 20, the superscript k indicates that the coefficients are associated with the neighboring segment S_k.</p> <p>Analysis of equations 19 and 20 indicates that the motion vector field of the neighboring segment S_k has become the prediction motion vector field of the segment S_i by simply extrapolating it to the pixels inside the current segment S_i.</p>
<p>24. A method according to claim 1, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p> <p><i>See, e.g.,</i></p> <p>17:23-18:2.</p>

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<p>with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>	<p>Whenever a segment is coded using a prediction field, whether there is an associated refinement field or not, it is necessary to provide information about the neighboring segment(s) used in the prediction. It is not necessary to transmit any motion coefficient data because the motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in) the decoder. Extra information may also be required if, for example, prediction is based on more than one neighboring segment, or neighboring segments have been divided into sub-segments and the motion field model of one or more of the sub-segments is used to form the prediction field.</p> <p>31:14-25.</p> <p>Therefore, with respect to motion vector fields, a given segment S_i can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p>
<p>25. A method according to claim 1, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>

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<p>preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>	<p><i>See, e.g.,</i></p> <p>5:28-6:2.</p> <p>Thus it is possible to take advantage of this high degree of correlation between consecutive frames when trying to reduce the amount of information when transmitting a video sequence. In other words, one frame can be predicted from a previous, so-called reference frame, which is usually, but not necessarily, the frame immediately preceding that currently being coded.</p> <p>17:23-18:2.</p> <p>Whenever a segment is coded using a prediction field, whether there is an associated refinement field or not, it is necessary to provide information about the neighboring segment(s) used in the prediction. It is not necessary to transmit any motion coefficient data because the motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in) the decoder. Extra information may also be required if, for example, prediction is based on more than one neighboring segment, or neighboring segments have been divided into sub-segments and the motion field model of one or more of the sub-segments is used to form the prediction field.</p> <p>31:14-25.</p> <p>Therefore, with respect to motion vector fields, a given segment S_i can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p>

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<p>28. A method according to claim 1, further comprising: deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.</p> <p><i>See, e.g.,</i></p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some “refinement” information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost" of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the “rate-distortion” considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A</p>

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	<p>given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>25:13-24.</p> <p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p>26:13-20.</p> <p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on the motion vector field of the “winning” candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>30:20-27.</p> <p>The output of the motion analyzer 64 forms the input to the motion coefficient remover 66. The operations performed by the remover 66 when setting some of the refinement motion field</p>

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	<p>coefficients to zero include, for instance, removing those elements that correspond to coefficients that can be removed from R, with $z \neq 1$. The result is a modified matrix R and vector z. Various manners can be utilized to specify, or imply by default, the segment or the set of neighboring segments from which the prediction motion field is derived.</p> <p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p>
<p>29. A method according to claim 1, further comprising: deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.</p> <p><i>See, e.g.,</i></p>

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segment neighboring the first segment.	<p>16:14-19.</p> <p>Thus, when considering a general segment in a frame to be coded, there are several possibilities for the prediction of motion coefficients. In a general case, the encoder can try to predict the motion coefficients for a given segment using the motion field model for the segment above it or to the left. Alternatively, it can form some kind of average, using the motion field model for both neighbors.</p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some "refinement" information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost" of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the "rate-distortion" considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A</p>

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	<p>given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>25:13-24.</p> <p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p>26:13-20.</p> <p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on the motion vector field of the “winning” candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>30:20-27.</p> <p>The output of the motion analyzer 64 forms the input to the motion coefficient remover 66. The operations performed by the remover 66 when setting some of the refinement motion field</p>

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	<p>coefficients to zero include, for instance, removing those elements that correspond to coefficients that can be removed from R, with $z \neq 1$. The result is a modified matrix R and vector z. Various manners can be utilized to specify, or imply by default, the segment or the set of neighboring segments from which the prediction motion field is derived.</p> <p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p>
<p>30. A method according to claim 1, wherein no residual information is provided for the first segment in the encoded bitstream.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that no residual information is provided for the first segment in the encoded bitstream.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 1[a].</i></p> <p><i>See claim 1[b].</i></p>

