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(54) Title: CONTROL SYSTEM AND CONTROL METHOD OF MANIPULATOR

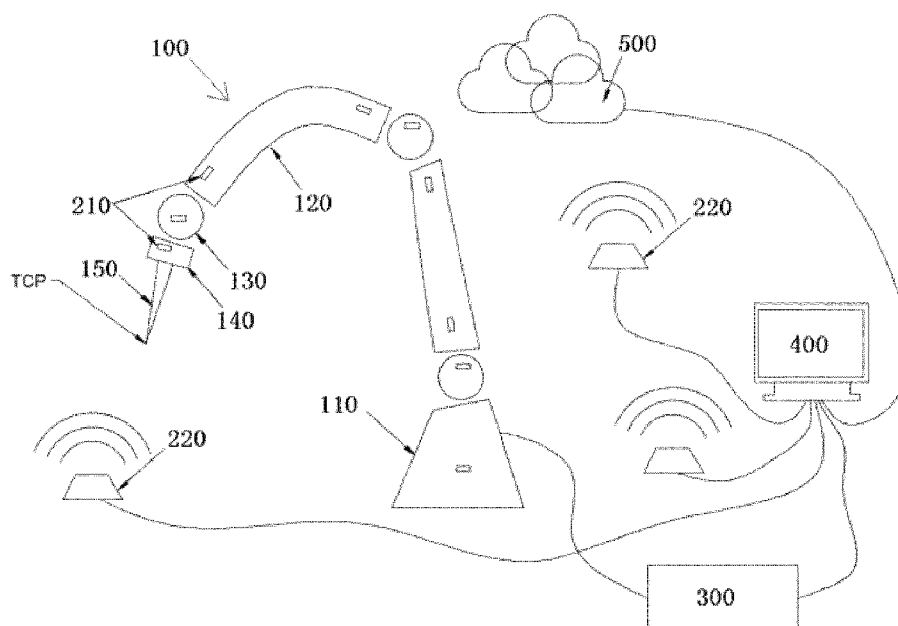


Fig.1

(57) Abstract: A control system for a manipulator, includes: at least one position indicator (210) provided on a flange (140) for mounting a tool (150) of the manipulator (100); a position detector (220) provided near the manipulator and configured to detect a position information of the position indicator (210) in real time; a computer (400) adapted to calculate a position data of the position indicator in real time according to the detected position information; a cloud server (500) adapted to calculate working parameters of each joint (130) of the manipulator in real time by an artificial intelligence neural network according to the calculated position data; and a controller (300) adapted to control each joint in real time based on the calculated working parameters. The artificial intelligence neuron network is a self-learning neural network, which calculates and automatically adjusts a weight (W) among neurons (N) based on the input position data, so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal.



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Control System and Control Method of Manipulator

CROSS-REFERENCE TO RELATED APPLICATION

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This application claims the benefit of Chinese Patent Application No. 201711285789.X filed on December 7, 2017 in the State Intellectual Property Office of China, the whole disclosure of which is incorporated herein by reference.

10 BACKGROUND OF THE INVENTION

Field of the Invention

At least one embodiment of the present disclosure relates to a control system and a control method for a manipulator.

15 Description of the Related Art

In the prior art, in order to improve the working precision of a manipulator, each arm of the manipulator has a very high stiffness, so that there will be no elastic deformation error in each arm of the manipulator. Thereby, special metal is often used to ensure the rigidity of the arm, which increases the weight and cost of the entire manipulator.

20 In addition, in order to ensure the working precision of the manipulator, it is required that a transmission gear in each joint of the manipulator has very high precision, and a tooth gap between the transmission gears is very small. Moreover, other components of the manipulator should also have high precision, which also increases the cost.

The traditional rigid manipulator is usually controlled by a control system with fixed
25 kinematics parameters. However, the control system with fixed structural parameters is not suitable for an elastic manipulator because the elastic manipulator has a large elastic deformation error and the structural parameters of the elastic manipulator will change continuously.

30 SUMMARY OF THE INVENTION

The present invention has been made to overcome or alleviate at least one aspect of the above mentioned disadvantages.

