The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

Paper No. 18

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte MOTOKI KATO

Appeal No. 1999-2018
Application 08/571,204[1]

ON BRIEF

Before KRASS, BARRETT, and BLANKENSHIP, Administrative Patent Judges.

BARRETT, Administrative Patent Judge.

DECISION ON APPEAL

[1] Application for patent filed December 12, 1995, entitled "Moving Image Encoding Method and Apparatus, and Moving Image Decoding Method and Apparatus," which claims the foreign filing priority benefit under 35 U.S.C. § 119 of Japanese Application 6-332673, filed December 12, 1994, and Japanese Application 7-210665, filed August 18, 1995.

This is a decision on appeal under 35 U.S.C. § 134 from the final rejection of claims 1-9. Claims 10-16 have been canceled. Claims 17-23 stand allowed.

We affirm.

BACKGROUND

The disclosed invention relates to a method of encoding moving images and decoding a coded moving image signal. In particular, the invention relates to selecting a predictive coding mode based upon an inter picture distance.

Claim 2 is reproduced below.

> 2. A moving image encoding method wherein the difference between a moving image signal to be coded and a predictive picture signal is calculated to generate a residual signal, said residual signal is orthogonal transformed to generate coefficient data, and said coefficient data is quantized to generate quantized data, wherein said predictive picture signal is generated by applying motion compensation to locally decoded quantized data, and wherein said quantized data is variable length coded and transmitted to a transmission line, said moving image encoding method, [sic, no comma needed] comprising:
>
> a first step of calculating a first inter picture distance indicating a nominal distance between said moving image signal and a past reference picture signal which temporally precedes said moving image signal, and a second inter picture distance indicating a nominal distance between said moving image signal and a future reference picture signal which temporally follows said moving image signal; and

a second step of selecting a predictive coding mode based upon the values of said first inter picture distance and said second inter picture distance.

The Examiner relies on the following prior art:

Sugiyama	4,982,285	January 1, 1991
Wai	5,347,308	September 13, 1994 (filed October 5, 1992)

Claims 1-9 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Sugiyama.

Claims 1-9 stand alternatively rejected under 35 U.S.C. § 103(a) as being unpatentable over Sugiyama and Wei.

We refer to the final rejection (Paper No. 7) and the examiner's answer (Paper No. 13) (pages referred to as "EA__") for a statement of the Examiner's position, and to the brief (Paper No. 12) (pages referred to as "Br__") and the reply brief (Paper No. 14) (pages referred to as "RBr__") for a statement of Appellant's arguments thereagainst.

OPINION

Grouping of claims

Appellant argues two groups of claims to stand or fall together: (1) claims 1-4 and 6-8; and (2) claims 5 and 9.

Because claim 5 in the second group depends indirectly on independent claim 2, claim 2 is analyzed as representative of the first group of claims.

Sugiyama

Sugiyama selects a predictive coding mode based on the lowest prediction error from among forward, backward, and bidirectional prediction errors. The output of cumulative adder 28 in Fig. 4 in Sugiyama is the sum of error-squared values of the preceding frame prediction error values from subtractor 20 and generally corresponds to Appellant's forward prediction error Ef, Eqn. 1, except it is the sum of the difference squared rather than the sum of the absolute value of the difference. The output of cumulative adder 30 in Fig. 4 is the sum of error-squared values of the succeeding frame prediction error from subtractor 22 and generally corresponds to Appellant's backward prediction error Eb, Eqn. 2, except it is the sum of the difference squared rather than the sum of the absolute value of the difference. The output of cumulative adder 29 in Fig. 4 is the sum of error-squared values of the weighted preceding/succeeding frame prediction error from subtractor 21 and generally corresponds to Appellant's bidirectional prediction error which is a function of Ef and Eb (specification, p. 25) except that the sum is weighted depending on the distance in terms of time (the closer frame is more heavily weighted, col. 3, lines 7-12; col. 11, lines 1-6). The output of 29 is biased by subtractor 36 to favor the bidirectional mode. The output of cumulative adder 31 in Fig. 4 is the sum of error-squared values of the current frame values with the DC component of the signal removed and generally corresponds to Appellant's Eintra, Eqn. 3, where the DC component corresponds to Aav, except it is the sum of the difference squared rather than the sum of the absolute value of the difference. The output of 31 is biased by adder 37 to prevent the intra mode from being selected with high probability (col. 13, lines 26-36).