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	<p>14:27-15:6.</p> <p>The second segment has one previously coded neighboring segment (i.e. the first segment). The encoder now considers whether it is “more efficient” to model the second segment in terms of the affine motion model previously determined for the first segment, rather than according to the newly determined affine motion coefficients for the second segment itself. The rationale is as follows: Since the motion coefficients for the first segment have already been determined and transmitted to the decoder, it may be possible to reduce the amount of information that must be transmitted to the decoder while encoding the second segment. Hence an improvement in coding efficiency may be obtained.</p> <p>15:7-25.</p> <p>However, it is unlikely that the motion coefficients for the first segment are exactly identical to those that most accurately model the motion vector field of the second segment. Therefore, the motion coefficients calculated for the first segment are not simply used as such, but a projection is performed in order to map the motion field of the first segment into the second segment. Even after this projection has been performed, it is still likely that some information about the difference between the motion fields of the first and second segments must also be sent to the decoder, in order to avoid unacceptable distortion in the reconstructed image. Thus, the encoder performs a comparison between the amount of data of required a) to transmit motion coefficient data determined specifically for the second segment and b) that required if the second segment's motion vector field is determined from a projection of the motion model of the first segment plus some “refinement” information. When making its choice of what information to transmit, the encoder must also take into account distortions that may introduced into the image by the prediction process. This comparison between options can be thought of as determining the "cost" of choosing a particular option, a tradeoff between the amount of information to be transmitted and the amount of distortion allowed.</p> <p>15:27-16:3.</p> <p>However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result</p>

