Claims

[Claim 1]

A wear inspection apparatus comprising:

a data acquisition unit which is configured to acquire surface shape data including information indicating a shape of a surface of a part worn as a vehicle travels;

a processing target extraction unit which is configured to distinguish between a gradient portion in which a difference between a value of each point included in the surface shape data and a value of an adjacent point is larger than a predetermined threshold value, and a flat portion in which the difference is smaller than the predetermined threshold value in the surface shape data, and extract a processing target section for calculating a degree of wear in the surface shape data from the gradient portion and the flat portion after the distinguishment; and

an approximation processing unit which is configured to calculate an approximation line for the surface shape data in the processing target section and calculate a degree of wear of the part from the approximation line and a worn portion included in the surface shape data.

[Claim 2]

The wear inspection apparatus according to claim 1, further comprising:

a noise elimination unit which is configured to eliminate noise from the surface shape data,

wherein the noise elimination unit is configured to perform coordinate conversion so that the pieces of surface shape data measured by a sensor in respective positional relationships are converted into pieces of surface shape data measured in the same positional relationship, in accordance with changes in a relative positional relationship between the part

and the sensor measuring the shape of the surface of the part.

[Claim 3]

The wear inspection apparatus according to claim 1 or 2

wherein the processing target extraction unit is configured to create a histogram according to each value included in the surface shape data and a frequency of appearance of the value, adjust a classification width of the histogram on the basis of a predetermined number of groups in a case where values corresponding to a surface portion or a worn portion which are selected from among the values included in the surface shape data are classified into the number of groups, create a histogram in which the pieces of surface shape data are classified into the number of groups, and extract a portion of surface shape data corresponding to the flat portion and a portion of surface shape data corresponding to the worn portion formed in the surface of the part from the created histogram.

[Claim 4]

The wear inspection apparatus according to claim 3,

wherein the approximation processing unit is configured to calculate the degree of wear of the part on the basis of a difference between the surface shape data corresponding to the worn portion which is extracted by the processing target extraction unit and the calculated approximation line.

[Claim 5]

The wear inspection apparatus according to claim 1 or 2,

wherein the processing target extraction unit is configured to extract the largest flat portion as a processing target section from the flat portion distinguished with the gradient

portion as a boundary, out of the flat portion and the gradient portion after the distinguishment.

[Claim 6]

The wear inspection apparatus according to claim 5,

wherein the approximation processing unit is configured to calculate an approximation straight line on the basis of surface shape data corresponding to the flat portion extracted by the processing target extraction unit, and calculate an amount of wear of the part by integrating a difference between a value of the approximation straight line and a value of the surface shape data with respect to a section in which wear occurs in the surface shape data, the approximation straight line being approximate to a sequence of points of an unworn portion of the part in the surface shape data.

[Claim 7]

The wear inspection apparatus according to any one of claims 1 to 6,

wherein the processing target extraction unit is configured to select the boundaries located at both ends of the boundaries from the flat portions to the gradient portions in the entire section including the flat portions and the gradient portions after the distinction and to extract section which is sandwiched the boundaries between the selected boundaries as the processing target section.

[Claim 8]

The wear inspection apparatus according to any one of claims 1 to 7, further comprising

an evaluation model creation unit which is configured to create an evaluation model

for evaluating the degree of wear of the part according to operation conditions of the vehicle on the basis of the degree of wear of the part which is calculated by the approximation processing unit and operation data indicating the operation conditions of the vehicle including the part; and

a replacement time prediction unit which is configured to acquire operation data on a target vehicle serving as an evaluation target, evaluate a degree of wear occurring in a part of the target vehicle on the basis of the operation data and the evaluation model, and predict a time for replacement of the part of the target vehicle for which the degree of wear is evaluated, on the basis of information indicating the time for replacement of the part which is determined in association with the degree of wear of the part of the target vehicle.

[Claim 9]

A wear inspection method comprising:

acquiring surface shape data including information indicating a shape of a surface of a part worn as a vehicle travels;

distinguishing between a gradient portion in which a difference between a value of each point included in the surface shape data and a value of an adjacent point is larger than a predetermined threshold value, and a flat portion in which the difference is smaller than the predetermined threshold value in the surface shape data, and extracting a processing target section for calculating a degree of wear in the surface shape data from the gradient portion and the flat portion after the distinguishment; and

calculating an approximation line for the surface shape data in the processing target section and calculating a degree of wear of the part from the approximation line and a worn portion included in the surface shape data.