The minimum value selector 32 in Fig. 4 determines which of these summed error-squared values has the lowest value and outputs a signal to select one of three predictive coding modes and one intra coding mode (col. 6, line 61 to col. 7, line 6; col. 10, lines 19-37; col. 12, lines 42-68): (1) Option 1 (Mode 1), bidirectionally predictive mode;

(2) Option 2 (Mode 2), forward predictive mode; (3) Option 3 (Mode 3), backward predictive mode; (4) Option 4 (Mode 4), intra mode.

The prediction error in the bidirectionally predictive mode is based on the "distance" in terms of the normalized number of frames from a B-picture to a preceding (past) or succeeding (future) reference frame. The preceding and succeeding reference frames are a fixed number of frames N apart. The predicted frame signal X is formed as a weighed sum of the "preceding independent frame signal" and the "succeeding independent frame signal." The forward weighting value is W=(mc-mp)/N, where mc-mp is the difference between the current frame number mc and the preceding independent frame number mp (col. 11, lines 1-6). The backward weighting value is 1-W, which is the same as the difference between the current frame number and the succeeding independent frame number divided by N when the distance between preceding and succeeding independent frame numbers is N. The "distance" in terms of number of frames is only used for the bidirectionally predictive mode.

Claims 1-4 and 6-8

Anticipation

The limitation at issue in claim 2 is "selecting a predictive coding mode based upon the values of [distance]." We find this limitation anticipated by Sugiyama because: (1) it only requires selecting one ("a") predictive coding mode based on distance, not one of several predictive coding modes based on distance, and is met by Sugiyama's selection of the bidirectionally predictive mode based on distance; and (2) the term "distance" does not distinguish over the forward and backward estimation error values in Sugiyama, which are used to select one of three predictive coding modes.

(1)

Appellant argues that Sugiyama uses inter picture distances "only to generate predicted picture signals in a bidirectional prediction mode, and not to select a prediction mode from among a multiple of available prediction modes" (Br8). It is argued that because the weight "W" is described as "0 < W < 1" (col. 11, line 3) for the bidirectional predictive mode, which does not include the end points "0" or "1", Sugiyama cannot realize a forward predictive weighting scheme in which the value of "W" would have to be "1", or a backward weighting scheme in which the value of "W" would have to be "0" (i.e., 1-W=1) (Br9-10).

The Examiner states (EA10): "[T]he whole process of selecting one from mode 1 to mode 4 depends on the values (mc-mp), W, and 1-W which provide the two inter picture distances. The selecting step cannot be performed without the two distances and thus is based upon the distances."

Appellant responds to this new rationale by stating that "Sugiyama's selection of a predictive coding mode is 'based upon' inter picture distances <u>only</u> when the 'bi-directional' mode is selected" (RBr2). It is argued that "based upon" as used in the claims should be read as requiring the consideration of the inter picture distances for each selectable inter picture coding mode (RBr3-4).