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	<p>in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second segment can be predicted purely on the basis of motion coefficients already stored in the decoder.</p> <p>17:1-18.</p> <p>As will be appreciated from the description above, there are several different ways in which a given segment can be coded. The choice of which option to use is made in the encoder on the basis of the “rate-distortion” considerations previously described. Consequently, several different types of data must be transmitted to the decoder, depending on the chosen coding option, and that information must be transmitted to the decoder in an unambiguous way, so that the segment can be correctly reconstructed and displayed. The various coding options are as follows. 1.) A given segment can be represented as a sum of a prediction field and a refinement field. 2.) The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero. 3.) The segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.</p> <p>17:23-18:2.</p> <p>Whenever a segment is coded using a prediction field, whether there is an associated refinement field or not, it is necessary to provide information about the neighboring segment(s) used in the prediction. It is not necessary to transmit any motion coefficient data because the motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in) the decoder. Extra information may also be required if, for example, prediction is based on more than one neighboring segment, or neighboring segments have been divided into sub-segments and the motion field model of one or more of the sub-segments is used to form the prediction field.</p> <p>18:29-19:9.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>As stated above, when the method according to the invention is applied in practice, it is often found that very little refinement information is required and the motion model of a general segment can be predicted with quite high precision from the motion field models of its neighbors. The invention includes a further feature, whereby individual coefficients of the refinement field or the entire refinement field may be set to zero, if that is efficient in a “rate-distortion sense.” In other words, the refinement field may be set to zero if the image distortion introduced in doing that is acceptable when considering the reduction in the amount of data to be transmitted. This additional feature further reduces the amount of data that must be transmitted from encoder to decoder.</p> <p>20:22-26.</p> <p>Difference values formed by the subtractor 24 are provided to a prediction error coder 42. The prediction error coder determines the differences in pixel value between the current input video frame and the MC predicted version of the frame in order to produce an indication of the prediction error.</p> <p>25:13-24.</p> <p>The prediction motion vector field is obtained from the motion vector field of one or more neighboring segments in one of several ways. For instance, in one implementation, the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent, segment inside the area covered by the current segment. As the current segment can have several neighboring segments, usually signaling information is provided to the decoder in order to specify which segment shall be used. In another implementation, the prediction motion vector field is obtained from a combination of affine motion vector fields of several neighboring segments using some particular method which is known both to the encoder and to the decoder. Such method is, for example, averaging or determining the median, of horizontal and vertical motion vector field components.</p> <p>26:13-20.</p> <p>The selector and builder 62 is operable, for a given segment, to determine a previously-encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a given, e.g., current segment. Based on</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>the motion vector field of the “winning” candidate, or candidates, the prediction motion field is computed as described above. Usually, signaling information is transmitted to the decoder to specify the most suitable amongst the several candidate segments.</p> <p>30:20-27.</p> <p>The output of the motion analyzer 64 forms the input to the motion coefficient remover 66. The operations performed by the remover 66 when setting some of the refinement motion field coefficients to zero include, for instance, removing those elements that correspond to coefficients that can be removed from R, with z 1. The result is a modified matrix R and vector z. Various manners can be utilized to specify, or imply by default, the segment or the set of neighboring segments from which the prediction motion field is derived.</p> <p>31:11-25.</p> <p>The way in which the prediction, the refinement, and the final motion prediction fields are obtained is described below. In the exemplary implementation, either of the motion prediction or motion refinement fields can be zero. Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.</p> <p>Claims 61, 64-65:</p> <p>61. In a method of encoding a video sequence, said video sequence being formed of at least a current video frame and a reference video frame, the current video frame comprising at least a first neighboring segment and a second neighboring segment, an improvement of a method for motion compensated prediction of the current video frame comprising:</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>defining a set of coding modes for said second neighboring segment;</p> <p>calculating a set of cost functions, each one of said cost functions being associated with one of said set of coding modes;</p> <p>choosing that one of said set of cost functions with a smallest absolute value;</p> <p>defining that one of said set of coding modes associated with said smallest absolute value as a chosen coding mode for said second neighboring segment;</p> <p>encoding information about said second neighboring segment according to said chosen coding mode.</p> <p>64. A method according to claim 61 wherein said set of coding modes comprises:</p> <p>A first coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a prediction motion field model and said second neighboring segment is represented by said prediction motion field model;</p> <p>a second coding mode wherein said second neighboring segment is represented by a motion field model derived from said reference frame;</p> <p>a third coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a projection field model and said second neighboring segment is represented by said prediction motion field model and a refinement motion field model.</p> <p>65. A method according to claim 64 wherein said set of coding modes further comprises:</p> <p>A fourth coding mode wherein said second neighboring segment is encoded using pixel values from said reference frame;</p> <p>a fifth coding mode wherein said second neighboring segment is encoded using pixel values from said current frame.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>32. A method according to claim 7, wherein if the second segment has a zero motion vector, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that if the second segment has a zero motion vector, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 6.</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p>
<p>34[preamble] A method according to claim 7, wherein if the second segment has a non-zero motion vector,</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious the second segment has a non-zero motion vector.</p> <p><i>See, e.g.,</i></p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p><i>See claim 23[preamble].</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($Ax_{prd}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p>
<p>34[a] the method further comprising deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment; and</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 23[a].</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($Ax_{prd}(x,y)$, $y_{prd}(x,y)$) and the refinement</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	motion vector field coefficients.
34[b] the predicted non-zero motion vector is assigned for the skip coding mode of the first segment; and	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious the predicted non-zero motion vector is assigned for the skip coding mode of the first segment.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 23[b].</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p>
34[c] the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector.</p> <p><i>See, e.g.,</i></p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>in part on the predicted non-zero motion vector.</p>	<p><i>See claim 23[c].</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p>
<p>36. A method according to claim 7, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 24.</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
reference frame associated with the zero motion vector.	encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.
39. A method according to claim 7, further comprising: deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 28.</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p>

