Paper No. 24

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte DO HUI TEH,
PEK YEW TAN,
and SUA HONG NEO

Appeal No. 1999-1793
Application 08/161,798[1]

ON BRIEF

Before HAIRSTON, JERRY SMITH, and BARRETT, Administrative Patent Judges.

BARRETT, Administrative Patent Judge.

DECISION ON APPEAL

[1] Application for patent filed December 6, 1993, entitled "Bit Allocation Method For Digital Audio Signals," which claims the foreign filing priority benefit under 35 U.S.C. § 119 of Japanese Application 5-030712, filed February 19, 1993.

This is a decision on appeal under 35 U.S.C. § 134 from the final rejection of claims 4-7, 9-12, 14-17, and 19-23. Claims 8, 13, 18, and 24 are allowed. Claims 1-3 are canceled.

We reverse.

BACKGROUND

The disclosed invention relates to a dynamic bit allocation method that is adapted to the human auditory system and yet has a low level of complexity. The complexity is reduced by allocating an initial bit number using approximations made in a mathematical model before the remaining bit numbers are allocated by a precise iterative process.

Claim 5 is reproduced below.

> 5. A method of determining a bit allocation for a quantization of digital audio signals having spectral and temporal structure wherein the digital audio signals are obtained by buffering audio signals in frames and decomposing the digital signals into spectral components, which comprises the steps of:
>
> a step for dividing at least one frequency interval into a plurality of frequency-units;
>
> a step for obtaining a representative of each frequency-unit obtained;
>
> a step for counting a number of available frequency-units by using the representative, based on psychoacoustic criteria;
>
> a first bit allocation step for determining an initial bit allocation for each of said available frequency-units by using

an approximate mathematical model using said counted number of available frequency-units; and

a second bit allocation step for determining further bit allocation for each of said available frequency-units based on psychoacoustic criteria.

The Examiner relies on the following prior art:

Veldhuis et al. (Veldhuis) 5,105,463 April 14, 1992
Nishiguchi et al. (Nishiguchi) 5,151,941 September 29, 1992

Claims 4[2]-7, 9-12, 14-17, and 19-23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Veldhuis and Nishiguchi.

We refer to the rejection (Paper No. 5), the final rejection (Paper No. 8) (pages referred to as "FR__") and the examiner's answer (Paper No. 15) (pages referred to as "EA__") for a statement of the Examiner's position, and to the appeal brief (Paper No. 14) (pages referred to as "Br__") and the reply brief (Paper No. 16) (pages referred to as "RBr__") for Appellants' arguments thereagainst.

OPINION

The claims are grouped to stand or fall together with independent claim 5 (Br5).

[2] The Examiner's statement of the rejection inadvertently omits claim 4.

Appellants argue that the Examiner has improperly read limitations into claim 5 (e.g., Br7-8; RBr5-6). To the extent this is so, we address only the actual limitations of claim 5.

The Examiner's[3] discussion of Veldhuis (FR5) is very cursory and does not correlate the actual limitations of claim 5 to the disclosure of Veldhuis. Therefore, we begin by making findings regarding the contents of Veldhuis and the differences between Veldhuis and the subject matter of claim 5.

Claim 5 recites "buffering audio signals in frames and decomposing the digital signals into spectral components" and "a step for dividing at least one frequency interval into a plurality of frequency-units." A "unit" is a frequency interval (specification, p. 8). Veldhuis does not disclose that the audio signal is buffered in frames; however, while this limitation is considered either inherent or obvious to one of ordinary skill in the art, it is not argued and will not be addressed. See 37 CFR § 1.192(c)(8)(iv) (1997) (brief must specify the errors in the rejection). Veldhuis discloses that the audio signal x(k) is applied to an analysis filter bank 3 which divides the signal band of 0-22.05 kHz into P=26

[3] As noted by Appellants (RBr2 n.1), there have been numerous examiners during prosecution.

subbands (col. 5, lines 58-64), the characteristics of which are shown in the table of figure 3. The bandwidths W(p) of the subbands approximately correspond to the critical bandwidths of the human auditory system in the respective frequency ranges (col. 6, lines 40-46). Thus, we find Veldhuis discloses "decomposing the digital signals into spectral components" and "a step for dividing at least one frequency interval into a plurality of frequency-units." The claim limitation of "at least one frequency interval" reads on the frequency interval corresponding to the upper subbands (13#p#26) in Veldhuis. Thus, Appellants' arguments that the lower subbands do not use adaptive bit allocation and that their invention allows for the possibility of assigning and allocating bits to the whole frequency spectrum (e.g., Br10-13) are not persuasive.