According to an aspect of the present disclosure, there is provided a control system for a manipulator, comprising: at least one position indicator provided on a flange for mounting
35 a tool of the manipulator; a position detector provided near the manipulator and configured to detect a position information of the position indicator in real time; a computer adapted to calculate a position data of the position indicator in real time according to the detected position information; a cloud server adapted to calculate working parameters of each joint of

the manipulator in real time by an artificial intelligence neural network according to the calculated position data; and a controller adapted to control each joint in real time based on the calculated working parameters, wherein the artificial intelligence neuron network comprises a self-learning neural network, which calculates and automatically adjusts a weight among neurons based on the input position data, so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal.

According to an exemplary embodiment of the present disclosure, the position indicator is a visual marker, the position detector is a camera, and the position information comprises an image of the visual marker captured by the camera; and the computer is adapted to process the image captured by the camera to obtain the position data of the position indicator.

According to another exemplary embodiment of the present disclosure, the position indicator is an Ultra Wide Band transmitter, the position detector is an Ultra Wide Band receiver, and the position information comprises a relative position of the Ultra Wide Band transmitter with respect to the Ultra Wide Band receiver obtained by the Ultra Wide Band receiver; and the computer is adapted to compute the position data of the position indicator according to the relative position obtained by the Ultra Wide Band receiver.

According to another exemplary embodiment of the present disclosure, at least one position indicator is provided on a base, each arm or each joint of the manipulator.

According to another exemplary embodiment of the present disclosure, at least one arm of the manipulator is elastic, and the manipulator has an elastic deformation error when subjected to a force.

According to another exemplary embodiment of the present disclosure, the precision of the manipulator is lower than a current industry design standard precision of a rigid manipulator.

According to another exemplary embodiment of the present disclosure, the working parameters comprise a rotation angle, a rotation speed and an acceleration of a driving motor provided at each joint of the manipulator.

According to another aspect of the present disclosure, there is provided a method of controlling a manipulator, comprising steps of:

S100: providing the above control system;

S200: controlling a tool center point of the manipulator by a manual teaching method to move the tool center point from a first point to a second point along a plurality of different paths, respectively, and calculating the position data of the position indicator at the first point and the second point;

S300: inputting the calculated position data into the artificial intelligence neuron network operated on the cloud server, wherein the artificial intelligence neuron network calculates and automatically adjusts the weight among the neurons based on the input

position data so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal.

According to an exemplary embodiment of the present disclosure, the above method further comprising steps of:

5 S400: controlling the tool center point of the manipulator by the manual teaching method to move the tool center point from the second point to a third point along a plurality of different paths, respectively, and calculating the position data of the position indicator at the second point and the third point; and

10 S500: inputting the calculated position data into the artificial intelligence neuron network operated on the cloud server, wherein the artificial intelligence neuron network calculates and automatically adjusts the weight among the neurons based on the input position data so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal.

15 According to another exemplary embodiment of the present disclosure, the above method further comprising steps of:

S600: controlling the tool center point of the manipulator by the manual teaching method to move the tool center point from a current point to a next point along a plurality of different paths, respectively, and calculating the position data of the position indicator at the current point and the next point; and

20 S700: inputting the calculated position data into the artificial intelligence neuron network operated on the cloud server, wherein the artificial intelligence neuron network calculates and automatically adjusts the weight among the neurons based on the input position data so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal.

25 According to another exemplary embodiment of the present disclosure, there are a plurality of key points in a working area of the manipulator, the key points at least comprises the first point, and the second point, the third point, the current point, and the next point; the method further comprising a step of:

30 S800: repeating the steps S600 and S700 until the manipulator has been moved to all key points.

According to another exemplary embodiment of the present disclosure, the above method the posture of the tool remains unchanged during the tool center point of the manipulator is moved from one point to another point along one path; and the posture of the tool during the tool center point of the manipulator is moved from one point to another point
35 along one path is different from the posture of the tool during the tool center point of the manipulator is moved from one point to another point along another path different from the one path.

According to another exemplary embodiment of the present disclosure, the above

method the posture of the tool is changeable during the tool center point of the manipulator is moved from one point to another point along one path.

According to another exemplary embodiment of the present disclosure, the above method the tool mounted on the manipulator are in an unloaded state without gripping any work piece in the above steps S100-S800.

According to another exemplary embodiment of the present disclosure, the above method after completing the steps S100 ~ S800, the tool mounted on the manipulator is in a load state of gripping a work piece, and the method further comprises a step of:

S900: repeating the steps S200 and S300.

