[DESCRIPTION]

[Title of Invention] ACOUSTIC SIGNAL PROCESSING METHOD, COMPUTER PROGRAM, AND ACOUSTIC SIGNAL PROCESSING DEVICE

[Technical Field]

[0001]

The present disclosure relates to an acoustic signal processing method, etc.

[Background Art]

[0002]

Patent Literature (PTL) 1 discloses a technique for outputting images and sound to create a realistic virtual space. In PTL 1, a technique is disclosed that changes the sound of wind in accordance with changes in wind strength in the virtual space.

[Citation List]

[Patent Literature]

[0003]

[PTL 1] International Patent Application Publication No. 2018/116544

[PTL 2] International Patent Application Publication No. 2021/180938

[Non Patent Literature]

[0004]

[NPL 1] Yoshinori Dobashi, et al., Real-time rendering of aerodynamic sound using sound textures based on computational fluid dynamics, ACM Transactions on Graphics, Vol. 22, No. 3, p732-740

[Summary of Invention]

[Technical Problem]

[0005]

With the technique disclosed in PTL 1, it may be difficult to provide a sense of realism to the listener.

[0006]

In view of this, the present disclosure has an object to provide, for instance, an acoustic signal processing method capable of providing a listener with a sense of realism.

[CLAIMS]

[Claim 1]

An acoustic signal processing method comprising:

obtaining sound data indicating a waveform of a reference sound;

processing the sound data to change at least one of a frequency component, a phase, or an amplitude value of the waveform based on simulated information in which variation of a natural phenomenon is simulated; and

outputting the sound data processed.

[Claim 2]

The acoustic signal processing method according to claim 1, wherein

the reference sound is an aerodynamic sound generated by wind, and

in the processing, the sound data is processed to change at least one of the frequency component, the phase, or the amplitude value of the waveform based on the simulated information in which variation of wind speed of the wind is simulated.

[Claim 3]

The acoustic signal processing method according to claim 2, wherein

the processing includes:

determining, as the simulated information, a smooth function in which variation of the wind speed of the wind is simulated; and

processing the sound data to change at least one of the frequency component, the phase, or the amplitude value of the waveform based on a value indicated by the smooth function determined.

[Claim 4]

The acoustic signal processing method according to claim 3,

wherein

the value indicated by the smooth function is information indicating a ratio between a wind speed of the aerodynamic sound as the reference sound and a wind speed of the aerodynamic sound indicated by the sound data after being processed in the processing.

[Claim 5]

The acoustic signal processing method according to claim 3, wherein

in the processing, the smooth function is so determined as to irregularly change a parameter specifying the smooth function.

[Claim 6]

The acoustic signal processing method according to claim 3, wherein

in the processing, the sound data is processed to shift the frequency component of the waveform to a frequency proportional to the value indicated by the smooth function determined.

[Claim 7]

The acoustic signal processing method according to claim 3, wherein

in the processing, the sound data is processed to change the amplitude value of the waveform in proportion to the value indicated by the smooth function determined raised to a power of α.

[Claim 8]

The acoustic signal processing method according to claim 4, wherein

in the processing, the sound data obtained is divided into processing frames of predetermined time, and the sound data is processed for each of the processing frames divided.

[Claim 9]

The acoustic signal processing method according to claim 8,

wherein

in the processing, the smooth function is so determined for each of the processing frames divided as to cause a value of the smooth function to be 1.0 at a start time and an end time of the processing frame.

[Claim 10]

An acoustic signal processing device comprising:

an obtainer that obtains sound data indicating a waveform of a reference sound;

a processor that processes the sound data to change at least one of a frequency component, a phase, or an amplitude value of the waveform based on simulated information in which variation of a natural phenomenon is simulated; and

an outputter that outputs the sound data processed.

[Claim 11]

The acoustic signal processing method according to claim 3, wherein

a parameter that specifies the smooth function is determined according to information on wind speed including momentary wind speed.

[Claim 12]

The acoustic signal processing method according to claim 3, wherein

in the processing, the smooth function is determined based on two or more parameters that change irregularly, and

one or more parameters among the two or more parameters indicate information related to wind speed.

[Claim 13]

The acoustic signal processing method according to claim 12, wherein

in the processing, the sound data obtained is divided into

processing frames of predetermined time, and the sound data is processed for each of the processing frames divided, and

one or more parameters among the two or more parameters indicate information related to a length of the processing frames.

[Claim 14]

The acoustic signal processing method according to claim 3, wherein

the processing includes:

dividing the sound data obtained into processing frames of predetermined time, and processing the sound data for each of the processing frames divided; and

determining a parameter specifying the smooth function for each of the processing frames divided.

[Claim 15]

The acoustic signal processing method according to claim 14, wherein

the parameter is an amount of time from a start time to an end time of the processing frame.

[Claim 16]

The acoustic signal processing method according to claim 14, wherein

the parameter is a value related to a maximum value of the smooth function.

[Claim 17]

A computer program for causing a computer to execute the acoustic signal processing method according to any one of claims 1 to 16.