Claim 5 recites "a step for obtaining a representative of each frequency-unit obtained." The term "representative" is not expressly defined in the specification. However, from the statement "the variance or a representative within a defined frequency interval as an accurate representation of the signals in the interval" (specification, p. 5), we interpret "representative" to mean a "characteristic representative of the signal." Veldhuis discloses a signal buffer 6(p) for each subband and a level detector 7(p)

connected to each signal buffer 6(p) to determine for each block stored having block number m a characteristic parameter G(p;m) representative of the signal level of the block (col. 6, lines 17-23). The signal level can be represented by the average value of the amplitude or the power of the signal samples of a block, and also by the peak value of the amplitude of the signal samples in a block (col. 6, lines 29-33). The set of "characteristic parameters G(p;m)" in Veldhuis is the "representative of each frequency-unit obtained." Thus, Veldhuis discloses "a step for obtaining a representative of each frequency-unit obtained."

Claim 5 recites "a step for counting a number of available frequency-units by using the representative, based on psychoacoustic criteria." For the upper group of subbands (13#p#26) in Veldhuis, the number of quantizing bits per signal sample B(p;m) is determined by the set of all characteristic parameters G(p;m) (col. 10, lines 8-18). As previously noted,
the "at least one frequency interval" in the first step of claim 5 reads on the frequency interval corresponding to the upper subbands (13#p#26) in Veldhuis, so it is proper to focus on these subbands (frequency-units). Parameter G(p;m) is compared to the threshold T(p) for the subband of band number p and a binary comparator signal

C(p;m) is generated having a first value C(p;m)="1" for G(p;m)$T(p) and a second value C(p;m)="0" for G(p;m)<T(p) (col. 11, lines 31-36). The thresholds are related to the thresholds of the human auditory system for perceiving single tones in the respective frequency ranges (col. 11, lines 36-44); thus, the thresholds are "based on psychoacoustic criteria." By these comparisons, the blocks (p;m) of subband signals $x_p(k)$ are divided into blocks (p;m) containing perceptually significant signal energy on the basis of the criterion G(p;m)$T(p) and thus having the value C(p;m)="1", and blocks (p;m) containing no perceptually significant energy on the basis of the criterion G(p;m)<T(p) and thus having a value of C(p;m)="0" (col. 11, lines 45-52). No quantizing bits are allocated to the blocks (p;m) within the same allocation window having C(p;m)="0" and the quantizing bits thus saved are used for the finer quantization of the blocks (p;m) within the same allocation window having C(p;m)="1" (col. 11, lines 52-57). This eliminates blocks (p;m) that are irrelevant. The blocks (p;m) having the value C(p;m)="1" are "available frequency-units" because they are available for bit allocation. The comparator signal C(p;m), which determines whether a block (p;m) is "available" is based on the threshold T(p) for the subband, which is "based on psychoacoustic criteria"; thus, the

determination of available frequency-units is based on psychoacoustic criteria. The number of blocks (p;m) in the allocation window having C(p;m)="1" is the count of available frequency-units. However, Veldhuis does not disclose "counting" the available blocks (p;n). Therefore, Veldhuis does not disclose "a step for counting a number of available frequency-units by using the representative, based on psychoacoustic criteria" (emphasis added).

Claim 5 recites "a first bit allocation step for determining an initial bit allocation for each of said available frequency-units by using an approximate mathematical model using said counted number of available frequency-units." The blocks (p;m) in the allocation window having C(p;m)="1" are the "available frequency-units." All of the blocks are initially allocated a minimum number of bits B(p;m) as a default value for the allocation pattern (e.g., col. 13, lines 60-64; col. 21, lines 35-37) and then those blocks (p;m) with C(p;m)="0" are set to B(p;m)=0 to produce sum S of "saved" number of bits (col. 13, line 68 to col. 14, line 12), leaving the initial allocations in blocks (p;m) with C(p;m)="1". This is a first bit allocation step for each available frequency-unit. However, this initial bit allocation is not disclosed or suggested to be made "using an approximate mathematical model using said counted number of

available frequency-units." Therefore, we find Veldhuis does not disclose "a first bit allocation step for determining an initial bit allocation for each of said available frequency-units by using an approximate mathematical model using said counted number of available frequency-units" (emphasis added)

Claim 5 lastly recites "a second bit allocation step for determining further bit allocation for each of said available frequency-units based on psychoacoustic criteria." As disclosed, the second step of allocating bits "based on psychoacoustic criteria" uses psychoacoustic criteria only in the sense that a psychoacoustic weighting factor F is used in reducing the variance of the unit (specification, p. 9, step [4]); thus, the allocation of bits "based on psychoacoustic criteria" can be interpreted broadly as very indirectly based on some psychoacoustic criterion. In Veldhuis, the blocks (p;m) having the greatest need of quantizing bits G'(p;m) are allocated further bits by jumping to the next level i in figure 10 (step 9-11 in fig. 9; col. 15, lines 58-63). The need of bits G'(p;m) is assigned a value of G'(p;m)/D, with D>1, so as to evenly distribute the numbers of quantization bits saved over the blocks (p;m) having a value of C(p;m)="1" (col. 15, line 63 to col. 16, line 1). The value D is not disclosed to be "based on

psychoacoustic criteria." Therefore, we find that Veldhuis does not teach "a second bit allocation step for determining further bit allocation for each of said available frequency-units based on psychoacoustic criteria" (emphasis added).

