

Description

METHOD FOR CONSTRUCTING PARAMETER SETTING MODEL AND METHOD FOR INDUSTRIAL PROCESS CONTROL

Cross-Reference to Related Application

This application claims priority to Chinese Patent Application No. 202210859981.X, entitled "METHOD FOR CONSTRUCTING PARAMETER SETTING MODEL CONSTRUCTION AND METHOD FOR INDUSTRIAL PROCESS CONTROL" and filed on July 22, 2022. The entire content of the above-referenced application is incorporated herein by reference.

Technical Field

The present application relates to the technical field of industrial automatic control, and in particular, to a method for constructing a parameter setting model and a method for industrial process control.

Background

PID (proportion, integral, differential) is the most widely used control policy at present. PID parameter setting is a core content of a control working process. Parameter setting is to determine proportional coefficient, integral time, and deviation values of differential time according to characteristics of a control system during working.

At present, a PID parameter setting method is generally an internal-model-based setting method. This method constructs a mathematical model for PID parameter setting, constructs a process mathematical model based on process historical data, and uses an internal model setting policy to obtain PID parameters according to the mathematical model. This method is a relatively effective PID parameter setting method.

However, in the internal-model-based setting method, a large amount of valid data is required to construct a process model. For process models constructed on a newly built apparatus, due to a small amount of available data information, it is not enough to construct a reliable process model. As a result, an actual effect of the PID parameter setting is poor.

Summary

The present application aims to provide a method for constructing a parameter setting model

and a method for industrial process control. By constructing an auxiliary training dataset for training, the defect of a small amount of available valid data of a newly built apparatus is effectively made up for, and the accuracy of proportion, integral, differential (PID) parameter setting of a parameter setting model constructed on the newly built apparatus is improved.

The embodiments of the present application can be implemented below:

According to a first aspect, the embodiments of the present application provide a method for constructing a parameter setting model. The method includes:

constructing an auxiliary training dataset and a validation dataset according to loop information of a newly built apparatus and running data of an auxiliary apparatus, wherein the newly built apparatus is an apparatus applied to a parameter setting model to be trained, and the auxiliary apparatus is an apparatus that has completed parameter setting and is run formally;

constructing a local training dataset according to initial running data of the newly built apparatus; and

performing training according to the auxiliary training dataset, the validation dataset, and the local training dataset to obtain a parameter setting model.

In some embodiments of the present application, constructing the auxiliary training dataset and the validation dataset according to loop information of the newly built apparatus and running data of the auxiliary apparatus includes:

obtaining a target dataset by screening the running data of the auxiliary apparatus according to a loop type of the newly built apparatus and a physical characteristic corresponding to a control loop; and

splitting the target dataset to obtain the auxiliary training dataset and the validation dataset.

In some embodiments of the present application, obtaining the target dataset by screening the running data of the auxiliary apparatus according to the loop type of the newly built apparatus and the physical characteristic corresponding to the control loop includes:

obtaining a plurality of selectable running data matched with the loop type by screening the running data of the auxiliary apparatus according to the loop type of the newly built apparatus; and

obtaining the target dataset by screening the plurality of selectable running data according to the physical characteristic corresponding to the control loop of the newly built apparatus.

In some embodiments of the present application, performing training according to the auxiliary

training dataset, the validation dataset, and the local training dataset to obtain the parameter setting model includes:

performing training according to the auxiliary training dataset and the local training dataset to obtain an intermediate setting model;

validating the intermediate setting model on the basis of the validation data set, and running, after validation succeeds, the intermediate setting model according to a preset input parameter value to obtain an output parameter value of the intermediate setting model;

obtaining a loop PID parameter value after the newly built apparatus is run according to the preset input parameter value; and

performing parameter optimization on the intermediate setting model according to the loop PID parameter value and the output parameter value to obtain the parameter setting model.

In some embodiments of the present application, performing parameter optimization on the intermediate setting model according to the loop PID parameter value and the output parameter value to obtain the parameter setting model includes:

determining a parameter error rate according to the loop PID parameter value and the output parameter value; and

performing iterative correction on model parameters of the intermediate setting model according to the parameter error rate to obtain the parameter setting model.

In some embodiments of the present application, the model parameters include a first intermediate weight vector and an intermediate offset parameter value;

performing iterative correction on model parameters of the intermediate setting model according to the parameter error rate to obtain the parameter setting model includes:

correcting the intermediate offset parameter value according to the parameter error rate to obtain a process offset parameter value;

correcting the first intermediate weight vector according to the process offset parameter value to obtain a first process weight vector;

obtaining a new intermediate setting model according to the process offset parameter value and the first process weight vector, and redetermining a parameter error rate of the intermediate setting model; and

repeating above process until the parameter error rate is less than a preset threshold, and using the intermediate setting model as the parameter setting model.

In some embodiments of the present application, before performing training according to the auxiliary training dataset and the local training dataset to obtain an intermediate setting model, the method further includes:

determining a root-mean-square error and a determination coefficient according to the auxiliary training dataset and the local training dataset;

determining a quantity of hidden layer nodes of an initial parameter setting model according to the root-mean-square error and the determination coefficient;

constructing the initial parameter setting model according to the quantity of hidden layer nodes, a preset quantity of input layer nodes, and a preset quantity of output layer nodes; and

training the initial parameter setting model according to the auxiliary training dataset and the local training dataset to obtain the intermediate setting model.

According to a second aspect, the embodiments of the present application provide a method for industrial process control. The method includes:

determining a set parameter value of a newly built apparatus to be controlled according to a parameter setting model, wherein the parameter setting model is obtained on the basis of any method for constructing the parameter setting model according to the first aspect; and

controlling the newly built apparatus according to the set parameter value to execute a target process.

According to a third aspect, the embodiments of the present application provide an apparatus for constructing the parameter setting model, including:

a dataset construction component, configured to construct an auxiliary training dataset and a validation dataset according to loop information of a newly built apparatus and running data of an auxiliary apparatus, wherein the newly built apparatus is an apparatus applied to a parameter setting model to be trained, and the auxiliary apparatus is an apparatus that has completed parameter setting and is run formally;

the dataset construction component is further configured to construct a local training dataset according to initial running data of the newly built apparatus; and

a model training component, configured to perform training according to the auxiliary training

dataset, the validation dataset, and the local training dataset to obtain a parameter setting model.

The dataset construction component is specifically configured to: obtain a target dataset by screening the running data of the auxiliary apparatus according to a loop type of the newly built apparatus and a physical characteristic corresponding to a control loop; and split the target dataset to obtain the auxiliary training dataset and the validation dataset.

