[CLAIMS]

[Claim 1]

A sound generation device comprising:

a direction obtainer that obtains a sound-source direction of a sound source; and

a panner that expresses the sound source, by applying a time shift and gain adjustment to the sound source to perform panning for distributing a signal of the sound source to a plurality of representative directions, based on the sound-source direction obtained by the direction obtainer.

[Claim 2]

The sound generation device according to claim 1,

wherein the panner sums distributed signals of the sound source at a plurality of representative positions for synthesizing a sound image of the sound source by using sounds from the plurality of representative directions.

[Claim 3]

The sound generation device according to claim 2,

wherein the panner applies, to the sound source,

a time shift calculated to maximize a cross-correlation between a head-related impulse response for the sound-source direction and a head-related impulse response for each of the plurality of representative directions, or

a minus-sign time shift resulting from assigning a minus sign to the time shift.

[Claim 4]

The sound generation device according to claim 3,

wherein a result obtained by calculating the cross-correlation after applying a weighting filter in a frequency domain is used for the time shift, a gain, or the time shift and a gain.

[Claim 5]

The sound generation device according to claim 3,

wherein for each of the plurality of representative positions, the panner applies a gain to the sound source, the gain being set for the sound source and a representative direction for the representative position.

[Claim 6]

The sound generation device according to claim 5,

wherein when a head-related impulse response (HRIR) vector for the sound-source direction is synthesized by using a sum of HRIR vectors for the plurality of representative directions to obtain a synthesized HRIR vector, the panner uses the gain calculated to cause an error signal vector between the synthesized HRIR vector and the HRIR vector for the sound-source direction to be orthogonal to each of the HRIR vectors for the plurality of representative directions.

[Claim 7]

The sound generation device according to claim 5,

wherein the panner uses the gain calculated to minimize an L2 norm or energy of an error signal vector between a synthesized head-related impulse response (HRIR) vector and an HRIR vector for the sound-source direction.

[Claim 8]

The sound generation device according to claim 7,

wherein a result obtained by applying a weighting filter in a frequency domain is used for the error signal vector.

[Claim 9]

The sound generation device according to claim 5,

wherein the panner uses corrected gains, the corrected gains being used to maintain an energy balance between left and right ears in head-related impulse responses from a position of the sound source, in substantially synthesized head-related impulse responses by

panning using head-related impulse responses from the plurality of representative positions.

[Claim 10]

The sound generation device according to claim 5,

wherein the panner applies the time shift to the sound source, treats signals to each of which the gain has been applied, as representative-position signals present at the plurality of representative positions, and convolves head-related impulse responses at the plurality of representative positions with a sum signal of the representative-position signals equal in number to a plurality of sound sources, to generate a signal that reaches an ear of a listener.

[Claim 11]

The sound generation device according to claim 3,

wherein in the time shift, a shift by a decimal of sampling is permitted.

[Claim 12]

The sound generation device according to claim 3,

wherein a reproduction high-frequency emphasis filter compensates a tendency for a high-frequency range to attenuate.

[Claim 13]

The sound generation device according to claim 1,

wherein the sound source is a sound signal of content or a sound signal of a participant of a remote call, and

the direction obtainer obtains a direction of the sound source in a view from a listener.

[Claim 14]

A sound reproduction device comprising:

the sound generation device according to any one of claims 1 to 13; and

a sound outputter that outputs a sound signal generated by the sound generation device.

[Claim 15]

A sound generation method executed by a sound generation device, the sound generation method comprising:

obtaining a sound-source direction of a sound source; and

expressing the sound source, by applying a time shift and gain adjustment to the sound source to perform panning for distributing a signal of the sound source to a plurality of representative directions, based on the sound-source direction obtained.

[Claim 16]

A sound signal processing program executed by a sound generation device, the sound signal processing program causing the sound generation device to:

obtain a sound-source direction of a sound source; and

express the sound source, by applying a time shift and gain adjustment to the sound source to perform panning for distributing a signal of the sound source to a plurality of representative directions, based on the sound-source direction obtained.