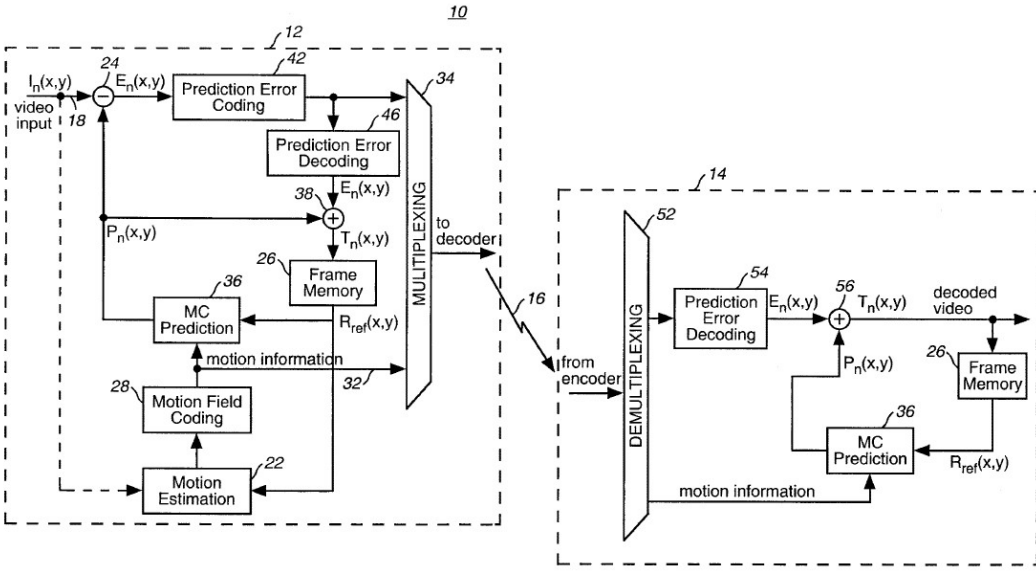
ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>40. A method according to claim 7, further comprising: deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 29.</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p>
<p>41. A method according to claim 7, wherein no residual information is provided for the first segment in the encoded bitstream.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that no residual information is provided for the first segment in the encoded bitstream.</p> <p><i>See, e.g.,</i></p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p><i>See claim 30.</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p>
<p>43. A method according to claim 7, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 25.</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
frame associated with the zero motion vector.	the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.
44[preamble] An encoder according to claim 10, wherein if the second segment has a non-zero motion vector,	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that the second segment has a non-zero motion vector.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 23[preamble].</i></p> <p>Fig. 1.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>The diagram illustrates a video coding system 10 and its corresponding decoder 14. The encoder 10 (enclosed in a dashed box) processes a video input $I_n(x,y)$ at block 18. This input is subtracted from a prediction $P_n(x,y)$ at block 24 to produce a prediction error $E_n(x,y)$ at block 26. The error $E_n(x,y)$ is then processed by a Prediction Error Coding block 42. The output of block 42 is multiplexed at block 34 with motion information derived from an MC Prediction block 36 and a Motion Field Coding block 28. The multiplexed signal is then sent to the decoder 14 (also in a dashed box). The decoder 14 demultiplexes the signal at block 52 to recover the prediction error $E_n(x,y)$ at block 54 and the motion information. The error $E_n(x,y)$ is then processed by a Prediction Error Decoding block 56. The output of block 56 is added to the prediction $P_n(x,y)$ at block 58 to produce the decoded video $T_n(x,y)$. The system also includes a Frame Memory block 26 that provides $R_{ref}(x,y)$ to the MC Prediction block 36 and the Motion Field Coding block 28. The Motion Field Coding block 28 also provides motion information to the MC Prediction block 36.</p>
<p>44[a] the motion estimation block is further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment; and</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious the motion estimation block is further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 10[b].</i></p>

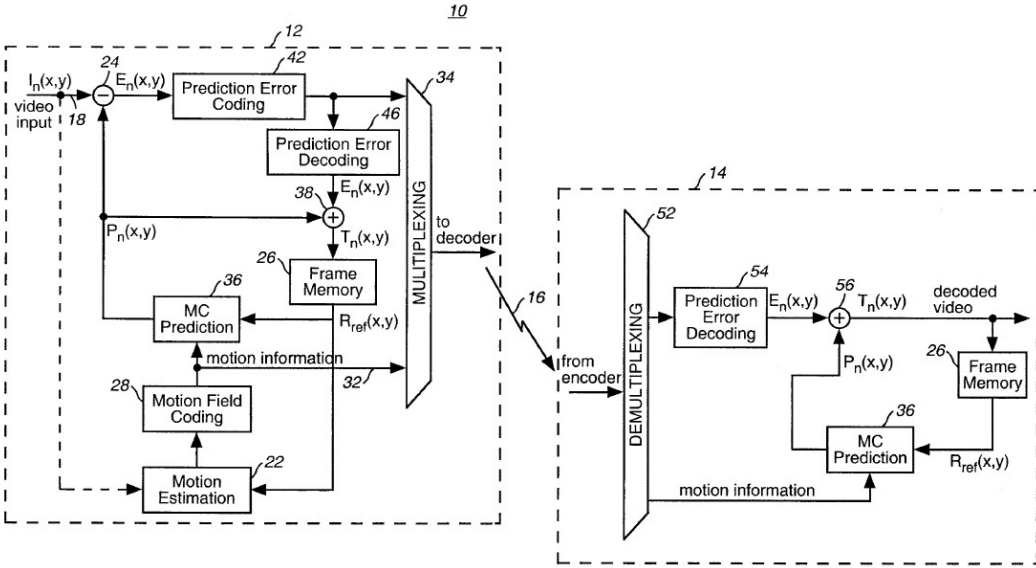
ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<i>See claim 23[a].</i>
44[b] the predicted non-zero motion vector is assigned for the skip coding mode for the first segment; and	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that the predicted non-zero motion vector is assigned for the skip coding mode for the first segment.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 23[b].</i></p>
44[c] the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector.	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 23[c].</i></p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>47. An encoder according to claim 10, wherein the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 10[b].</i></p> <p><i>See claim 28.</i></p> <p>Fig. 1.</p> 