In the above various exemplary embodiments of the present disclosure, the artificial intelligence neuron network in the control system may automatically adjust a weight between neurons based on the input position data, so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal. Thereby, the artificial intelligence neuron network may improve the control accuracy of the control system.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features of the present disclosure will become more apparent by describing in detail exemplary embodiments thereof with reference to the accompanying drawings, in which:

Fig.1 is an illustrative view of a control system for a manipulator according to an exemplary embodiment of the present disclosure;

Fig.2 shows a process of moving the manipulator shown in Fig.1 by a manual teaching method according to an exemplary embodiment of the present disclosure;

Fig.3 shows an illustrative simple schematic model of an artificial intelligence neural network according to an exemplary embodiment of the present disclosure.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Exemplary embodiments of the present disclosure will be described hereinafter in detail with reference to the attached drawings, wherein the like reference numerals refer to the like elements. The present disclosure may, however, be embodied in many different forms and should not be construed as being limited to the embodiment set forth herein; rather, these embodiments are provided so that the present disclosure will be thorough and complete, and will fully convey the concept of the disclosure to those skilled in the art.

In the following detailed description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced

without these specific details. In other instances, well-known structures and devices are schematically shown in order to simplify the drawing.

According to a general concept of the present disclosure, there is provided a control system for a manipulator, comprising: at least one position indicator provided on a flange for mounting a tool of the manipulator; a position detector provided near the manipulator and configured to detect a position information of the position indicator in real time; a computer adapted to calculate a position data of the position indicator in real time according to the detected position information; a cloud server adapted to calculate working parameters of each joint of the manipulator in real time by an artificial intelligence neural network according to the calculated position data; and a controller adapted to control each joint in real time based on the calculated working parameters, wherein the artificial intelligence neuron network is a self-learning neural network, which calculates and automatically adjusts a weight among neurons based on the input position data, so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal.

According to another general concept of the present disclosure, there is provided a method of controlling a manipulator, comprising steps of: providing the above control system; controlling a tool center point of the manipulator by a manual teaching method to move the tool center point from a first point to a second point along a plurality of different paths, respectively, and calculating the position data of the position indicator at the first point and the second point; inputting the calculated position data into the artificial intelligence neuron network operated on the cloud server, wherein the artificial intelligence neuron network calculates and automatically adjusts the weight among neurons based on the input position data so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal.

Fig.1 is an illustrative view of a control system for a manipulator according to an exemplary embodiment of the present disclosure.

As shown in Fig.1, in an embodiment, the control system for a manipulator mainly comprises at least one position indicator 210, a position detector 220, a controller 300, a computer 400, and a cloud server 500.

As shown in Fig.1, in an embodiment, the at least one position indicator 210 is provided on a flange 140 for mounting a tool 150 of the manipulator 100. The position detector 220 is provided near the manipulator 100 and configured to detect position information of the position indicator 210 in real time. The computer 400 is adapted to calculate a position data of the position indicator 210 in real time according to the detected position information. The cloud server 500 is adapted to calculate working parameters of each joint 130 of the manipulator 100 in real time by an artificial intelligence neural network according to the calculated position data. The working parameters may comprise a rotation angle, a rotation speed and an acceleration of a driving motor provided at each joint of the

manipulator 100. The controller 300 is adapted to control each joint 130 in real time based on the calculated working parameters.

Fig.3 shows an illustrative simple schematic model of an artificial intelligence neural network according to an exemplary embodiment of the present disclosure.

5 As shown in Figs.1 and 3, in an embodiment, the artificial intelligence neuron network is a self-learning neural network, which calculates and automatically adjusts a weight W between neurons N based on the input position data, so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal.

As shown in Fig.1, in an embodiment, the position indicator 210 may comprise an
10 Ultra Wide Band (UWB) transmitter, the position detector 220 may comprise an Ultra Wide Band receiver, and the position information comprises a relative position of the Ultra Wide Band transmitter with respect to the Ultra Wide Band receiver obtained by the Ultra Wide Band receiver. The computer 400 is adapted to compute the position data of the position indicator 210 according to the relative position obtained by the Ultra Wide Band receiver.

15 However, the present disclosure is not limited to this, for example, in another embodiment, the position indicator 210 may comprise a visual marker, the position detector 220 may comprise a camera, and the position information comprises an image of the visual marker captured by the camera. The computer 400 is adapted to process the image captured by the camera to obtain the position data of the position indicator 210.