The dataset construction component is specifically configured to: obtain a plurality of selectable running data matched with the loop type by screening the running data of the auxiliary apparatus according to the loop type of the newly built apparatus; and obtain the target dataset by screening the plurality of selectable running data according to the physical characteristic corresponding to the control loop of the newly built apparatus.

The model training component is specifically configured to: perform training according to the auxiliary training dataset and the local training dataset to obtain an intermediate setting model; validate the intermediate setting model on the basis of the validation data set, and run, after validation succeeds, the intermediate setting model according to a preset input parameter value to obtain an output parameter value of the intermediate setting model; obtain a loop PID parameter value after the newly built apparatus is run according to the preset input parameter value; and perform parameter optimization on the intermediate setting model according to the loop PID parameter value and the output parameter value to obtain the parameter setting model.

The model training component is specifically configured to: determine a parameter error rate according to the loop PID parameter value and the output parameter value; and perform iterative correction on model parameters of the intermediate setting model according to the parameter error rate to obtain the parameter setting model.

the model parameters includes a first intermediate weight vector and an intermediate offset parameter value; the model training component is specifically configured to: correct the intermediate offset parameter value according to the parameter error rate to obtain a process offset parameter value; correct the first intermediate weight vector according to the process offset parameter value to obtain a first process weight vector; obtain a new intermediate setting model according to the process offset parameter value and the first process weight vector, and redetermine a parameter error rate of the intermediate setting model; and repeat the above process until the parameter error rate is less than a preset threshold, and use the intermediate setting model as the parameter setting model.

The model construction component is configured to determine a root-mean-square error and a

determination coefficient according to the auxiliary training dataset and the local training dataset; determine a quantity of hidden layer nodes of an initial parameter setting model according to the root-mean-square error and the determination coefficient; construct the initial parameter setting model according to the quantity of hidden layer nodes, a preset quantity of input layer nodes, and a preset quantity of output layer nodes; and train the initial parameter setting model according to the auxiliary training dataset and the local training dataset to obtain the intermediate setting model.

According to a fourth aspect, the embodiments of the present application provide an apparatus for industrial process control, including:

a determination component, configured to determine a set parameter value of a newly built apparatus to be controlled according to a parameter setting model, wherein the parameter setting model is obtained on the basis of any method for constructing the parameter setting model according to the first aspect; and

a control component, configured to control the newly built apparatus according to the set parameter value to execute a target process.

According to a fifth aspect, the embodiments of the present application provides a processing device. The processing device includes a processor, a storage medium, and a bus, wherein the storage medium stores machine-readable instructions executable by the processor; when the processing device is run, the processor communicates with the storage medium through the bus; and the processor executes the machine-readable instructions to execute the steps of any method for constructing the parameter setting model in the first aspect or the steps of the method for industrial process control in the second aspect.

According to a sixth aspect, the embodiments of the present application provide a computer-readable storage medium. The computer-readable storage medium stores a computer program, and the computer program, when executed by a processor, implements the steps of any method for constructing the parameter setting model in the first aspect or the steps of the method for industrial process control in the second aspect.

Beneficial effects of the embodiments of the present application include:

By the adoption of the method for constructing the parameter setting model and the method for industrial process control according to the present application, the auxiliary training dataset can be constructed by virtue of the running data of the auxiliary apparatus, and the parameter setting model is trained and constructed by the auxiliary training dataset and the local training dataset constructed using the running data of the newly built apparatus. The present application fully uses

the running data of the auxiliary apparatus that has completed parameter setting and is run formally to train the parameter setting model, which makes up for the defect of a small amount of available valid data of the newly built apparatus and improves the accuracy and efficiency of PID parameter setting of the parameter setting model constructed on the newly built apparatus.

Brief Description of the Drawings

For clearer descriptions of the technical solutions of the embodiments of the present application, the drawings required to be used in the embodiments are briefly introduced below. It should be understood that the drawings below are only some embodiments of the present application. Therefore, the embodiments shall not be regarded as limitations on the scope. A person of ordinary skill in the art can also obtain other relevant drawings according to these drawings without creative work.

Fig. 1 is a flowchart of steps of a method for constructing parameter setting model according to the embodiments of the preset application;

Fig. 2 is a flowchart of a dataset construction step of a method for constructing parameter setting model according to the embodiments of the preset application;

Fig. 3 is a flowchart of a dataset screening step of a method for constructing parameter setting model according to the embodiments of the preset application;

Fig. 4 is a flowchart of a model training optimization step of a method for constructing parameter setting model according to the embodiments of the preset application;

Fig. 5 is a flowchart of implementation of a method for constructing parameter setting model according to the embodiments of the preset application;

Fig. 6 is a flowchart of a parameter optimization step of a method for constructing parameter setting model according to the embodiments of the preset application;

Fig. 7 is a flowchart of another parameter optimization step of a method for constructing parameter setting model according to the embodiments of the preset application;

Fig. 8 is a flowchart of a model construction step of a method for constructing parameter setting model according to the embodiments of the preset application;

Fig. 9 is a flowchart of steps of an method for industrial process control according to the embodiments of the preset application;

Fig. 10 is a schematic structural diagram of an apparatus for constructing parameter setting model according to the embodiments of the preset application;

Fig. 11 is a schematic structural diagram of an apparatus for industrial process control according to the embodiments of the preset application; and

Fig. 12 is a schematic structural diagram of a processing device according to the embodiments of the present application.

Reference numerals: 100: apparatus for constructing parameter setting model; 1001: dataset construction component; 1002: model training component; 1003: model construction component; 110: apparatus for industrial process control; 1101: determination component; 1102: control component; 2001: processor; and 2002: memory.

Detailed Description of the Embodiments

In order to make the objectives, technical solutions, and advantages of the embodiments of the present application clearer, the technical solutions in the embodiments of the present application are clearly and completely described below with reference to the accompanying drawings in the embodiments of the present application. Apparently, the described embodiments are merely some rather than all of the embodiments of the present application. Assemblies of the embodiments of the present application commonly described and shown in the accompanying drawings here may be arranged and designed in a variety of different configurations.

Accordingly, the following detailed descriptions of the embodiments of the present application provided in the accompanying drawings are not intended to limit the scope of the claimed present application, but merely represents selected embodiments of the present application. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present application without making creative efforts shall fall within the protection scope of the present application.

