Claims

[Claim 1]

An acceleration monitoring device comprising:

an acquisition unit that acquires a measurement acceleration waveform which is an acceleration waveform measured by a vehicle running on a track;

a storage unit that stores a reference acceleration waveform which is an acceleration waveform as a reference for the measurement acceleration waveform for a predetermined region of interest which is a partial region of the track; and

a monitoring unit that monitors an acceleration value of a non-linear expansion and contraction measurement acceleration waveform which is an acceleration waveform corresponding to the reference acceleration waveform by nonlinearly expanding and contracting a time axis of the measurement acceleration waveform by using dynamic programming matching,

wherein the region of interest is a region surrounding a step, which is an expansion joint or a guide rail joint, or a turnout,

wherein the acceleration value is a peak value corresponding to a predetermined peak value included in the reference acceleration waveform, and wherein a generation timing of the peak value corresponds to a position of the region of interest,

wherein the acquisition unit acquires an impact acceleration which is generated at the step, which is the expansion joint or the guide rail joint, or the turnout surrounded by the region of interest, and

wherein the monitoring unit identifies the acceleration waveform corresponding to the region of interest included in the measurement acceleration waveform.

[Claim 2]

The acceleration monitoring device according to claim 1, wherein

the storage unit stores a plurality of the reference acceleration waveforms for each of a plurality of running lanes on the track, and

the device further comprises

a running lane identification unit that identifies the running lane by comparing each correlation coefficient between each non-linear expansion and contraction measurement acceleration waveform which is each acceleration waveform corresponding to each reference acceleration waveform for each running lane by nonlinearly expanding and contracting the time axis of the measurement acceleration waveform, and each corresponding reference acceleration waveform, and

the monitoring unit monitors the acceleration value of the non-linear expansion and contraction measurement acceleration waveform in which the time axis of the measurement acceleration waveform is nonlinearly expanded and contracted so as to correspond to the reference acceleration waveform of the identified running lane.

[Claim 3]

The acceleration monitoring device according to claim 2, wherein

the vehicle includes a vehicle body, a bogie, and a shock absorbing device provided between the vehicle body and the bogie,

the measurement acceleration waveform includes a first measurement acceleration waveform measured by a first acceleration sensor mounted on the vehicle body and a second measurement acceleration waveform measured by a second acceleration sensor mounted on the bogie,

the reference acceleration waveform includes a first reference acceleration

waveform for each running lane corresponding to the first acceleration sensor and a second reference acceleration waveform for each running lane corresponding to the second acceleration sensor, and

the running lane identification unit identifies the running lane by comparing each correlation coefficient between each non-linear expansion and contraction measurement acceleration waveform corresponding to each first reference acceleration waveform for each running lane by nonlinearly expanding and contracting a time axis of the first measurement acceleration waveform, and each corresponding first reference acceleration waveform.

[Claim 4]

The acceleration monitoring device according to any one of claims 1 to 3, wherein

the monitoring unit further determines whether there is an abnormality in a first vehicle or on the track, based on a result of comparison between the acceleration value for each section of the non-linear expansion and contraction measurement acceleration waveform corresponding to the measurement acceleration waveform measured by a second vehicle and a predetermined threshold value for each section, in a case where the acceleration value for each predetermined section of the non-linear expansion and contraction measurement acceleration waveform corresponding to the measurement acceleration waveform measured by the first vehicle exceeds the threshold value for each section.

[Claim 5]

The acceleration monitoring device according to any one of claims 1 to 3, wherein

the acquisition unit further acquires position identification information associated

with the measurement acceleration waveform, and

the device further comprises

a position identification unit that identifies a generation position of an acceleration value exceeding a predetermined threshold value based on the position identification information, in a case where the acceleration value of the measurement acceleration waveform other than the measurement acceleration waveform corresponding to the reference acceleration waveform by nonlinearly expanding and contracting the time axis exceeds the threshold value.

[Claim 6]

The acceleration monitoring device according to claim 5 wherein

the position identification information is information corresponding to a speed of the vehicle, and

the position identification unit identifies the generation position based on an integrated value of the speed with reference to a position of a nearest region of interest.

[Claim 7]

The acceleration monitoring device according to claim 2 or 3, wherein

the acquisition unit further acquires position identification information associated with the measurement acceleration waveform, and

the device further comprises

a recording unit that associates and records an acceleration value and a generation position based on the position identification information, when the acceleration value of the measurement acceleration waveform exceeds a predetermined threshold value in a case where the running lane identification unit does not identify the running lane.

[Claim 8]

The acceleration monitoring device according to any one of claims 1 to 3, wherein the acceleration waveform is an acceleration in a translational direction.

[Claim 9]

The acceleration monitoring device according to claim 3, wherein

the acceleration value is monitored based on the second measurement acceleration waveform after the running lane is identified.

[Claim 10]

An acceleration monitoring method comprising:

a step of acquiring a measurement acceleration waveform which is an acceleration waveform measured by a vehicle running on a track; and

a step of monitoring an acceleration value of a non-linear expansion and contraction measurement acceleration waveform which is an acceleration waveform corresponding to a reference acceleration waveform which is an acceleration waveform as a reference for the measurement acceleration waveform for a predetermined region of interest which is a partial region of the track by nonlinearly expanding and contracting a time axis of the measurement acceleration waveform by using dynamic programming matching,

wherein the region of interest is a region surrounding a step, which is an expansion joint or a guide rail joint, or a turnout,

wherein the acceleration value is a peak value corresponding to a predetermined peak value included in the reference acceleration waveform, and wherein a generation timing of the peak value corresponds to a position of the region of interest,

wherein, in the step of acquiring, acquiring an impact acceleration which is generated at the step, which is the expansion joint or the guide rail joint, or the turnout surrounded by the region of interest, and

wherein, in the step of monitoring, identifying the acceleration waveform corresponding to the region of interest included in the measurement acceleration waveform.

[Claim 11]

A program that causes a computer to execute:

a step of acquiring a measurement acceleration waveform which is an acceleration waveform measured by a vehicle running on a track; and

a step of monitoring an acceleration value of a non-linear expansion and contraction measurement acceleration waveform which is an acceleration waveform corresponding to a reference acceleration waveform which is an acceleration waveform as a reference for the measurement acceleration waveform for a predetermined region of interest which is a partial region of the track by nonlinearly expanding and contracting a time axis of the measurement acceleration waveform by using dynamic programming matching,

wherein the region of interest is a region surrounding a step, which is an expansion joint or a guide rail joint, or a turnout,

wherein the acceleration value is a peak value corresponding to a predetermined peak value included in the reference acceleration waveform, and wherein a generation timing of the peak value corresponds to a position of the region of interest,

wherein, in the step of acquiring, acquiring an impact acceleration which is generated at the step, which is the expansion joint or the guide rail joint, or the turnout

surrounded by the region of interest, and

wherein, in the step of monitoring, identifying the acceleration waveform corresponding to the region of interest included in the measurement acceleration waveform.