Claims

[Claim 1] A quantizing method comprising:
quantizing an input signal by selecting one of a first quantization scheme not using an inter-frame prediction and a second quantization scheme using the inter-frame prediction, in consideration of at least one of a prediction mode, a predictive error and a transmission channel state.

[Claim 2] The quantizing method of claim 1, wherein the first quantization scheme comprises a first quantization process that roughly quantizes the input signal, and a second quantization process that precisely quantizes a quantization error signal indicating an error determined between the input signal and an output signal of the first quantization process.

[Claim 3] The quantizing method of claim 1, wherein the second quantization scheme comprises an inter-frame prediction process that performs the inter-frame prediction of the input signal, and a Block-Constrained Trellis-Coded Quantization (BC-TCQ) process having an intra-frame prediction function that quantizes predictive errors.

[Claim 4] The quantizing method of claim 3, wherein the BC-TCQ process determines a quantization index by using weighted distortion.

[Claim 5] The quantizing method of claim 1, wherein the predictive error is obtained by using a weighting function related to an importance of the input signal.

[Claim 6] The quantizing method of claim 5, wherein the weighting function is determined by using at least one of a frequency band of the input signal, an encoding mode, and spectrum analysis information.

[Claim 7] The quantizing method of claim 1, wherein, when the input signal is non-stationary, the first quantization scheme is selected.

[Claim 8] The quantizing method of claim 1, wherein, when the input signal is stationary, one of the first quantization scheme and the second quantization scheme is selected based on the predictive error.

[Claim 9] The quantizing method of claim 1, wherein the quantizing of an input signal comprises:
determining a prediction mode of the input signal;
selecting the first quantization scheme or the second quantization scheme as the quantization path of the input signal by using the prediction mode of the input signal;

if the quantization path of the input signal is not determined by using the prediction mode of the input signal, comparing a first predictive error obtained from a current frame and a previous frame with a first threshold; and

if the first predictive error is greater than or equal to the first threshold, selecting the first quantization scheme as the quantization path of the input signal, and if the first predictive error is not greater than or equal to the first threshold, selecting the second quantization scheme as the quantization path of the input signal.

[Claim 10] The quantizing method of claim 9, wherein the quantizing of an input signal further comprises:

if an error occurs in the previous frame, comparing a second predictive error obtained from the current frame and the previous frame with a second threshold; and

if the second predictive error is greater than or equal to the second threshold, selecting the first quantization scheme as the quantization path of the input signal, and if the second predictive error is not greater than or equal to the second threshold, selecting the second quantization scheme as the quantization path of the input signal.

[Claim 11] The quantizing method of claim 1, wherein in the quantizing of an input signal, a selection ratio of the first quantization scheme is adjusted according to a transmission channel state.

[Claim 12] The quantizing method of claim 11, wherein in the quantizing of an input signal, the first quantization scheme is selected, if the transmission channel state is more unstable than a threshold stability level.

[Claim 13] The quantizing method of claim 1 further comprising: determining a quantizer type for the input signal as one of an open-loop type and a closed-loop type, based on at least one of a bit rate of the input signal, a bandwidth of the input signal, and an internal sampling frequency, prior to quantizing the input signal.

[Claim 14] A de-quantizing method comprising:

de-quantizing an input signal by selecting one of a first de-quantization scheme not using an inter-frame prediction, and a second de-quantization scheme using the inter-frame prediction, based on path information included in a bitstream,

the path information being determined in consideration of at least one of a prediction mode, a predictive error and a transmission channel

state, in an encoding end.

[Claim 15] The de-quantizing method of claim 14, wherein the first de-quantization scheme comprises a first de-quantization process that roughly de-quantizes LPC parameters, and a second de-quantization process that precisely de-quantizes the LPC parameters.

[Claim 16] An encoding method comprising:
determining a coding mode of an input signal;
quantizing the input signal by selecting one of a first quantization scheme not using an inter-frame prediction and a second quantization scheme using the inter-frame prediction, according to path information determined in consideration of at least one of a prediction mode, a predictive error and a transmission channel state;
encoding the quantized input signal in the coding mode; and
generating a bitstream including one of a result quantized in the first quantization scheme and a result quantized in the second quantization scheme, the coding mode of the input signal, and path information related to the quantization of the input signal.

[Claim 17] A decoding method comprising:
decoding Linear Predictive Coding (LPC) parameters and a coding mode included in a bitstream;
de-quantizing the decoded LPC parameters by using one of a first de-quantization scheme not using inter-frame prediction and a second de-quantization scheme using the inter-frame prediction based on path information included in the bitstream; and
decoding the de-quantized LPC parameters in the decoded coding mode,
wherein the path information is determined in consideration of at least one of a prediction mode, a predictive error and a transmission channel state in an encoding end.