It should be noted that similar reference numerals and letters indicate similar items in the following drawings. Therefore, once a certain item is defined in one drawing, it is unnecessary to further define and explain it in the subsequent drawings.

In addition, the terms "first", "second", and the like are only for the purpose of distinguishing, and may not be understood as indicating or implying the relative importance.

It should be noted that features in the embodiments of the present application may be mutually combined without conflicts.

PID parameter setting is a process of setting three parameters, namely a proportional parameter, an integral parameter, and a differential parameter to achieve required dynamic and static performance of a system and to achieve performance index to be optimal. At present, common parameter setting methods are parameter setting methods based on internal model setting. This method constructs a loop process model by acquiring historical input-output relationship parameters on a target apparatus, and obtains setting parameter results according to an internal model setting policy and the loop process model, thereby obtaining real-time PID parameters for the target apparatus. However, the model obtained in this way needs to be driven by a large amount of valid historical data. For a newly built apparatus, due to a small amount of available data information, it is not enough to train a reliable model. As a result, an actual effect of the PID parameter setting is poor.

Based on this, the applicant has proposed a method for constructing parameter setting model and a method for industrial process control through researches. An auxiliary training dataset can be constructed using an auxiliary apparatus that has completed parameter setting, and is used to assist a local training dataset in constructing a parameter setting model, which avoids the problem of low accuracy caused by insufficient model training due to insufficient historical data and improves the accuracy and efficiency of PID parameter setting of the newly built apparatus.

Transfer learning simulates a thinking process of a human brain. After working out a question, people will have a better and faster solution to a new related question. In other words, the transfer learning is different from previous machine learning methods. The transfer learning can use "knowledge" learned from tasks in the same domain as a target domain, such as data features and model parameters, to assist a learning process in a new domain, thus obtaining a model that can be applied to the target domain.

An industrial control system includes various different types of control loops. Although scales and data distributions of different industrial control systems may vary, at the level of the control loops, the control loops of the different industrial control systems may possibly have some similar feature information. Based on this, the embodiments of the present application provide a method for constructing parameter setting model and a method for industrial process control. Through transfer learning, running data of an auxiliary apparatus that has already completed parameter setting is applied to training of a parameter setting model of a newly built apparatus, which solves the problem that an existing network model relies heavily on valid data of the newly built apparatus in a training process, and improves the construction speed and accuracy of the parameter setting model on the newly built apparatus.

A plurality of specific application examples are combined below to explain and describe the method for constructing parameter setting model and the method for industrial process control provided in the embodiments of the present application.

Fig. 1 is a flowchart of steps of a method for constructing parameter setting model according to the embodiments of the preset application. An executive body of the method can be a computer device with computing and processing capabilities. As shown in Fig. 1, the method includes the following steps:

S101, an auxiliary training dataset and a validation dataset are constructed according to loop information of a newly built apparatus and running data of an auxiliary apparatus.

The newly built apparatus is an apparatus applied to a parameter setting model to be trained, and the auxiliary apparatus is an apparatus that has completed parameter setting and is run formally.

The newly built apparatus can be an apparatus that has been constructed and requires construction of a parameter setting model for PID parameter setting. Exemplarily, the newly built apparatus may be a plurality of apparatuses included in an ethylene system, such as one or more of an ethylene apparatus, a cracked gasoline hydrogenation apparatus, a butadiene extraction apparatus, an aromatics extraction apparatus, an MTBE/butene-1 apparatus, an ethylene glycol apparatus, and a POX apparatus. In some embodiments of the present application, the respective apparatuses can further include a plurality of control loops.

The auxiliary apparatus can be an apparatus that includes a plurality of control loops, has completed parameter setting, and is normal in running state. One or more of these control loops can be matched with some features of the control loops of the newly built apparatus. It can be understood that there can be more than one auxiliary apparatus, and the control loops included in the plurality of auxiliary apparatuses together form a control loop set that is matched with the plurality of control loops in the newly built apparatus in a one-to-one correspondence manner.

An auxiliary training dataset $T_a = \{X_i^a, C(X_i^a)\}$ in which data does not overlap, where $X_i^a \in X_a$ in case of $i = 1, 2, \dots, n$, and a validation data set $S = \{X_i^t, C(X_i^t)\}$, where $X_i^t \in X_a$ in case of $i = 1, 2, \dots, k$, are constructed according to running data generated in the control loop set described above. X_i^a and $C(X_i^a)$ are an input parameter and output parameter of the auxiliary training dataset T_a ; X_i^t and $C(X_i^t)$ are an input parameter and output parameter of the validation dataset S ; X_a is the running data of the auxiliary apparatus; n is control loop data contained in the auxiliary training dataset T_a ; and k is a quantity of control loops contained in the validation dataset S .

S102, a local training dataset is constructed according to initial running data of the newly built apparatus.

In some embodiments of the present application, some initial input parameters can be input to the newly built apparatus by performing manual PID parameter setting on the newly built apparatus, to obtain corresponding initial output parameters. The local training dataset $T_b = \{X_j^b, C(X_j^a)\}$ is constructed according to the initial input parameters, the initial output parameters, and a correspondence relationship between the initial input parameters and the initial output parameters, where $X_j^b \in X_b$ in case of $i = 1, 2, \dots, m$, where X_j^b is an input parameter of the local training dataset T_b ; $C(X_j^a)$ is an output parameter of the local training dataset T_b ; and X_b is the initial running data of the newly built apparatus.

In addition, due to a small amount of the initial running data obtained through the manual PID parameter setting, a data volume contained in the auxiliary training dataset T_a and a data volume contained in the validation dataset S can be much greater than a data volume in the local training dataset T_b .

In some embodiments of the present application, parameters contained in the input parameters and output parameters of the auxiliary training dataset T_a , validation dataset S , and local training dataset T_b may be the same. The input parameters can include: apparatuses to which the control loops belong, a loop type, closed-loop steady-state time T_s of the loops, peak time T_p , a maximum overshoot $Y_{\max}$, positive and negative effects of a controller, physical characteristics corresponding to the control loops, and the like. The output parameters can include: loop PID parameters, namely a proportional coefficient (a proportional degree), integral time (minutes), and differential time (minutes).

In the above input parameters, T_s refers to response time to a transition period of the control loop from excitation to steadiness; T_p is a moment of a maximum value of the control loop in the transition period; $Y_{\max}$ is a maximum value that exceeds a set value in the transition period; and the positive and negative effects of the controller refer to a positive feedback or negative feedback effect of the controller on the control loop.