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>48. An encoder according to claim 10, wherein the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 10[b].</i></p> <p><i>See claim 29.</i></p> <p>Fig. 1.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>49. An encoder according to claim 10, wherein no residual information is provided for the first segment in the encoded bitstream.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that no residual information is provided for the first segment in the encoded bitstream.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 30.</i></p>

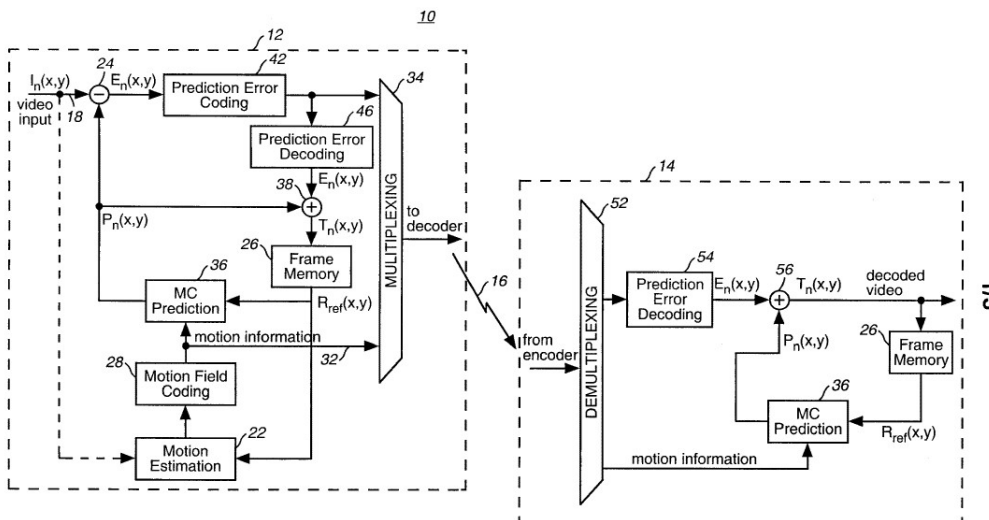
ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p data-bbox="625 435 709 467">Fig. 1.</p> <p>The diagram illustrates a video encoding and decoding system. The encoder (10) processes a video input $I_n(x,y)$ through a series of blocks: Motion Estimation (22), Motion Field Coding (28), MC Prediction (36), and Frame Memory (26). The output of the MC Prediction block is combined with the video input to produce a prediction error $E_n(x,y)$, which is then coded by the Prediction Error Coding block (42). The coded error is multiplexed (34) with the output of the Frame Memory (26) to produce a multiplexed stream 16. The decoder (14) demultiplexes (52) the stream 16 into a prediction error $E_n(x,y)$ and a reference frame $R_{ref}(x,y)$. The prediction error is decoded by the Prediction Error Decoding block (54) and combined with the reference frame to produce the decoded video $T_n(x,y)$. The Frame Memory (26) in the decoder stores the decoded video and provides it as a reference frame for the MC Prediction block (36).</p>
<p data-bbox="205 1214 596 1409">51. An encoder according to claim 10, wherein if the second segment has a zero motion vector, the zero motion vector is assigned to the skip coding mode of the</p>	<p data-bbox="625 1214 1923 1344">Karczewicz, as evidenced by the example citations below, discloses or renders obvious that if the second segment has a zero motion vector, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>	<p>See, e.g.,</p> <p>See claim 6.</p> <p>Fig. 1.</p> 
<p>52. An encoder according to claim 10, wherein if the</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious if the second segment has a zero motion vector and the second segment is predicted using motion-compensated</p>

