

CLAIMS

[Claim 1]

A classification model learning device that generates a classification model classifying sensor data acquired from target objects by a predetermined sensor,

the classification model including:

a clustering model configured to classify the sensor data into a plurality of groups on the basis of a similarity of the sensor data using a predetermined clustering technique; and

a classification unit configured to classify the sensor data included in an extraction target group among a plurality of groups classified using the clustering model,

the classification model learning device comprising:

a sensor data acquiring unit configured to acquire a plurality of pieces of sensor data acquired from the target objects included in a first target object group formed from the plurality of target objects as first sensor data using the sensor acquiring states of the target objects and acquire a plurality of pieces of sensor data acquired from the target objects included in a second target object group that is a target object group acquired by excluding one or more target objects from the first target object group as second sensor data using the sensor;

a clustering model generating unit configured to update parameters of the clustering model by classifying a sensor data group formed from the plurality of pieces of the first sensor data and the plurality of pieces of the second sensor data into a plurality of groups using the clustering model;

a designation unit configured to designate a group in which the number of pieces of the second sensor data included in the group is smaller than the number of pieces of the first sensor data by a predetermined degree or more from among a plurality of groups classified using the clustering model as the extraction target group; and

a learning unit configured to perform learning of the classification model by repeating a learning process including a process of acquisition of the first sensor data and the second sensor data using the sensor data acquiring unit, update of the parameters of the clustering model using the clustering model generating unit, and designation of the extraction target group using the designation unit.

[Claim 2]

The classification model learning device according to claim 1, wherein the sensor data acquiring unit acquires a reference sensor data set formed from a plurality of pieces of sensor data prepared in advance, and

wherein the learning unit ends the learning process in a case in which a difference between a classification result of sensor data acquired by inputting the reference sensor data set to the classification model after performance of the learning process n times (here, n is an integer equal to or larger than 1) and a classification result of sensor data acquired by inputting the reference sensor data set to the classification model after performance of the learning process $(n+1)$ times becomes less than a predetermined degree.

[Claim 3]

The classification model learning device according to claim 1 or
2,

wherein the clustering model generating unit uses a sensor data
group formed from the plurality of pieces of the first sensor data and the
5 plurality of pieces of the second sensor data acquired on the basis of
sensing of a predetermined one unit using the sensor as a sensor data
group of one unit and performs classification of sensor data and update
of the parameters using the clustering model for each sensor data group
of one unit, and

10 wherein the designation unit designates the extraction target
group every time classification of the sensor data group of one unit is
performed.

[Claim 4]

The classification model learning device according to claim 1 or
15 2,

wherein the clustering model generating unit uses a sensor data
group formed from the plurality of pieces of the first sensor data and the
plurality of pieces of the second sensor data acquired on the basis of
sensing of a predetermined one unit using the sensor as a sensor data
20 group of one unit and performs classification of sensor data and update
of the parameters using the clustering model for the sensor data group of
at least two units or more, and

wherein the designation unit designates the extraction target
group every time classification of the sensor data group of two units or
25 more is performed.

[Claim 5]

A classification model learning device that generates a classification model classifying sensor data acquired from target objects by a predetermined sensor,

the classification model including:

5 a clustering model configured to classify the sensor data into a plurality of groups on the basis of a similarity of the sensor data using a predetermined clustering technique; and

 a classification unit configured to classify the sensor data included in each of i -th (here, $i = 1, 2, \dots, m$; m is an integer equal to or
10 larger than 2) extraction target group among a plurality of groups clustered using the clustering model, for each of the extraction target groups, and

the classification model learning device comprising:

 a sensor data acquiring unit configured to acquire a plurality of
15 pieces of sensor data acquired from the target objects included in a first target object group formed from the plurality of target objects as first sensor data using the sensor acquiring states of the target objects, and acquire, as second sensor data to $(m + 1)$ th sensor data, a plurality of pieces of sensor data acquired from target objects included in second to
20 $(m + 1)$ th target object groups obtained by removing one or more objects from each of the first to m -th object groups;

 a clustering model generating unit configured to update parameters of the clustering model by classifying a sensor data group including the plurality of first sensor data and the plurality of second
25 sensor data to the plurality of $(m + 1)$ th sensor data into a plurality of groups using the clustering model;

a designation unit configured to designate, as the i-th extraction target group, a group in which the number of pieces of (i+1)-th sensor data included in the group is smaller than the number of pieces of i-th sensor data by a predetermined degree or more from among a plurality of groups classified by the clustering model; and

a learning unit configured to perform learning of the classification model by repeating a learning process including a process of acquisition of the sensor data using the sensor data acquiring unit, update of the parameters of the clustering model using the clustering model generating unit, and designation of the extraction target group using the designation unit.

[Claim 6]

A classification model learning method for generating a classification model classifying sensor data acquired from target objects by a predetermined sensor,

the classification model including:

a clustering model configured to classify the sensor data into a plurality of groups on the basis of a similarity of the sensor data using a predetermined clustering technique; and

a classification unit configured to classify the sensor data included in an extraction target group among a plurality of groups classified using the clustering model,

the classification model learning method comprising:

a sensor data acquiring step of acquiring a plurality of pieces of sensor data acquired from the target objects included in a first target object group formed from the plurality of target objects as first sensor

data using the sensor acquiring states of the target objects and acquiring a plurality of pieces of sensor data acquired from the target objects included in a second target object group that is a target object group acquired by excluding one or more target objects from the first target object group as second sensor data using the sensor;

a clustering model generating step of updating parameters of the clustering model by classifying a sensor data group formed from the plurality of pieces of the first sensor data and the plurality of pieces of the second sensor data into a plurality of groups using the clustering model;

a designation step of designating a group in which the number of pieces of the second sensor data included in the group is smaller than the number of pieces of the first sensor data by a predetermined degree or more from among a plurality of groups classified using the clustering model as the extraction target group; and

a learning step of performing learning of the classification model by repeating a learning process including a process of acquisition of the first sensor data and the second sensor data in the sensor data acquiring step, update of the parameters of the clustering model in the clustering model generating step, and designation of the extraction target group in the designation step.