In some embodiments of the present application, the running data X_a of the auxiliary apparatus and the initial running data X_b of the newly built apparatus can be stored in a form of a table, and the various input parameters and output parameters can be extracted and obtained according to corresponding data items in the table.

S103, training is performed according to the auxiliary training dataset, the validation dataset, and the local training dataset to obtain a parameter setting model.

A type of the parameter setting model can be a BP neural network model, which includes an input layer, a hidden layer, and an output layer. Each layer contains a plurality of network parameters to describe a mapping relationship between the input parameters and the output parameters

In order to make the mapping relationship more accurate, the auxiliary training dataset T_a , the local training dataset T_b , and the validation dataset S can be used to jointly train and validate the BP neural network model constructed on the basis of a newly built model. The network model describing the mapping relationship is corrected to obtain the parameter setting model.

In some embodiments of the present application, the parameter setting model is jointly trained using the auxiliary training dataset, the validation dataset, and the local dataset. The running data of the auxiliary apparatus is added to training data of the parameter setting model, which makes up for the defect of a small amount of available valid data of the newly built apparatus and improves the accuracy and efficiency of PID parameter setting of the parameter setting model constructed on the newly built apparatus.

In some embodiments of the present application, as shown in Fig. 2, in step S101 described above, an auxiliary training dataset and a validation dataset are constructed according to loop information of a newly built apparatus and running data of an auxiliary apparatus, which can be implemented by step S201 to step S202 below.

S201, a target dataset is obtained by screening the running data of the auxiliary apparatus according to a loop type of the newly built apparatus and a physical characteristic corresponding to a control loop.

According to the above embodiments, the loop type of the newly built apparatus and the physical characteristic corresponding to the control loop are both included in the input parameters of each dataset. The loop type can include: a flowrate type, a liquid level type, a pressure type, a temperature type, and the like. The physical characteristic corresponding to the control loop can include: a liquid phase, a non-pipeline gas phase, a pipeline gas phase, and the like. Of course, this is not limited thereto.

The loop type and the physical characteristic corresponding to the control loop can form a group of labels used for identifying process types of the newly built apparatus and the auxiliary apparatus. It can be understood that when the process type of a certain control loop of the newly

built apparatus and the process type of a certain control loop in the auxiliary apparatus are matched with each other, a data similarity between them is the highest. The running data of the control loop in the auxiliary apparatus can be used as the target dataset to train the matched control loop of the newly built apparatus.

S202, the target dataset is split to obtain the auxiliary training dataset and the validation dataset.

Next, the target dataset determined on the basis of the running data of the auxiliary apparatus can be split into the auxiliary training dataset and the validation dataset, data of which does not overlap. A data volume of the auxiliary training dataset can be greater than a data volume of the validation dataset.

The auxiliary training dataset can be used for training a process of obtaining the parameter setting model, and the validation dataset can be used for validating an accuracy of the trained model after the training is completed.

In some embodiments of the present application, after the target dataset is obtained by screening, the target dataset is split into the auxiliary training dataset and the validation dataset. A training level of the model is confirmed using homologous data, which improves the accuracy of PID parameters output by the parameter setting model.

In some embodiments of the present application, as shown in Fig. 3, in step S201 described above, a target dataset is obtained by screening the running data of the auxiliary apparatus according to a loop type of the newly built apparatus and a physical characteristic corresponding to a control loop, which can be achieved by following step S301 to S302.

S301, a plurality of selectable running data matched with the loop type are obtained by screening the running data of the auxiliary apparatus according to the loop type of the newly built apparatus.

First, a plurality of control loops to be set can be determined in the newly built apparatus. Exemplarily, 20 control loops can be selected from the newly built apparatus, wherein each control loop type corresponds to five control loops. For a system containing seven newly built apparatuses, 140 control loops can be determined.

In some embodiments of the present application, control loops that are matched with the loop types of the control loops selected from the newly built apparatus are selected from the control loops of the auxiliary apparatuses, and running data of these selected control loops of the auxiliary

apparatuses are used as the selectable running data.

S302, the target dataset is obtained by screening the plurality of selectable running data according to the physical characteristic corresponding to the control loop of the newly built apparatus.

On the basis of the above steps, the selectable running data can be further screened. On the basis that the loop types of a plurality of control loops of the auxiliary apparatus are matched with the loop types of the control loops to be set of a newly built apparatus, the control loops of one or more auxiliary apparatuses that are matched with the physical characteristics corresponding to the control loops to be set are obtained by screening, and the running data of the finally obtained control loops of the auxiliary apparatuses is used as the target dataset.

In some embodiments of the present application, the running data similar to the control loops to be set is obtained as the target data set according to the loop types of the control loops of the newly built apparatus and auxiliary apparatus and a matching degree of the physical characteristics corresponding to the control loops, so that the accuracy of the trained parameter setting model is guaranteed from a data source.

In some embodiments of the present application, as shown in Fig. 4, in step S103, training is performed according to the auxiliary training dataset, the validation dataset, and the local training dataset to obtain a parameter setting model, which can be implemented by following steps S401 to S405.

S401, training is performed according to the auxiliary training dataset and the local training dataset to obtain an intermediate setting model.

In some embodiments of the present application, the intermediate setting model can be a preliminarily pre-trained BP neural network. After the auxiliary training dataset and the local training dataset are combined, a plurality of groups of input parameter values are input to the preliminarily constructed BP neural network in sequence. Due to the introduction of the auxiliary training dataset during the training of the intermediate setting model to increase the data volume for training, the local training dataset ensures that the trained intermediate setting model can better fit the newly built apparatus.

Next, a comparison difference value is determined by comparing an output value of the preliminarily constructed BP neural network with values of the output parameters corresponding to the input parameters.

Finally, forward feedback is performed according to the comparison difference value to correct an initial first weight vector W , an initial second weight vector P , and an initial offset parameter value β of the preliminarily constructed BP neural network, thus obtaining the intermediate setting model.

S402, the intermediate setting model is validated on the basis of the validation dataset.

As described in the previous embodiments of the present application, the validation dataset is a dataset that is homologous to the auxiliary training dataset. After the input parameter corresponding values of this dataset are input to the intermediate setting model, the intermediate setting model outputs corresponding intermediate setting model output parameter corresponding values.

Then, the difference values between the output parameter corresponding values of the intermediate setting model and the output parameter values corresponding to the input parameter values in the validation dataset are calculated. If the difference values are less than a preset difference value threshold, a result indicating that the validation on this group of input parameters succeeds is obtained. Otherwise, the validation fails. A plurality groups of input parameters in the validation dataset are input to the intermediate setting model in sequence, thus obtaining a plurality of groups of validation results.