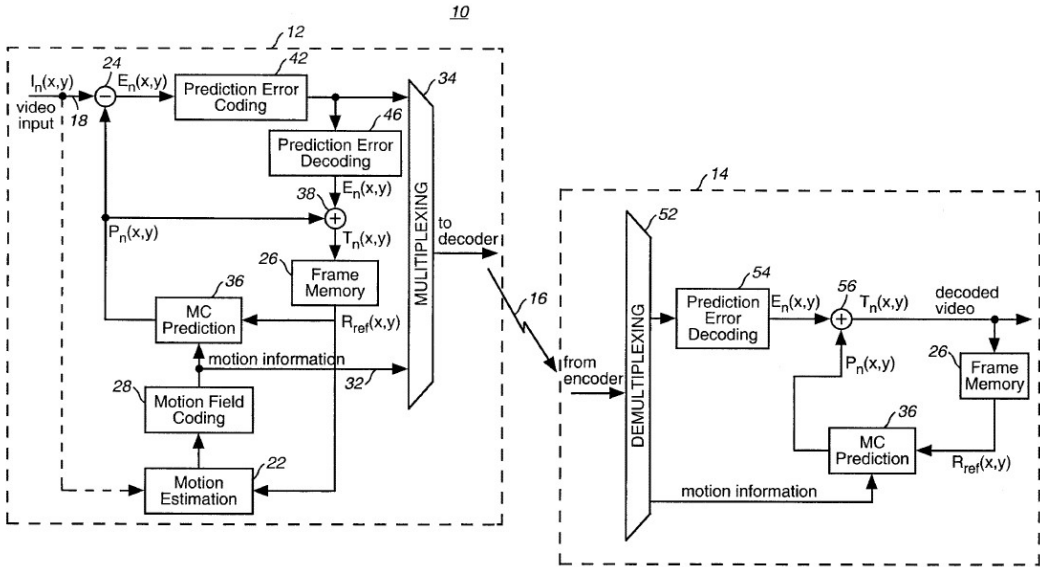
ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>	<p>prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p> <p>See, e.g.,</p> <p>See claim 24.</p> <p>Fig. 1.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>53. An encoder according to claim 10, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 25.</i></p> <p>Fig. 1.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>The diagram illustrates a video encoding and decoding system. The encoder (10) processes video input $I_n(x,y)$ through several stages: Motion Estimation (22), Motion Field Coding (28), MC Prediction (36), and Frame Memory (26). It generates a prediction $P_n(x,y)$ and a prediction error $E_n(x,y)$. The error is coded (42) and then decoded (46) to produce $E_n(x,y)$. These are combined to form the prediction $P_n(x,y)$ and the final prediction error $E_n(x,y)$. The system then multiplexes (34) the prediction and the error into a stream. The decoder (14) performs the reverse process: it demultiplexes (52) the stream into $P_n(x,y)$ and $E_n(x,y)$. The prediction is decoded (54) and combined with the error to produce the decoded video $T_n(x,y)$. The decoder also includes a Frame Memory (26) and an MC Prediction (36) block that receives motion information from the encoder.</p>
<p>54. A decoder according to claim 16, wherein if the second segment has a zero motion vector, the zero-motion vector is assigned to the skip coding mode for the first segment and the prediction for the first segment is formed with respect to a corresponding</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that if the second segment has a zero motion vector, the zero-motion vector is assigned to the skip coding mode for the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 6.</i></p>