Based on the above analysis, we summarize that the differences between the subject matter of claim 5 and Veldhuis are that Veldhuis does not teach: (1) "a step for counting a number of available frequency-units by using the representative, based on psychoacoustic criteria" (emphasis added); (2) "a first bit allocation step for determining an initial bit allocation for each of said available frequency-units by using an approximate mathematical model using said counted number of available frequency-units" (emphasis added); and (3) "a second bit allocation step for determining further bit allocation for each of said available frequency-units based on psychoacoustic criteria" (emphasis added).

The Examiner has further applied Nishiguchi. The Examiner finds that "Nishiguchi et al. teach a method for determining a bit allocation comprising a first and second bit allocation which incorporates psychoacoustic criteria (their initial allocation followed by a 'correcting step' col. 2 line 64- col. 3 line 14; and psychoacoustics col. 4)" (FR6). The Examiner concludes that it would

have been obvious to use the two-step process of Nishiguchi in the adaptive bit allocation taught by Veldhuis "because the number of available bits can change dynamically which results in bits being in surplus or deficit and leading to less efficient bit allocation, thus, requiring more bandwidth (Nishiguchi et al., col. 1)" (FR6).

We analyze the three differences noted above.

Difference (1) - counting available frequency-units

Appellants argue that the Examiner has not shown where the step of counting the number of available frequency-units is found in Veldhuis or Nishiguchi (RBr6). We do not find any discussion of the counting step by the Examiner.

We agree that neither Veldhuis nor Nishiguchi discloses counting the number of available frequency-units. In Veldhuis, the blocks (p;m) in the allocation window having C(p;m)="1" are "available frequency-units." However, Veldhuis does not disclose "counting" the number of available blocks (p;n) having C(p;m)="1". We do not find any disclosure of counting available frequency-units in Nishiguchi. Thus, the counting step is a difference which is not accounted for in the rejection.

Difference (2) - mathematical model using counted number of available frequency-units

The Examiner finds that Veldhuis teaches a "mathematical model" and points to Veldhuis at column 2, lines 54-64, showing B(p), G(p;m), and C(p;m) (EA6). The Examiner states that a mathematical model or algorithm is a series of mathematical steps as shown in Veldhuis at figures 8 and 9 (EA7).

Appellants respond that a "mathematical model" is not the same thing as a "mathematical algorithm" (RBr8-10) and that Nishiguchi does not teach or suggest a mathematical model using the counted number of available frequency-units (RBr10).

We agree with Appellants that a "mathematical model" is not necessarily a "mathematical algorithm." However, it is not necessary to explore the nuances in any detail since the Examiner has not shown a mathematical algorithm "using said counted number of available frequency-units," as claimed. The initial bit allocations in Veldhuis are all predetermined. Thus, the mathematical model using the counted number of frequency-units is a difference which is not accounted for in the rejection.

Difference (3) - second step of bit allocation based on psychoacoustic criteria

Appellants argue that the second step of further bit allocation in claim 5 is different than the second step of bit correction in Nishiguchi (Br12; RBr11-12). Appellants argue that Nishiguchi teaches only one bit allocation step that is amorphously connected with a correction of the allocation and that Nishiguchi does not make obvious two separate and distinct allocation steps (RBr7-8).

The Examiner disagrees (EA7), but we do not understand the Examiner's rationale.

The arguments are directed to the existence of a two step allocation process, an initial allocation followed by a further bit allocation, rather than to the limitation of the further bit allocation being based on psychoacoustic criteria. We have found that Veldhuis discloses a two step process. Since the limitation about further allocation "based on psychoacoustic criteria" is not argued, it is not addressed. See 37 CFR § 1.192(c)(8)(iv).

CONCLUSION

Because the combination of Veldhuis and Nishiguchi does not disclose at least the limitations of "a step for counting a number of available frequency-units by using the representative, based on psychoacoustic criteria" (emphasis added) and "a first bit allocation step for determining an initial bit allocation for each of said available frequency-units by using an approximate mathematical model using said counted number of available frequency-units" (emphasis added), the Examiner has failed to establish a prima facie case of obviousness. The rejection of claims 4-7, 9-12, 14-17, and 19-23 is reversed.

REVERSED

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Administrative Patent Judge)
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