[Claim 7]

A classification model learning program causing a computer to function as a classification model learning device that generates a classification model classifying sensor data acquired from target objects by a predetermined sensor,

the classification model including:

a clustering model configured to classify the sensor data into a plurality of groups on the basis of a similarity of the sensor data using a predetermined clustering technique; and

a classification unit configured to classify the sensor data included in an extraction target group among a plurality of groups classified using the clustering model,

the classification model learning program causing the computer to implement:

a sensor data acquiring function of acquiring a plurality of pieces of sensor data acquired from the target objects included in a first target object group formed from the plurality of target objects as first sensor data using the sensor acquiring states of the target objects and acquiring a plurality of pieces of sensor data acquired from the target objects included in a second target object group that is a target object group acquired by excluding one or more target objects from the first target object group as second sensor data using the sensor;

a clustering model generating function of updating parameters of the clustering model by classifying a sensor data group formed from the plurality of pieces of the first sensor data and the plurality of pieces of the second sensor data into a plurality of groups using the clustering model;

a designation function of designating a group in which the number of pieces of the second sensor data included in the group is smaller than the number of pieces of the first sensor data by a predetermined degree or more from among a plurality of groups classified using the clustering model as the extraction target group; and

a learning function of performing learning of the classification model by repeating a learning process including a process of acquisition of the first sensor data and the second sensor data using the sensor data acquiring function, update of the parameters of the clustering model using the clustering model generating function, and designation of the extraction target group using the designation function.

[Claim 8]

A learned classification model causing a computer to function to classify sensor data acquired from target objects using a predetermined sensor,

the classification model comprising:

a clustering model configured to classify the sensor data into a plurality of groups on the basis of a similarity of the sensor data using a predetermined clustering technique; and

a classification unit configured to classify the sensor data included in an extraction target group among a plurality of groups classified using the clustering model,

wherein the clustering model is built by updating parameters of the clustering model by classifying a sensor data group formed from first sensor data formed from a plurality of pieces of sensor data acquired from the target objects included in a first target object group formed from a plurality of target objects using the sensor and second sensor data formed from a plurality of pieces of sensor data acquired from the target objects included in a second target object group that is a target object group acquired by excluding one or more target objects from the first target

object group using the sensor into a plurality of groups using the clustering model, and

wherein the classification unit classifies the sensor data using a group in which the number of pieces of the second sensor data included in the group is smaller than the number of pieces of the first sensor data by a predetermined degree or more among the plurality of groups classified using the clustering model as an extraction target group.

[Claim 9]

A classification device that classifies sensor data acquired from target objects using a predetermined sensor using a learned classification model,

wherein the classification model is a model for causing a computer to function and includes:

a clustering model configured to classify the sensor data into a plurality of groups on the basis of a similarity of the sensor data using a predetermined clustering technique; and

a classification unit configured to classify the sensor data included in an extraction target group among a plurality of groups classified using the clustering model,

wherein the clustering model is built by updating parameters of the clustering model by classifying a sensor data group formed from first sensor data formed from a plurality of pieces of sensor data acquired from the target objects included in a first target object group formed from a plurality of target objects using the sensor and second sensor data formed from a plurality of pieces of sensor data acquired from the target objects included in a second target object group that is a target object group

acquired by excluding one or more target objects from the first target object group using the sensor into a plurality of groups using the clustering model,

wherein the classification unit classifies the sensor data using a group in which the number of pieces of the second sensor data included in the group is smaller than the number of pieces of the first sensor data by a predetermined degree or more among the plurality of groups classified using the clustering model as an extraction target group, and

wherein the classification device includes:

an acquisition unit configured to acquire sensor data of classification targets; and

an extraction unit configured to extract sensor data classified into the extraction target group by using the classification model by inputting the sensor data of the classification target to the classification model.

[Claim 10]

A sorting device for sorting target objects from a target object group on the basis of states of the target objects, the sorting device comprising:

a first sensor module configured to include a first sensor acquiring the states of the target objects included in a first target object group formed from a plurality of target objects; and

a lower process module disposed on a downstream process side of the first sensor module and configured using one of a second sensor module including a second sensor that is the same sensor as the first sensor and acquires the states of the target objects included in a second

target object group that is a target object group acquired by excluding one or more target objects from the first target object group;

wherein the first sensor acquires a plurality of pieces of sensor data acquired from the target objects included in the first target object group as first sensor data,

wherein the second sensor acquires a plurality of pieces of sensor data acquired from the target objects included in the second target object group as second sensor data,

wherein the first sensor data and the second sensor data are used to learn a classification model for classifying sensor data acquired from the target object, and

wherein the classification model includes:

a clustering model configured to classify the sensor data into a plurality of groups on the basis of a similarity of the sensor data using a predetermined clustering technique; and

a classification unit configured to classify the sensor data included in an extraction target group among a plurality of groups classified using the clustering model,

wherein the clustering model is built by updating parameters of the clustering model by classifying a sensor data group formed from the first sensor data and the second sensor data into a plurality of groups using the clustering model, and

wherein the classification unit classifies the sensor data using a group in which the number of pieces of the second sensor data included in the group is smaller than the number of pieces of the first sensor data by a predetermined degree or more among the plurality of groups

classified using the clustering model as an extraction target group.