<p>ASSERTED CLAIMS</p>	<p>PRIOR ART REFERENCE:</p> <p>Karczewicz</p>
<p>segment of the reference frame associated with the zero motion vector.</p>	<p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{xpr}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p> <p>Fig. 1.</p>  <p>The diagram illustrates a motion compensated predictor system, labeled FIG. 1, showing the internal structure of an encoder (12) and a decoder (14). The encoder (12) is enclosed in a dashed box and includes a video input (18) which is subtracted from a reference frame $I_n(x,y)$ (24) to produce a prediction error $E_n(x,y)$ (42). This error is then processed by a Prediction Error Coding block (46) and a Prediction Error Decoding block (38). The output of the decoding block is added to a prediction $P_n(x,y)$ (36) to produce a reconstructed frame $T_n(x,y)$ (34). The reconstructed frame is then processed by a Motion Field Coding block (28) and a Motion Estimation block (22) to produce motion information (32). The motion information is then processed by an MC Prediction block (36) to produce a refined prediction $P_n(x,y)$ (36). The refined prediction is then added to the prediction error $E_n(x,y)$ (42) to produce the final reconstructed frame $T_n(x,y)$ (34). The decoder (14) is also enclosed in a dashed box and includes a DEMULTIPLEXING block (52) which receives motion information from the encoder. The output of the demultiplexing block is processed by a Prediction Error Decoding block (54) and a Prediction Error Coding block (56). The output of the coding block is added to a prediction $P_n(x,y)$ (36) to produce a reconstructed frame $T_n(x,y)$ (56). The reconstructed frame is then processed by an MC Prediction block (36) to produce a refined prediction $P_n(x,y)$ (36). The refined prediction is then added to the prediction error $E_n(x,y)$ (54) to produce the final reconstructed frame $T_n(x,y)$ (56). The reconstructed frame is then processed by a Motion Field Coding block (28) and a Motion Estimation block (22) to produce motion information (32). The motion information is then processed by an MC Prediction block (36) to produce a refined prediction $P_n(x,y)$ (36). The refined prediction is then added to the prediction error $E_n(x,y)$ (54) to produce the final reconstructed frame $T_n(x,y)$ (56). The reconstructed frame is then processed by a Motion Field Coding block (28) and a Motion Estimation block (22) to produce motion information (32). The motion information is then processed by an MC Prediction block (36) to produce a refined prediction $P_n(x,y)$ (36). The refined prediction is then added to the prediction error $E_n(x,y)$ (54) to produce the final reconstructed frame $T_n(x,y)$ (56).</p> <p>FIG. 1</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>58. A decoder according to claim 16, wherein the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment.</p> <p><i>See, e.g., See claim 16[b].</i></p> <p><i>See claim 28.</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p> <p>Fig. 1.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	
<p>59. A decoder according to claim 16, wherein the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.</p> <p><i>See, e.g.,</i></p>

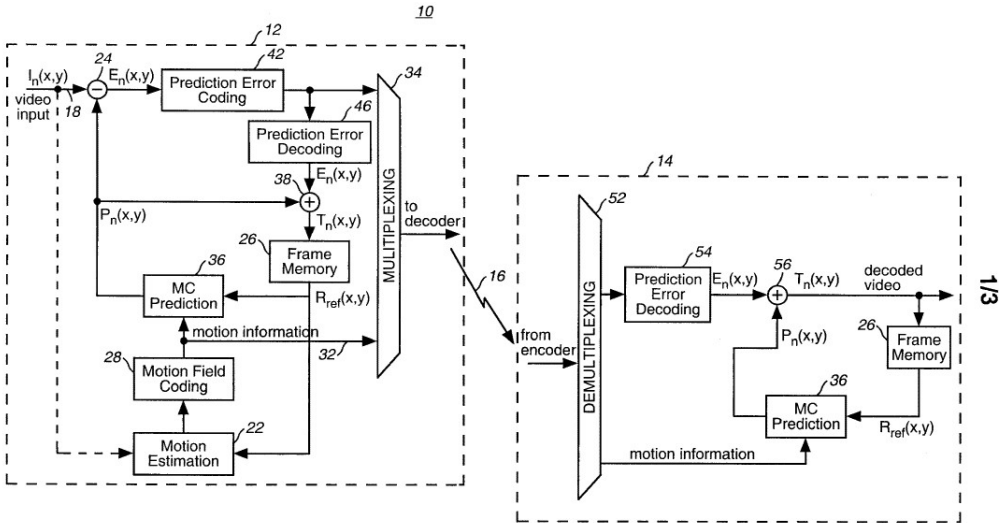
ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p><i>See claim 16[b].</i></p> <p><i>See claim 29.</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p> <p>Fig. 1.</p>

