

being monitored.

CITATION LIST

PATENT LITERATURE

[0003] Patent Literature 1: International Publication Pamphlet No. WO 2013/042789

Patent Literature 2: Japanese Laid-open Patent Publication No. 2009-199533

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0004] However, the following problems exist in the conventional technology. First, in a situation where the existence of abnormalities is determined based on whether or not a threshold value set by a veteran worker or the like based on many years of experience and intuition is exceeded, there is a problem of difficulty in setting of the threshold value when the veteran worker no longer works in the company due to retirement or the like. Further, in the case of using invariant analysis, there arises a problem in that the system configuration is complicated and becomes large in scale, and since it is necessary to define relations between a plurality of pieces of data in advance, the setting work becomes complex and cannot be easily mastered.

[0005] Embodiments of the present invention have been made in consideration of the above described problems, and seek to detect a non-normal state that

is different from a normal state by data analysis
without performing complicated

processing.

SUMMARY

[0006] Embodiments of the present invention include an information processing apparatus including: a first divider configured to divide time series data measured at a normal time into periodic data in a period unit; a reference data generator configured to generate reference data based on a plurality of pieces of periodic data; an allowable error calculator configured to calculate an allowable error of a divergence value, based on the time series data of the normal time and the reference data, the divergence value indicates a degree of divergence from the reference data; a divergence value calculator configured to calculate a divergence value between time series data for detection and the reference data, the time series data for detection is a detection object for detection of a non-normal state; and a detector configured to detect the non-normal state in accordance with whether or not the divergence value is within a range of the allowable error.

[0006a] A first aspect of the present invention provides an information processing apparatus, comprising:

a first divider configured to divide time series data measured at a normal time into periodic data in a period unit;

a reference data generator configured to generate reference data based on a plurality of pieces of periodic data;

an allowable error calculator configured to calculate an allowable error of a divergence value, based on the time series data of the normal time and the reference data, the divergence value indicates a degree of divergence from the reference data;

a divergence value calculator configured to calculate a divergence value between time series data for detection and the reference data, the time series data for detection is a detection object for detection of a non-normal state; and

a detector configured to detect the non-normal state in accordance with whether or not the divergence value is within a range of the allowable error.

[0006b] A second aspect of the present invention provides an information processing system, comprising:

a first divider configured to divide time series data measured at a normal time into periodic data in a period unit;

a reference data generator configured to generate reference data based on a plurality of pieces of periodic data;

an allowable error calculator configured to calculate an allowable error of a divergence value,

based on the time series data of the normal time and the reference data, the divergence value indicates a degree of divergence from the reference data;

a divergence value calculator configured to calculate a divergence value between time series data for detection and the reference data, the time series data for detection is a detection object for detection of a non-normal state; and

a detector configured to detect the non-normal state in accordance with whether or not the divergence value is within a range of the allowable error.

[0006c] A third aspect of the present invention provides an information processing method that is a method that an information processing apparatus executes, comprising:

a first dividing step of dividing time series data measured at a normal time into periodic data in a period unit;

a reference data generating step of generating reference data based on a plurality of pieces of periodic data;

an allowable error calculation step of calculating an allowable error of a divergence value, based on the time series data of the normal time and the reference data, the divergence value indicates a degree of divergence from the reference data;

a divergence value calculation step of

calculating a divergence value between time series data for detection and the reference data, the time series data for detection is a detection object for detection of a non-normal state; and

a detection step of detecting the non-normal state in accordance with whether or not the divergence value is within a range of the allowable error.

[0006d] A fourth aspect of the present invention provides an information processing method that is a method that an information processing system executes, comprising:

a first dividing step of dividing time series data measured at a normal time into periodic data in a period unit;

a reference data generating step of generating reference data based on a plurality of pieces of periodic data;

an allowable error calculation step of calculating an allowable error of a divergence value, based on the time series data of the normal time and the reference data, the divergence value that indicates a degree of divergence from the reference data;

a divergence value calculation step of calculating a divergence value between time series data for detection and the reference data, the time series data for detection is a detection object for

detection of a non-normal state; and

a detection step of detecting the non-normal state in accordance with whether or not the divergence value is within a range of the allowable error.