Finally, a success ratio of the validation dataset is determined according to a ratio, in the plurality of groups of validation results, of a quantity of groups that succeed in the validation to a total quantity of groups of data in the validation data set. In some embodiments of the present application, if the success ratio is greater than a preset succeed threshold, it can be considered that the training of the intermediate setting model has been completed. Otherwise, if the success ratio is less than or equal to the preset success threshold, the above steps can be repeated to continue the training to obtain a new intermediate setting model until the success ratio is greater than the preset success threshold.

S403, running, after the validation succeeds, the intermediate setting model according to a preset input parameter value to obtain an output parameter value of the intermediate setting model.

If the validation on the intermediate setting model in the above steps succeeds, the intermediate setting model can be run on the newly built apparatus to further improve the accuracy of the output parameters of the intermediate setting model on the newly built apparatus.

In some embodiments of the present application, a group of preset input parameter values can be input to the intermediate setting model, and the intermediate setting model outputs corresponding output parameter values. The preset input parameter values can be a plurality of groups of test input values preset by a person. Parameters corresponding to the preset input

parameter values and output parameter values can be the same as the parameters corresponding to the input parameter values and output parameter values in the auxiliary training dataset mentioned above.

S404, a loop PID parameter value after the newly built apparatus is run according to the preset input parameter value is obtained.

The above preset input parameter values can also be input to a corresponding control loop of the newly built apparatus that is not included in the local training dataset. After the newly built apparatus is actually run, an output PID parameter of the newly built apparatus can be obtained, wherein the PID parameter of the newly built apparatus includes: a proportional coefficient (a proportional degree), integral time (minutes), and differential time (minutes).

S405, parameter optimization is performed on the intermediate setting model according to the loop PID parameter value and the output parameter value to obtain the parameter setting model.

The loop PID parameter value and output parameter value corresponding to the same preset input parameter are compared to obtain a comparison difference value. Based on the comparison difference value, the parameter optimization is performed on the intermediate setting model to obtain the parameter setting model.

It should be noted that the preset input parameter value can be input to control loops of the newly built apparatus that is not involved in the construction of the local training dataset. Then, the intermediate setting model can be optimized according to comparison results between the loop PID parameter values output by these control loops and the output parameter values, so as to improve the coverage of the parameter setting model for the various newly built apparatuses in a control system to be set.

In summary, based on the above embodiments, the process of training and optimizing the parameter setting model is shown in Fig. 5.

First, the running data of the auxiliary apparatus is extracted, thus obtaining the target dataset. Afterwards, the target dataset was further split to generate the auxiliary training dataset and the validation dataset.

Some control loops can also be selected from the newly built apparatus for PID parameter setting to obtain the initial running data, and the initial running data is extracted to obtain the local training dataset.

Afterwards, the auxiliary training dataset and the local training dataset are combined as the

training dataset to train the constructed BP neural network model, thus obtaining the intermediate setting model.

Based on this, the intermediate setting model can be validated through the validation dataset constructed in the above step until the success ratio is greater than the preset success ratio, otherwise, the above training process is repeated.

Finally, the intermediate setting model is further subjected to the parameter optimization on the control loops, which do not participate in the construction of the local training dataset, of the respective newly built models in the system to be set, thus obtaining the parameter setting model.

In some embodiments of the present application, the parameter setting model is obtained by validating and performing the further parameter optimization on the intermediate setting model, which further improves the accuracy of the output parameter values of the parameter setting model.

In some embodiments of the present application, as shown in Fig. 6, in step S405 described above, parameter optimization is performed on the intermediate setting model according to the loop PID parameter value and the output parameter value to obtain the parameter setting model, which is implemented by following steps S501 to S502.

S501, a parameter error rate is determined according to the loop PID parameter value and the output parameter value.

The parameter error rate ε_t can be calculated by the following formula:

$$\varepsilon_t = \sum_{i=n+1}^{n+m} \frac{W_i^t |h_t(x_i) - c(x_i)|}{\sum_{i=n+1}^{n+m} W_i^t}$$

where n is a quantity of the control loops in the auxiliary training dataset, and m is a quantity of the control loops in the local training dataset. W_i^t is a first weight vector of ε_t of the intermediate setting model in an i^{th} control loop. $h_t(x_i)$ is the output parameter value output by the intermediate setting model, and $c(x_i)$ is the loop PID parameter value output by the newly built apparatus.

In this way, the parameter error rate is calculated according to the difference value between the output parameter value and loop PID parameter value corresponding to the same preset input parameter value.

S502, iterative correction is performed on model parameters of the intermediate setting model according to the parameter error rate to obtain the parameter setting model.

Based on this, a maximum mean difference method can be used to determine a difference

between a model data distribution composed of the preset input parameter value and output parameter value of the intermediate setting model and a data distribution composed of the preset input parameter value and the loop PID parameter value. This difference can be represented by the parameter error rate ε_t .

Afterwards, mapping of intermediate setting parameters from the input values to the output values is further corrected according to the parameter error rate ε_t , so that the mapping is closer to a mapping relationship of the newly built model, thus obtaining the parameter setting model.

In some embodiments of the present application, the parameter error rate is determined according to the loop PID parameter value and output parameter value run on the newly built model, and the parameter setting is further corrected according to the parameter error rate, which improves the mapping accuracy of the parameter setting model.

In some embodiments of the present application, the model parameters include: a first weight vector and an offset parameter value,

wherein the first weight vector can represent a weight of each layer of the multilayer BP neural network that constitutes the intermediate setting model, and the offset parameter value is a control parameter value for an activated state of neurons in the BP neural network. In some embodiments of the present application, a second weight vector P can also be set in the BP neural network to determine the mapping relationship between the input value and output value of the intermediate setting model together with the first weight vector.

As shown in Fig. 7, in step S502 described above, iterative correction is performed on model parameters of the intermediate setting model according to the parameter error rate to obtain the parameter setting model, which can be implemented by following steps S601 to S604.

S601, the intermediate offset parameter value is corrected according to the parameter error rate to obtain a process offset parameter value.

The intermediate offset parameter value described above is corrected according to the parameter error rate ε_t determined in the above step, which can be expressed by the following formula:

$$\beta_t = \varepsilon_t / (1 - \varepsilon_t)^b \quad \text{in case of } =n+1, \dots, n+m$$

Afterwards, the original intermediate offset parameter value is replaced with the corrected intermediate offset parameter value which is the process offset parameter value.