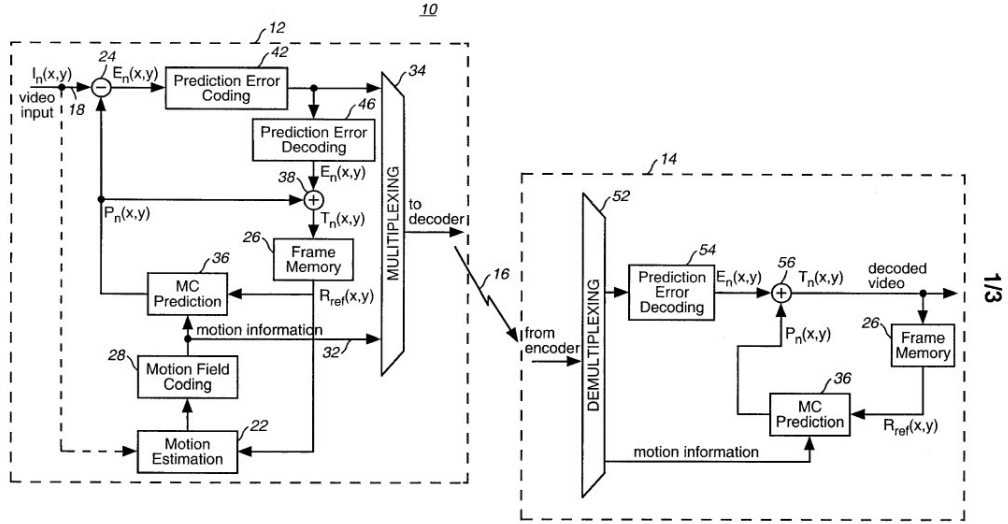
ASSERTED CLAIMS	<p style="text-align: center;">PRIOR ART REFERENCE:</p> <p style="text-align: center;">Karczewicz</p>
	<p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{xprd}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p> <p>Fig. 1.</p> <p style="text-align: center;">FIG. 1</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>62. A decoder according to claim 16, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 24.</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p> <p>Fig. 1.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	<p>The diagram illustrates a video coding system with an encoder (10) and a decoder (14). The encoder (10) takes a video input (18) and processes it through several blocks: a summing junction (24) that subtracts a prediction $P_n(x,y)$ from the input to produce a prediction error $E_n(x,y)$; a Prediction Error Coding block (42) that encodes the error; a Prediction Error Decoding block (46) that decodes the error; a Frame Memory (26) that stores reference frames $R_{ref}(x,y)$; an MC Prediction block (36) that generates the prediction $P_n(x,y)$ based on motion information and reference frames; a Motion Field Coding block (28) that encodes motion information; and a Motion Estimation block (22) that estimates motion information. The encoded prediction error and motion information are multiplexed (34) and sent to the decoder (14). The decoder (14) performs demultiplexing (52) to separate the prediction error and motion information. It then uses a Prediction Error Decoding block (54) to decode the error, a summing junction (56) to add the error to the prediction $P_n(x,y)$ (which is generated by an MC Prediction block (36) using motion information and reference frames from a Frame Memory (26)), and a Motion Estimation block (22) to estimate motion information. The final output is the decoded video (1/3).</p>
<p>63. A decoder according to claim 16, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p> <p><i>See, e.g.,</i></p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.</p>	<p><i>See claim 25.</i></p> <p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{x_{prd}}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p> <p>Fig. 1.</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
	 <p style="text-align: center;">FIG. 1</p>
<p>64. A decoder according to claim 16, wherein no further motion vector information for the first segment is retrieved from an encoded bitstream.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that no further motion vector information for the first segment is retrieved from an encoded bitstream.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 1[d].</i></p>

ASSERTED CLAIMS	<p style="text-align: center;">PRIOR ART REFERENCE:</p> <p style="text-align: center;">Karczewicz</p>
	<p>27:15-22.</p> <p>Figure 3 illustrates the motion compensated (MC) predictor 36 forming portions of both the encoder and decoder 12 and 14 respectively, as shown in Figure 1. The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. The motion vector field is computed based upon a prediction motion vector field ($A_{xprd}(x,y)$, $y_{prd}(x,y)$) and the refinement motion vector field coefficients.</p> <p>Fig. 1.</p>  <p style="text-align: center;">FIG. 1</p>

ASSERTED CLAIMS	PRIOR ART REFERENCE: Karczewicz
<p>65. A method according to claim 7, wherein no further motion vector information for the first segment is retrieved from the encoded bitstream.</p>	<p>Karczewicz, as evidenced by the example citations below, discloses or renders obvious that no further motion vector information for the first segment is retrieved from the encoded bitstream.</p> <p><i>See, e.g.,</i></p> <p><i>See claim 64.</i></p>