[0006e] A fifth aspect of the present invention provides a program that causes a computer to function as:

a first divider configured to divide time series data measured at a normal time into periodic data in a period unit;

a reference data generator configured to generate reference data based on a plurality of pieces of periodic data;

an allowable error calculator configured to calculate an allowable error of a divergence value, based on the time series data of the normal time and the reference data, the divergence value indicates a degree of divergence from the reference data;

a divergence value calculator configured to calculate a divergence value between time series data for detection and the reference data, the time series data for detection is a detection object for detection of a non-normal state; and

a detector configured to detect the non-normal state in accordance with whether or not the divergence value is within a range of the allowable error.

ADVANTAGEOUS EFFECTS OF INVENTION

[0007] According to the present invention, a non-normal state that is different from a normal state can be detected by data analysis without performing complicated processing.

BRIEF DESCRIPTION OF DRAWINGS

[0008] [Fig. 1] Fig. 1 is a view illustrating the

[0036] Fig. 7A to Fig. 7C are explanatory diagrams for describing the inter-data distance. It is assumed that reference data 700 is generated from normal-time data as illustrated in Fig. 7A. In contrast, as illustrated in Fig. 7B, non-normal-time data 701 for which the amplitude is small in comparison to the reference data 700 is sometimes measured. For example, a case is conceivable in which air conditioning of the external device 110 stopped.

[0037] Fig. 7C is a view illustrating divergence values of respective indices obtained with respect to the detection object data 701. As illustrated in Fig. 7C, it is found that although the values of the non-normal-time data 701 and the values of the normal-time data cannot be effectively separated with respect to the correlation coefficient and the total sum of differences, it is possible to effectively separate the values of the non-normal-time data 701 and the normal-time data with respect to the inter-data distance. In other words, as described in the foregoing, it is found that the inter-data distance is suitable for detecting a non-normal state in which the amplitude of data changes.

[0038] Fig. 8A and Fig. 8B are explanatory diagrams for describing a case of using a combination of the foregoing three indices, namely, the correlation coefficient, the total sum of differences and the inter-data distance. As illustrated in Fig. 8A, non-

according to claim 1 or 2, wherein:

the allowable error calculator calculates the allowable error based on a total sum of differences between each of the plurality of pieces of time series data and the reference data; and

the divergence value calculator calculates a total sum of differences between the time series data for detection and the reference data as the divergence value.

[Claim 6] The information processing apparatus according to claim 5, wherein:

the allowable error calculator calculates a range from a smallest value to a maximum value of total sums of differences between each of the plurality of pieces of time series data and the reference data as the allowable error.

[Claim 7] The information processing apparatus according to claim 1 or 2, wherein:

the allowable error calculator calculates the allowable error based on an inter-data distance between each of the plurality of pieces of time series data and the reference data; and

the divergence value calculator calculates an inter-data distance between the time series data for detection and the reference data as the divergence value.

[Claim 8] The information processing apparatus according to claim 7, wherein:

the allowable error calculator calculates a

maximum value of inter-data distances between each of the plurality of pieces of time series data and the reference data as the allowable error.

[Claim 9] The information processing apparatus according to any one of claims 1 to 8, wherein:

the reference data generator updates the reference data based on time series data, the time series data is measured at a normal time and newly obtained;

in a case where the reference data is updated, the allowable error calculator updates the allowable error using the reference data after updating; and

the divergence value calculator calculates a divergence value between the time series data for detection and the updated reference data.

[Claim 10] The information processing apparatus according to any one of claims 1 to 9, further comprising:

a period unit determiner configured to determine a period unit based on the time series data of the normal time,

wherein the first divider divides the time series data into the periodic data in the period unit determined by the period unit determiner.

[Claim 11] The information processing apparatus according to any one of claims 1 to 10, wherein:

in a case where the time series data of the normal time includes a plurality of pieces of periodic data having differing trends to each other,