S602, the first intermediate weight vector is corrected according to the process offset parameter value to obtain a first process weight vector.

Based on this, the first intermediate weight vector is continued to be corrected according to the following formula by using the process offset parameter determined in the above step:

$$w_i^{t+1} = \begin{cases} w_i^t \beta^{|h_t(x_i) - c(x_i)|}, & \text{when } i=1, \dots, n \\ w_i^t \beta^{-|h_t(x_i) - c(x_i)|}, & \text{when } i=n+1, \dots, n+m \end{cases}$$

The first intermediate weight vector is replaced with the corrected first process weight vector, thus completing the correction process of the first intermediate weight vector once.

S603, a new intermediate setting model is obtained according to the process offset parameter value and the first process weight vector, and a parameter error rate of the intermediate setting model is redetermined.

In this way, a new intermediate setting model is formed by the process offset parameter value, the first process weight vector, and the second weight vector. The preset input parameter is input to the newly built apparatus and the new intermediate setting model respectively. The new parameter error rate is recalculated and redetermined according to the above formula, the loop PID parameter value of the newly built apparatus, and the output parameter value of the new intermediate setting model.

S604, whether the parameter error rate is less than a preset threshold is determined.

In some embodiments of the present application, the preset threshold can be set. When the redetermined parameter error rate is greater than or equal to the preset threshold, the above steps can be repeated to continue to correct the intermediate setting model.

S605, the above process is repeated until the parameter error rate is less than the preset threshold, and the intermediate setting model is used as the parameter setting model.

When the redetermined parameter error rate is less than the preset threshold, it can be considered that the correction of the intermediate setting model has been completed, and the corrected intermediate setting model is used as the final parameter setting model.

In some embodiments of the present application, the iterative correction is performed on the intermediate setting model according to the parameter error rate, which improves the fitting degree between the intermediate setting model and the newly built model, and improves the accuracy of

the output parameter value of the parameter setting model on the newly built model.

In some embodiments of the present application, as shown in Fig. 8, before above step S401: training is performed according to the auxiliary training dataset and the local training dataset to obtain an intermediate setting model, the method can further include the following steps:

S701, a root-mean-square error and a determination coefficient are determined according to the auxiliary training dataset and the local training dataset.

In some embodiments of the present application, the root-mean-square error (RMSE) can be determined by the following formula:

$$RMSE = \sqrt{\frac{1}{m} \sum_{i=1}^m (y'_i - y_i)^2}$$

the determination coefficient R^2 can be determined by the following formula:

$$R^2 = 1 - \frac{\sum_{i=1}^m (y'_i - y_i)^2}{\sum_{i=1}^m (y_i - \bar{y})^2}$$

where m represents a sample volume of a training set composed of the auxiliary training dataset and the local training dataset; y_i represents a sample true value of an i^{th} sample of the training set on the newly built apparatus and the auxiliary apparatus; y'_i represents a predicted value output by the i^{th} sample on the constructed model; and $\bar{y}$ represents a mean value of sample true values.

S702, a quantity of hidden layer nodes of an initial parameter setting model is determined according to the root-mean-square error and the determination coefficient.

In some embodiments of the present application, the quantity of the hidden layer nodes of the initial parameter setting model is selected according to values of the determined root-mean-square error and determination coefficient described above. Exemplarily, the root-mean-square error and the determination coefficient can be classified into a plurality of ranges corresponding to the quantity of the hidden layer nodes in a one-to-one manner. When the root-mean-square error and the determination coefficient fall into the ranges, the corresponding quantities of the hidden layer nodes can be determined.

In some embodiments, in the embodiments of the present application, the quantity of the hidden layer nodes can be 5.

S703, the initial parameter setting model is constructed according to the quantity of hidden layer nodes, a preset quantity of input layer nodes, and a preset quantity of output layer nodes.

The preset quantity of input layer nodes can be determined according to a quantity of the input parameters, for example, the preset quantity of input layer nodes can be 7. The preset quantity of output layer nodes can be determined according to a quantity of the output parameters, for example, the preset quantity of output layer nodes can be 3.

In this way, a network structure of the BP neural network can be preliminarily constructed according to the quantity of the hidden layer nodes, the preset quantity of the input layer nodes, and the preset quantity of the output layer nodes.

In some embodiments of the present application, based on this, when the initial parameter setting model is constructed, the initial first weight vector W , initial second weight vector P , and initial offset value β of the initial parameter setting model can also be initialized. In some embodiments of the present application, the initial weight vector is $W^1 = (W_1^1, \dots, W_{n+m}^1)$, where

$$W_i^1 = \begin{cases} 1/n & \text{when } i=1, \dots, n \\ 1/m & \text{when } i=n+1, \dots, n+m \end{cases}$$

n is a quantity of the control loops in the auxiliary training dataset, and m is a quantity of the control loops in the local training dataset.

The initial offset parameter value β can be set to be $\beta = 1/(1 + \sqrt{2 \ln n / N})$, and N is a value of $n+m$.

$$P^t = \frac{w^t}{\sum_{i=n+1}^{n+m} w_i^t}$$

The initial second weight vector can be set to be P^t , which corresponds to the initial weight vector.

After the construction of the network structure and parameters of the BP neural network is completed, the initial parameter setting model is obtained.

S704, the initial parameter setting model is trained according to the auxiliary training dataset and the local training dataset to obtain the intermediate setting model.

Finally, the constructed initial parameter setting model is trained according to the constructed

auxiliary training dataset and local training dataset in the embodiments described above, and parameters of the initial parameter setting model are corrected, thus obtaining the intermediate setting model.

In some embodiments of the present application, the quantity of the hidden layer nodes is determined according to the root-mean-square error and the determination coefficient, and the initial parameter setting model is further constructed, so that the constructed model is more suitable for the data volume of the training set, with higher fitting ability and faster training.

As shown in Fig. 9, the embodiments of the present application further provide a method for industrial process control. The method can be applied to a processing device capable of performing PID parameter setting on a newly built apparatus. Referring to Fig. 9, the method can include the following steps:

S801, a set parameter value of a newly built apparatus to be controlled is determined according to a parameter setting model, wherein the parameter setting model is obtained on the basis of the method for constructing the parameter setting model in any one of the foregoing embodiments.

In some embodiments of the present application, the parameter setting model can be determined according to the embodiments described above. The model can be applied to the newly built apparatus. A corresponding PID parameter value can be output according to an input parameter value in the newly built apparatus, namely, the set parameter value of the newly built apparatus to be controlled.