Claim 2 recites "selecting <u>a</u> predictive coding mode based upon the values of [distance]" (emphasis added). This language only requires selecting one ("a") predictive code mode based on distance, not one of several predictive coding modes based on distance, as argued. Because the bidirectionally predictive mode is based on "distance," in the same sense of the number of frames from past and future reference pictures as Appellant's distance, Sugiyama selects a predictive coding mode based on the values of forward and backward distances. We do not agree with the Examiner's claim interpretation that selection of the forward predictive coding mode (mode 2, col. 12, lines 48-53) and the backward predictive coding mode (mode 3, col. 12, lines 54-59) are "based upon" the inter picture distance because the bidirectionally predictive coding mode (mode 1, col. 12, lines 42-47) uses distances W and 1-W. Nevertheless, since claim 2 does not recite selecting one of several predictive coding modes based upon distance, the error is harmless. No other limitations have been argued. See 37 CFR § 1.192(c)(8)(iii) (1997) (the brief shall specify the errors in the anticipation rejection including any specific limitations in the rejected claims which are not described in the prior art relied upon in the rejection). Accordingly, the anticipation rejection of claims 1-4 and 6-8 is sustained.

(2)

Appellant argues that "unlike the present method of claim 1 which selects a predictive coding mode based upon the values of the first and second inter picture distances, Sugiyama selects a prediction option based on the lowest prediction error" (Br8).

We interpret the "inter picture distances" in claim 2 as broad enough to read on the forward and backward estimation error values in Sugiyama which are used to select the three predictive coding modes. Claim 2 does not define "distance" as a count of the number of pictures from a past or future reference picture. Therefore, while Appellant's invention, as disclosed, is different from Sugiyama, claim 2 is so broad that it is anticipated by Sugiyama for this additional reason.

Appellant's specification defines the forward prediction error (motion vector estimation error between a B-picture and a past reference picture) as Ef, and the backward prediction error (motion vector estimation error between a B-picture and a future reference picture) as Eb (specification, p. 6), where Ef and Eb are a measure of the correlation degree; the smaller the number, the greater the degree of correlation. Appellant observes that where two or more B-pictures exist between I- and P-pictures or between P-pictures, as in Fig. 7, the correlation degree between the B-picture and the past reference picture, and between the B-picture and the future reference picture depend on the distance (specification, pp. 16-17):

> [T]he correlation degree with the past reference picture and the correlation degree with the future reference picture depend upon the distance between the B-picture and the past reference picture and the distance between the B-picture and the future reference picture. Therefore, in the present invention, the coding of the B-picture is performed by adaptively switching the prediction coding of the B-picture in accordance with the distance between the B-picture and the past reference picture and the distance between the B-picture and the future reference picture. Note that the aforementioned distance can be considered as time.

The estimation errors Ef, Eb are measures of correlation degree and are directly related to distance. For example, in Fig. 7, Ef1 < Ef2 < Ef3 in the forward direction and Eb3 < Eb2 < Eb1 in the backward direction (specification, p. 16). Therefore, forward estimation error Ef can be considered a "first inter picture distance indicating a nominal distance between said moving image signal and a past reference picture signal" (claim 2) and backward estimation error Eb can be considered a "second inter picture distance indicating a nominal distance between said moving image signal and a future reference picture signal" (claim 2).

Claim 2 does not particularly recite that the distance is a count of the number of pictures from a past or future reference picture, as disclosed. Nor does it particularly recite the disclosed selection method. The disclosed invention assigns a distance Df between a B-picture and a past reference picture (an I- or P-picture) and a distance Db between the B-picture and a future reference picture (a P-picture) based on a count of the number of B-pictures from the past or future reference picture (specification, p. 22; Fig. 9). The distances Df, Db from the inter picture distance calculation circuit 10 are output to the predictive mode determination circuit 8 which selects one of the intra mode, the forward predictive mode, the backward predictive mode, or the bidirectionally predictive mode (specification, pp. 22-23; Fig. 8), based on two stored curves, one for Df=1, Db=2 and one for Df=2, Db=1 (for the case where there are two B-pictures between past and future reference pictures), as shown in Figs. 11A and 11B. Based on calculated values of Ef and Eb, and based on Df and Db, one of the non-intra modes is selected. The forward predictive mode has a larger area and is more likely to be selected when the B-picture is closer in distance to the past reference picture (Fig. 11A, Df=1) and the backward predictive mode has a larger area and is more likely to be selected when the B-picture is closer in distance to the future reference picture (Fig. 11B, Db=1) (specification, pp. 24-25). However, the details of the disclosed method are not claimed.