20 In order to increase the amount of position data, as shown in Fig.1, in an embodiment, at least one position indicator 210 is provided on a base 110, each arm 120 and each joint 130 of the manipulator 100.

As shown in Fig.1, in an embodiment, at least one arm 120 of the manipulator 100 is elastic, and the manipulator 100 has an elastic deformation error when subjected to a force.

25 In an embodiment of the present disclosure, the mechanical precision of the manipulator 100 is lower than a current industry design standard precision of a rigid manipulator. For example, the transmission gears of the aforementioned manipulator 100 are allowed to have large tooth gaps, and the components of the manipulator 100 may have large dimensional errors. In this way, it may greatly decrease the cost of manufacturing the
30 manipulator 100.

Fig.2 shows a process of moving the manipulator shown in Fig.1 by a manual teaching method according to an exemplary embodiment of the present disclosure.

Hereafter, it will describe a method of controlling a manipulator with reference to Figs.1-3 according to an exemplary embodiment of the present disclosure. The method may
35 comprise steps of:

S100: as shown in Fig.1, providing the control system according to any one embodiment as mentioned above;

S200: as shown in Fig.2, controlling a tool center point TCP of the manipulator 100 by

a manual teaching method to move the tool center point from a first point A to a second point B along a plurality of different paths LAB1, LAB2, respectively, and calculating the position data of the position indicator 210 at the first point A and the second point B;

5 S300: as shown in Figs.2 and 3, inputting the calculated position data into the artificial intelligence neuron network operated on the cloud server 500, wherein the artificial intelligence neuron network calculates and automatically adjusts the weight W among neurons N based on the input position data so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal.

10 As shown in Fig.3, in an embodiment, only two paths LAB1, LAB2 are shown, But, it is appreciated for those skilled in this art, times that the manipulator 100 is moved from the first point A to the second point B should reach a certain amount, so that the weights W among the neurons of the artificial intelligence neural network may be adjusted to the optimum, so as to minimize the accommodation time, the steady-state error and the trajectory error of the control system. Thereby, the times that the manipulator 100 is moved
15 from the first point A to the second point B along the paths LAB1, LAB2, respectively, is usually not less than 10 times.

As shown in Figs.2-3, in an embodiment, the above method may further comprise steps of:

20 S400: controlling the tool center point TCP of the manipulator 100 by the manual teaching method to move the tool center point from the second point B to a third point C along a plurality of different paths LAC1, LAC2, respectively, and calculating the position data of the position indicator 210 at the second point B and the third point C;

25 S500: inputting the calculated position data into the artificial intelligence neuron network operated on the cloud server 500, wherein the artificial intelligence neuron network calculates and automatically adjusts the weight W among the neurons N based on the input position data so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal.

As shown in Figs.2-3, in an embodiment, the above method may further comprise steps of:

30 S600: controlling the tool center point TCP of the manipulator 100 by the manual teaching method to move the tool center point from a current point to a next point along a plurality of different paths, respectively, and calculating the position data of the position indicator 210 at the current point and the next point;

35 S700: inputting the calculated position data into the artificial intelligence neuron network operated on the cloud server 500, wherein the artificial intelligence neuron network calculates and automatically adjusts the weight W among the neurons N based on the input position data so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal.

As shown in Figs.2-3, in an embodiment, there are a plurality of key points in a working area of the manipulator 100, the key points at least comprises the first point A, the second point B, the third point C, the current point, and the next point. The above method may further comprise a step of:

- 5 S800: repeating the steps S600 and S700 until the manipulator 100 has been moved to all key points.

As shown in Fig.2, in an embodiment, the posture of the tool remains unchanged during the tool center point of the manipulator 100 is moved from one point A to another point B along one path LAB1 or LAB2. The posture of the tool during the tool center point of the manipulator 100 is moved from one point A to another point B along one path LAB1 is different from the posture of the tool during the tool center point of the manipulator 100 is moved from one point A to another point B along another path LAB2 different from the one path LAB1.

But the present disclosure is not limited to this, in another embodiment, the posture of the tool may be changeable during the tool center point of the manipulator 100 is moved from one point A to another point B along one path LAB1, LAB2.

As shown in Fig.2, in an embodiment, the tool 150 mounted on the manipulator 100 are in an unloaded state without gripping any work piece in the above steps S100-S800.