It can be understood that due to the introduction of a plurality of newly built apparatuses in an industrial control system to be set in the process of training the parameter setting model, the parameter setting model can output accurate set parameter values for the plurality of newly built apparatuses in the industrial control system to be set.

S802, the newly built apparatus is controlled according to the set parameter value to execute a target process.

The target process can be a process of running the newly built apparatus according to the set parameter value. It can be understood that the set parameter value is a value that is output by the parameter setting model and needs to be adjusted for the newly built apparatus. Therefore, the set parameter value can be input to the newly built apparatus to control the newly built apparatus to run to execute the target process.

In some embodiments of the present application, the newly built apparatus is controlled to run

according to the set parameter value output by the parameter setting model, so that a preset control effect can be achieved at high efficiency on the newly built apparatus, and the automation degree of parameter setting can be improved.

Referring to Fig. 10, the embodiments of the present application further provide an apparatus for constructing a parameter setting model 100, including:

a dataset construction component 1001, configured to construct an auxiliary training dataset and a validation dataset according to loop information of a newly built apparatus and running data of an auxiliary apparatus, wherein the newly built apparatus is an apparatus applied to a parameter setting model to be trained, and the auxiliary apparatus is an apparatus that has completed parameter setting and is run formally;

the dataset construction component 1001 is further configured to construct a local training dataset according to initial running data of the newly built apparatus; and

a model training component 1002, configured to perform training according to the auxiliary training dataset, the validation dataset, and the local training dataset to obtain a parameter setting model.

The dataset construction component 1001 is specifically configured to: obtain a target dataset by screening the running data of the auxiliary apparatus according to a loop type of the newly built apparatus and a physical characteristic corresponding to a control loop; and split the target dataset to obtain the auxiliary training dataset and the validation dataset.

The dataset construction component 1001 is specifically configured to: obtain a plurality of selectable running data matched with the loop type by screening the running data of the auxiliary apparatus according to the loop type of the newly built apparatus; and obtain the target dataset by screening the plurality of selectable running data according to the physical characteristic corresponding to the control loop of the newly built apparatus.

The model training component 1002 is specifically configured to: perform training according to the auxiliary training dataset and the local training dataset to obtain an intermediate setting model; validate the intermediate setting model on the basis of the validation data set, and run, after the validation succeeds, the intermediate setting model according to a preset input parameter value to obtain an output parameter value of the intermediate setting model; obtain a loop PID parameter value after the newly built apparatus is run according to the preset input parameter value; and perform parameter optimization on the intermediate setting model according to the loop PID parameter value and the output parameter value to obtain the parameter setting model.

The model training component 1002 is specifically configured to: determine a parameter error rate according to the loop PID parameter value and the output parameter value; and perform iterative correction on model parameters of the intermediate setting model according to the parameter error rate to obtain the parameter setting model.

the model parameters includes a first intermediate weight vector and an intermediate offset parameter value; the model training component 1002 is specifically configured to: correct the intermediate offset parameter value according to the parameter error rate to obtain a process offset parameter value; correct the first intermediate weight vector according to the process offset parameter value to obtain a first process weight vector; obtain a new intermediate setting model according to the process offset parameter value and the first process weight vector, and redetermine a parameter error rate of the intermediate setting model; and repeat the above process until the parameter error rate is less than a preset threshold, and use the intermediate setting model as the parameter setting model.

The model construction component 1003 is configured to determine a root-mean-square error and a determination coefficient according to the auxiliary training dataset and the local training dataset; determine a quantity of hidden layer nodes of an initial parameter setting model according to the root-mean-square error and the determination coefficient; construct the initial parameter setting model according to the quantity of hidden layer nodes, a preset quantity of input layer nodes, and a preset quantity of output layer nodes; and train the initial parameter setting model according to the auxiliary training dataset and the local training dataset to obtain the intermediate setting model.

Referring to Fig. 11, the embodiments of the present application further provide an apparatus for industrial process control 110, including:

a determination component 1101, configured to determine a set parameter value of a newly built apparatus to be controlled according to a parameter setting model, wherein the parameter setting model is obtained on the basis of the method for constructing the parameter setting model in any one of the foregoing embodiments; and

a control component 1102, configured to control the newly built apparatus according to the set parameter value to execute a target process.

Referring to Fig. 12, this embodiment further provides a processing device. The processing device includes a processor 2001, a memory 2002, and a bus, wherein the memory 2002 stores machine-readable instructions executable by the processor 2001; the processing device is run to

execute the above machine-readable instructions; the processor 2001 communicates with the memory 2002 through the bus; and the processor 2001 is configured to execute the steps of the method for constructing the parameter setting model or the steps of the method for industrial process control in the foregoing embodiments.

The memory 2002, the processor 2001, and the bus are directly or indirectly electrically connected to each other to achieve data transmission or interaction. For example, these elements can be electrically connected to each other through one or more communication buses or signal lines. An apparatus for data processing of a system for constructing a parameter setting model or a system for industrial process control includes at least one software functional component that can be stored in the memory 2002 in the form of software or firmware or solidified in an operating system (OS) of the processing device. The processor 2001 is configured to execute executable components stored in the memory 2002, such as software functional components and computer programs included in the apparatus for data processing of the system for constructing the parameter setting model or the system for industrial process control.

The memory 2002 can be, but is not limited to, a random access memory (RAM), a read only memory (ROM), a programmable read-only memory (PROM), an erasable programmable read-only memory (EPROM), an electrically erasable programmable read-only memory (EEPROM), and the like.

In some embodiments, the present application further provides a storage medium. The storage medium stores a computer program. The computer program, when executed by a processor, executes the steps of the above method embodiments. Specific implementations and technical effects are similar, and will not be elaborated here.

A person skilled in the art can clearly understand that for the convenience and conciseness of the description, specific working processes of the system and apparatus described above can refer to the corresponding processes in the method embodiments, and will not be described in detail in the present application. In the several embodiments provided in the present application, it should be understood that the disclosed system, apparatus, and method are achieved in other manners. The above-described apparatus embodiments are merely illustrative. For example, the division of the components is only one type of logical functional division, and other divisions is achieved in practice. For another example, multiple components or components can be combined or integrated into another system, or some features can be omitted, or not executed. In addition, the shown or discussed mutual coupling or direct coupling or communication connection is an indirect coupling or communication connection through some communication interfaces, apparatuses or components,

and is in an electrical, mechanical or another form.