Our interpretation of distance as the motion vector estimation error Ef or Eb is consistent with claim 4. Claim 4 recites that the step of selecting a predictive coding mode based upon the values of the first inter picture distance and the second inter picture distance uses a forward motion vector estimation residuum and a backward motion vector estimation residuum, which correspond to Ef and Eb. Claim 4 does not recite that a distance value is used in addition to the motion vector estimation residuums and does not recite selecting different stored curves for selecting a predictive coding mode. Thus, it is fair to interpret the forward and backward motion vector estimation residuums of claim 4 as the first and second inter picture distances, respectively, of claim 2. However, claim 4 is not at issue as argued.

Because Sugiyama uses the forward prediction error and the backward prediction error (corresponding to Appellant's Ef and Eb), which are a measure of distance, to select a predictive coding mode, Sugiyama anticipates the first and second steps of claim 2. No other differences have been argued. See 37 CFR § 1.192(c)(8)(iii). For this additional reason, the anticipation rejection of claims 1-4 and 6-8 is sustained.

Obviousness

The Examiner states that when Sugiyama is read narrowly, it may not show the use of motion compensation and motion vector estimation and applies Wai (EA7). Appellant argues that Wai does not cure the deficiency of Sugiyama with respect to the step of selecting a predictive coding mode based upon inter picture distance values in claim 2 (Br12-13).

Because Appellant does not argue any limitation in claim 2 other than the step of selecting a predictive coding mode, which has been discussed in the anticipation rejection, we do not need to discuss Wai. The obviousness rejection of claims 1-4 and 6-8 is sustained for the reasons discussed in the anticipation rejection.

Claims 5 and 9

Anticipation

Appellant argues that claim 5 requires a predictive coding mode to be chosen from among three possible predictive coding modes based upon the values of the first and second inter picture distances and that, by contrast, the option 1 arrangement of Sugiyama merely uses a single bidirectionally predictive coding mode (Br14).

As previously discussed, we do not agree with the Examiner's claim interpretation that selection of the forward predictive coding mode and the backward predictive coding mode in Sugiyama are "based upon" inter picture distances just because the bidirectionally predictive coding mode uses distances. Nevertheless, it does not appear that claim 5 requires selection from among a plurality of predictive coding modes based on distance. Claim 2 recites "selecting a predictive coding mode based upon the values of [distance]" (emphasis added), which only requires selecting one ("a") predictive code mode based on distance. Claim 5 recites that "said predictive coding mode includes a forward predictive coding mode ..., a backward predictive coding mode ..., and a bidirectional predictive coding mode." Claim 5 does not require selecting each of the three modes based on distance. That is, claim 2 as modified by claim 5 only requires selecting one of the three possible predictive coding modes in claim 5 based on distance, which is anticipated by Sugiyama for the reasons discussed in regard to claim 2.

Assuming, arguendo, that claim 5 is interpreted to require selection of each of the three predictive coding modes based upon distance, under our interpretation of "distance" as broad enough to read on the forward and backward estimation error values in Sugiyama, which are used to select each of the three predictive coding modes listed in claim 5, the subject matter of claim 5 is anticipated.

For the reasons stated above, the anticipation rejection of claims 5 and 9 is sustained.

Obviousness

Appellant does not argue any limitation in claim 5 other than the step of selecting one of the three predictive coding modes based on distance, which has been discussed in the anticipation rejection of claim 5. Thus, we do not need to discuss Wai. The obviousness rejection of claims 5 and 9 is sustained for the reasons given in the anticipation analysis.

CONCLUSION

The rejections of claims 1-9 are sustained.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED

ERROL A. KRASS)
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