Although it is not shown, in another embodiment, in order to enable the artificial intelligence neural network of the manipulator control system to adapt to a load state better, after completing the steps S100 ~ S800, the tool 150 mounted on the manipulator 100 is in a load state of gripping a work piece, and the above method may further comprise a step of:

S900: repeating the steps S200 and S300.

It should be appreciated for those skilled in this art that the above embodiments are intended to be illustrated, and not restrictive. For example, many modifications may be made to the above embodiments by those skilled in this art, and various features described in different embodiments may be freely combined with each other without conflicting in configuration or principle.

Although several exemplary embodiments have been shown and described, it would be appreciated by those skilled in the art that various changes or modifications may be made in these embodiments without departing from the principles and spirit of the disclosure, the scope of which is defined in the claims and their equivalents.

As used herein, an element recited in the singular and proceeded with the word "a" or "an" should be understood as not excluding plural of said elements or steps, unless such exclusion is explicitly stated. Furthermore, references to "one embodiment" of the present disclosure are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Moreover, unless explicitly stated to the contrary, embodiments "comprising" or "having" an element or a plurality of elements

having a particular property may include additional such elements not having that property.

What is claimed is,

1. A control system for a manipulator, characterized in that the control system comprises:

5 at least one position indicator (210) provided on a flange (140) for mounting a tool (150) of the manipulator (100);

 a position detector (220) provided near the manipulator (100) and configured to detect a position information of the position indicator (210) in real time;

 a computer (400) adapted to calculate a position data of the position indicator (210) in
10 real time according to the detected position information;

 a cloud server (500) adapted to calculate working parameters of each joint (130) of the manipulator (100) in real time by an artificial intelligence neural network according to the calculated position data; and

 a controller (300) adapted to control each joint (130) in real time based on the
15 calculated working parameters,

 wherein the artificial intelligence neuron network comprises a self-learning neural network, which calculates and automatically adjusts a weight (W) among neurons (N) based on the input position data, so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal.

20

2. The control system according to claim 1,

 wherein the position indicator (210) comprises a visual marker, the position detector (220) comprises a camera, and the position information comprises an image of the visual marker captured by the camera; and

25 wherein the computer (400) is adapted to process the image captured by the camera to obtain the position data of the position indicator (210).

3. The control system according to claim 1 or 2,

 wherein the position indicator (210) comprises an Ultra Wide Band transmitter, the
30 position detector (220) comprises an Ultra Wide Band receiver, and the position information comprises a relative position of the Ultra Wide Band transmitter with respect to the Ultra Wide Band receiver obtained by the Ultra Wide Band receiver; and

 wherein the computer (400) is adapted to compute the position data of the position indicator (210) according to the relative position obtained by the Ultra Wide Band receiver.

35

4. The control system according to any one of claims 1-3,

 wherein at least one position indicator (210) is provided on a base (110), each arm (120) or each joint (130) of the manipulator (100).

5. The control system according to any one of claims 1-4,
wherein at least one arm (120) of the manipulator (100) is elastic, and the manipulator
(100) has an elastic deformation error when subjected to a force.

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6. The control system according to any one of claims 1-5,
wherein the precision of the manipulator (100) is lower than a current industry design
standard precision of a rigid manipulator.

10

7. The control system according to any one of claims 1-6,
wherein the working parameters comprise a rotation angle, a rotation speed and an
acceleration of a driving motor provided at each joint of the manipulator (100).

8. A method of controlling a manipulator, comprising steps of:

15 S100: providing the control system according to any one embodiment mentioned
above;

S200: controlling a tool center point (TCP) of the manipulator (100) by a manual
teaching method to move the tool center point from a first point (A) to a second point (B)
along a plurality of different paths (LAB1, LAB2), respectively, and calculating the position
20 data of the position indicator (210) at the first point (A) and the second point (B); and

S300: inputting the calculated position data into the artificial intelligence neuron
network operated on the cloud server (500), wherein the artificial intelligence neuron
network calculates and automatically adjusts the weight (W) among the neurons (N) based
on the input position data so that the accommodation time, the steady-state error and the
25 trajectory error of the control system are minimal.