[Claim 18] A non-transitory computer-readable recording medium storing a computer-readable program for executing the method of claim 1.

[Claim 19] A non-transitory computer-readable recording medium storing a computer-readable program for executing the method of claim 14.

[Claim 20] A non-transitory computer-readable recording medium storing a computer-readable program for executing the method of claim 16.

[Claim 21] A non-transitory computer-readable recording medium storing a computer-readable program for executing the method of claim 17.

[Claim 22] A method of determining a quantizer type, the method comprising:

comparing a bit rate of an input signal with a first reference value;
comparing a bandwidth of the input signal with a second reference value;
comparing an internal sampling frequency with a third reference value; and
determining the quantizer type for the input signal as one of an open-loop type and a closed-loop type based on the results of one or more of the comparisons.

CLAIMS

What is claimed is:

1. A quantizing method comprising:

selecting, based on a predictive error, one of a first quantization module without inter-frame prediction and a second quantization with the inter-frame prediction, in an open-loop manner; and

quantizing, performed by a processor, an input signal using the selected quantization module.

2. The quantizing method of claim 1, wherein the first quantization module comprises a trellis-structured quantizer with block constraints and an intra-frame predictor.

3. The quantizing method of claim 2, wherein the trellis-structured quantizer with block constraints is configured to search for an index based on a weighting function.

4. The quantizing method of claim 1, wherein the second quantization module comprises a trellis-structured quantizer with block constraints, an intra-frame predictor and an inter-frame predictor.

5. The quantizing method of claim 4, wherein the trellis-structured quantizer with block constraints is configured to search for an index based on a weighting function.

6. The quantizing method of claim 1, wherein the first quantization module comprises a first trellis-structured quantizer with block constraints and an intra-frame predictor, and the second quantization module comprises a second trellis-structured quantizer with block constraints, an intra-frame predictor and an inter-frame predictor.

7. The quantizing method of claim 6, wherein the first and second trellis-

structured quantizers with block constraints are configured to search for an index based on a weighting function.

8. The quantizing method of claim 1, wherein the predictive error is based on a weighting function.

9. The quantizing method of claim 1, wherein the predictive error is based on at least one of linear spectral frequency (LSF) coefficients of a current frame, LSF coefficients of a previous frame, auto-regressive prediction coefficients, and a weighting function related to signal characteristics.

10. The quantizing method of claim 1, wherein the predictive error is a weighted predictive error based on a weighting function, and the weighting function is determined by using at least one of a bandwidth, a coding mode, and spectrum analysis information of the input signal.

11. The quantizing method of claim 1, wherein a coding mode of the input signal is a generic coding mode.

12. The quantizing method of claim 1, wherein a coding mode of the input signal is a voiced coding mode.

13. The quantizing method of claim 1, wherein the predictive error Ep is obtained by an equation:

$$E_p=\Sigma_{i=0}^{M-1} w_{end}(i)(z_k(i)-z_{k-1}(i)p(i))^2,$$

where M denotes a dimension of linear spectral frequency (LSF) coefficients, $z_k(i)$ denotes an i^{th} LSF coefficient of a k^{th} frame, $z_{k-1}(i)$ denotes an i^{th} LSF coefficient of a $(k-1)^{th}$ frame, p(i) denotes an i^{th} auto-regressive prediction coefficient, and $w_{end}(i)$ denotes an i^{th} weight.

14. The quantizing method of claim 1, wherein the selecting comprises comparing the predictive error with a threshold, to select the first quantization module if the predictive error is greater than the threshold and selecting the second quantization

module if the predictive error is less than or equal to the threshold.

15. The quantizing method of claim 14, wherein the threshold is a fixed value.

16. The quantizing method of claim 14, wherein the threshold is a variable value.

17. The quantizing method of claim 1, wherein the selector is configured to select the first quantization module if the input signal is non-stationary.

18. The quantizing method of claim 1, wherein the first quantization module comprises a trellis-structured quantizer with block constraints, an intra-frame predictor and a vector quantizer.

19. The quantizing method of claim 1, wherein the second quantization module comprises a trellis-structured quantizer with block constraints, an intra-frame predictor, an inter-frame predictor and a vector quantizer.

20. The quantizing method of claim 1, wherein the first quantization module comprises a first trellis-structured quantizer with block constraints, an intra-frame predictor and a first vector quantizer, and the second quantization module comprises a second trellis-structured quantizer with block constraints, an intra-frame predictor, an inter-frame predictor and a second vector quantizer.