In addition, functional units in embodiments of the present application may be integrated into one processing unit, or each of the units may exist alone physically, or two or more units are integrated into one unit. The functions, if implemented in the form of software functional units and sold or used as stand-alone products, may be stored in one computer-readable storage medium. Based on such an understanding, the technical solutions of the present application essentially, or the part contributing to the related technology, or some of the technical solutions may be implemented in the form of a software product. The computer software product is stored in a storage medium and includes several instructions for instructing a computer device (which may be a personal computer, a server, a network device, or the like) to execute all or some of the steps of the methods described in the various embodiments of the present application. The aforementioned storage media include: various media that can store program codes, such as a USB flash disk, a mobile hard disk drive, a ROM, a RAM, a magnetic disk, and an optical disc.

The foregoing descriptions are merely specific implementations of the present application, but are not intended to limit the protection scope of the present application. Any variation or replacement readily figured out by a person skilled in the art within the technical scope disclosed in the present application shall fall within the protection scope of the present application. Therefore, the protection scope of the present application shall be subject to the protection scope of the claims.

Industrial practicability

The technical solutions provided by the embodiments of the present application are applicable to the technical field of industrial automatic control. By the adoption of the method for constructing the parameter setting model and the method for industrial process control according to the present application, the auxiliary training dataset can be constructed by virtue of the running data of the auxiliary apparatus, and the parameter setting model is trained and constructed by the auxiliary training dataset and the local training dataset constructed using the running data of the newly built apparatus. The present application fully uses the running data of the auxiliary apparatus that has completed parameter setting and is run formally to train the parameter setting model, which makes up for the defect of a small amount of available valid data of the newly built apparatus and improves the accuracy and efficiency of PID parameter setting of the parameter setting model constructed on the newly built apparatus.

Claims

1. A method for constructing a parameter setting model, wherein the method comprises:

constructing an auxiliary training dataset and a validation dataset according to loop information of a newly built apparatus and running data of an auxiliary apparatus, wherein the newly built apparatus is an apparatus applied to a parameter setting model to be trained, and the auxiliary apparatus is an apparatus that has completed parameter setting and is run formally;

constructing a local training dataset according to initial running data of the newly built apparatus;
and

performing training according to the auxiliary training dataset, the validation dataset, and the local training dataset to obtain a parameter setting model.

2. The method for constructing the parameter setting model as claimed in claim 1, wherein constructing the auxiliary training dataset and the validation dataset according to loop information of the newly built apparatus and running data of the auxiliary apparatus comprises:

obtaining a target dataset by screening the running data of the auxiliary apparatus according to a loop type of the newly built apparatus and a physical characteristic corresponding to a control loop; and

splitting the target dataset to obtain the auxiliary training dataset and the validation dataset.

3. The method for constructing the parameter setting model as claimed in claim 2, wherein obtaining the target dataset by screening the running data of the auxiliary apparatus according to the loop type of the newly built apparatus and the physical characteristic corresponding to the control loop comprises:

obtaining a plurality of selectable running data matched with the loop type by screening the running data of the auxiliary apparatus according to the loop type of the newly built apparatus;
and

obtaining the target dataset by screening the plurality of selectable running data according to the physical characteristic corresponding to the control loop of the newly built apparatus.

4. The method for constructing the parameter setting model as claimed in any one of claims 1 to 3, wherein performing training according to the auxiliary training dataset, the validation dataset, and the local training dataset to obtain the parameter setting model comprises:

performing training according to the auxiliary training dataset and the local training dataset to

obtain an intermediate setting model;

validating the intermediate setting model on the basis of the validation dataset, and running, after validation succeeds, the intermediate setting model according to a preset input parameter value to obtain an output parameter value of the intermediate setting model;

obtaining a loop PID parameter value after the newly built apparatus is run according to the preset input parameter value; and

performing parameter optimization on the intermediate setting model according to the loop PID parameter value and the output parameter value to obtain the parameter setting model.

5. The method for constructing the parameter setting model as claimed in claim 4, wherein performing parameter optimization on the intermediate setting model according to the loop PID parameter value and the output parameter value to obtain the parameter setting model comprises:

determining a parameter error rate according to the loop PID parameter value and the output parameter value; and

performing iterative correction on model parameters of the intermediate setting model according to the parameter error rate to obtain the parameter setting model.

6. The method for constructing the parameter setting model as claimed in claim 5, wherein the model parameters comprise a first intermediate weight vector and an intermediate offset parameter value;

performing iterative correction on model parameters of the intermediate setting model according to the parameter error rate to obtain the parameter setting model comprises:

correcting the intermediate offset parameter value according to the parameter error rate to obtain a process offset parameter value;

correcting the first intermediate weight vector according to the process offset parameter value to obtain a first process weight vector;

obtaining a new intermediate setting model according to the process offset parameter value and the first process weight vector, and redetermining a parameter error rate of the intermediate setting model; and

repeating above process until the parameter error rate is less than a preset threshold, and using the intermediate setting model as the parameter setting model.

7. The method for constructing the parameter setting model as claimed in claim 4, wherein before

performing training according to the auxiliary training dataset and the local training dataset to obtain an intermediate setting model, the method further comprises:

determining a root-mean-square error and a determination coefficient according to the auxiliary training dataset and the local training dataset;

determining a quantity of hidden layer nodes of an initial parameter setting model according to the root-mean-square error and the determination coefficient;

constructing the initial parameter setting model according to the quantity of hidden layer nodes, a preset quantity of input layer nodes, and a preset quantity of output layer nodes; and

training the initial parameter setting model according to the auxiliary training dataset and the local training dataset to obtain the intermediate setting model.

8. A method for industrial process control, wherein the method comprises:

determining a set parameter value of a newly built apparatus to be controlled according to a parameter setting model, wherein the parameter setting model is obtained on the basis of the method for constructing the parameter setting model as claimed in any one of claims 1 to 7; and

controlling the newly built apparatus according to the set parameter value to execute a target process.

9. A processing device, wherein the processing device comprises a processor, a storage medium, and a bus, wherein the storage medium stores machine-readable instructions executable by the processor; when the processing device is run, the processor communicates with the storage medium through the bus; and the processor executes the machine-readable instructions to execute the steps of the method for constructing the parameter setting model as claimed in any one of claims 1 to 7 or the steps of the method for industrial process control as claimed in claim 8.

10. A computer-readable storage medium, wherein the computer-readable storage medium stores a computer program, and the computer program, when executed by a processor, implements the steps of the method for constructing the parameter setting model as claimed in any one of claims 1 to 7 or the steps of the method for industrial process control as claimed in claim 8.