9. The method according to claim 8, further comprising steps of:

S400: controlling the tool center point (TCP) of the manipulator (100) by the manual
teaching method to move the tool center point from the second point (B) to a third point (C)
30 along a plurality of different paths (LAC1, LAC2), respectively, and calculating the position
data of the position indicator (210) at the second point (B) and the third point (C); and

S500: inputting the calculated position data into the artificial intelligence neuron
network operated on the cloud server (500), wherein the artificial intelligence neuron
network calculates and automatically adjusts the weight (W) among the neurons (N) based
35 on the input position data so that the accommodation time, the steady-state error and the
trajectory error of the control system are minimal.

10. The method according to claim 9, further comprising steps of:

S600: controlling the tool center point (TCP) of the manipulator (100) by the manual teaching method to move the tool center point from a current point to a next point along a plurality of different paths, respectively, and calculating the position data of the position indicator (210) at the current point and the next point; and

S700: inputting the calculated position data into the artificial intelligence neuron network operated on the cloud server (500), wherein the artificial intelligence neuron network calculates and automatically adjusts the weight (W) among the neurons (N) based on the input position data so that the accommodation time, the steady-state error and the trajectory error of the control system are minimal.

11. The method according to claim 10,

wherein there are a plurality of key points in a working area of the manipulator (100), the key points at least comprises the first point (A), the second point (B), the third point (C), the current point, and the next point; and

wherein the method further comprising a step of:

S800: repeating the steps S600 and S700 until the manipulator (100) has been moved to all key points.

12. The method according to claim 11,

wherein the posture of the tool remains unchanged during the tool center point of the manipulator (100) is moved from one point (A) to another point (B) along one path (LAB1 or LAB2); and

wherein the posture of the tool during the tool center point of the manipulator (100) is moved from one point (A) to another point (B) along one path (LAB1) is different from the posture of the tool during the tool center point of the manipulator (100) is moved from one point (A) to another point (B) along another path (LAB2) different from the one path (LAB1).

13. The method according to claim 11 or 12,

wherein the posture of the tool is changeable during the tool center point of the manipulator (100) is moved from one point (A) to another point (B) along one path (LAB1, LAB2).

14. The method according to any one of claims 11-13,

wherein the tool mounted on the manipulator (100) are in an unloaded state without gripping any work piece in the above steps S100-S800.

15. The method according to claim 14,
wherein after completing the steps S100 ~ S800, the tool mounted on the manipulator (100) is in a load state of gripping a work piece, and the method further comprises a step of:
S900: repeating the steps S200 and S300.

5

DRAWINGS

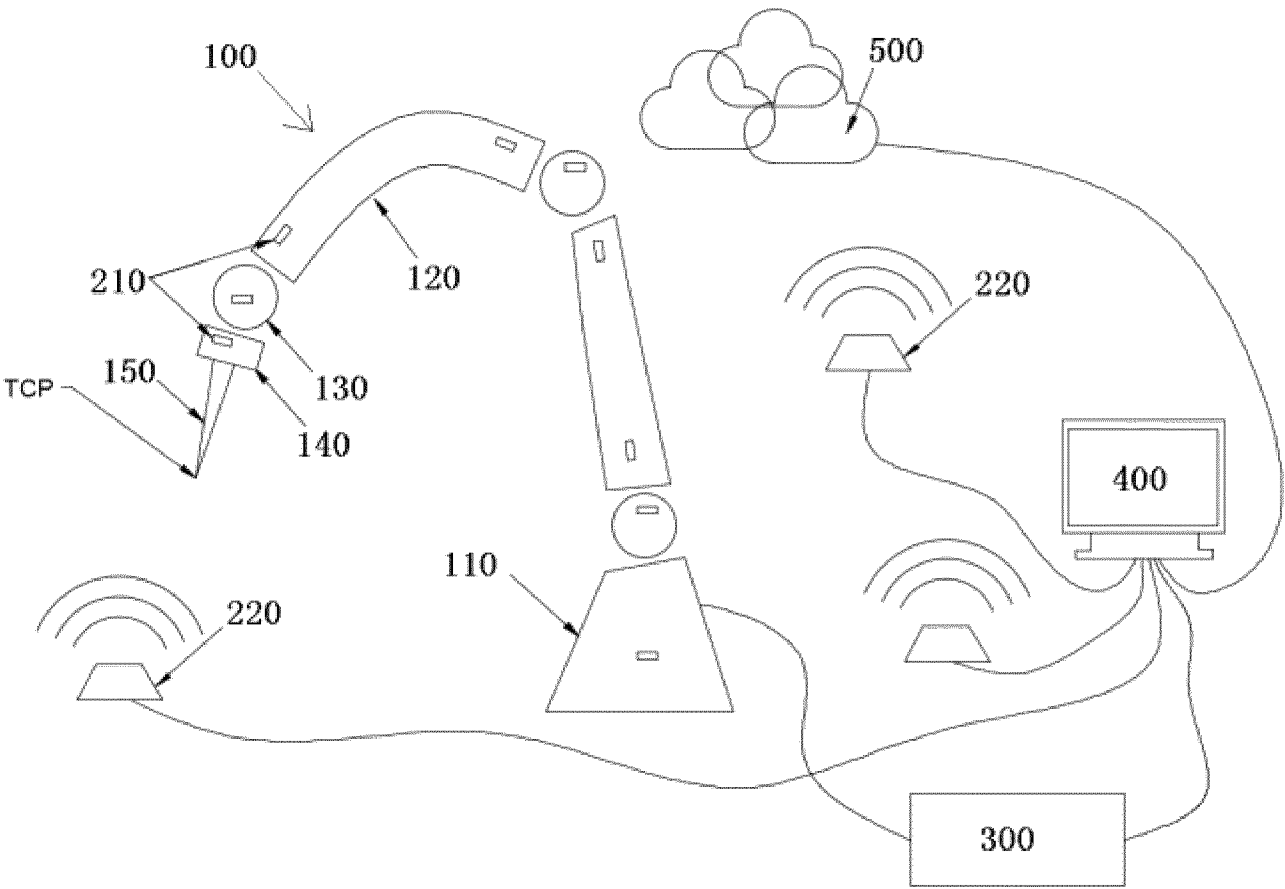


Fig.1

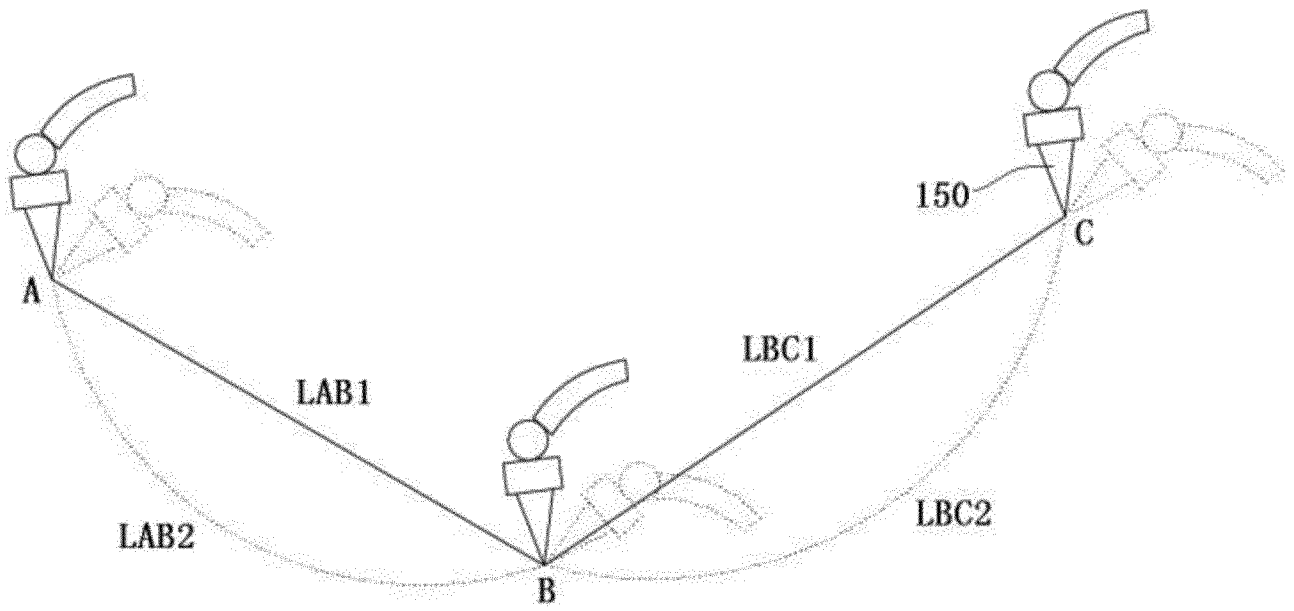


Fig.2

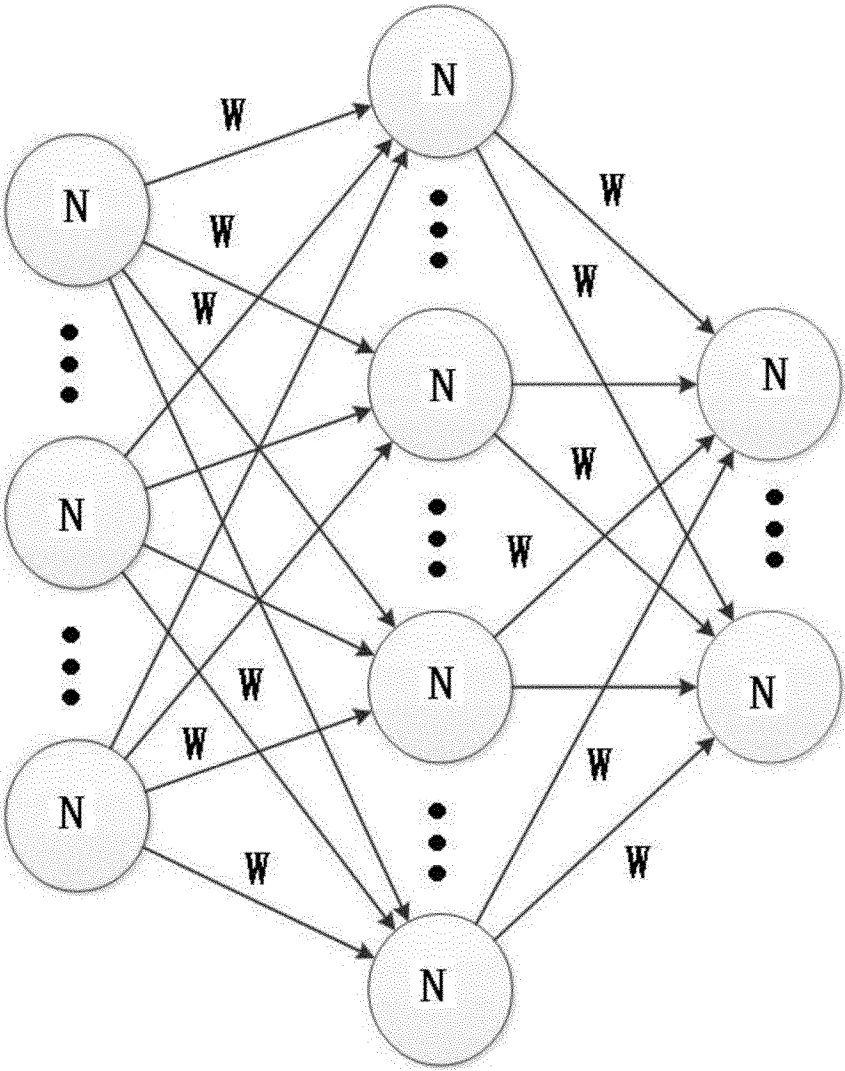


Fig.3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/083461

A. CLASSIFICATION OF SUBJECT MATTER
INV. B25J9/16
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B25J G05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP H04 336303 A (DAIKIN IND LTD) 24 November 1992 (1992-11-24) paragraph [0001] paragraph [0012] - paragraph [0025] -----	1-4,7,8, 12-15
X	PHUNG A S ET AL: "Data based kinematic model of a multi-flexible-link robot arm for varying payloads", ROBOTICS AND BIOMIMETICS (ROBIO), 2011 IEEE INTERNATIONAL CONFERENCE ON, IEEE, 7 December 2011 (2011-12-07), pages 1255-1260, XP032165958, DOI: 10.1109/ROBIO.2011.6181460 ISBN: 978-1-4577-2136-6 page 1256 - page 1259; figures 1,4,5 ----- -/--	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"E" earlier application or patent but published on or after the international filing date

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2018/083461

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Daniel Pop: "Machine Learning and Cloud Computing: Survey of Distributed and SaaS Solutions", 29 March 2016 (2016-03-29), pages 1-12, XP055556061, Retrieved from the Internet: URL:https://arxiv.org/pdf/1603.08767.pdf [retrieved on 2019-02-13] page 2 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP H04336303	A	24-11-1992	NONE
