iNexBot

Robot Operation Manual

6-Axis Collaborative

<<<

Catalogue

6-Axis Collaborative Robot

Introduction

Collaborative robots, as the name implies, emphasize the concept of "collaboration" and focus on the collaboration between humans and robots. For this reason, usability, safety, and intelligence are particularly important.

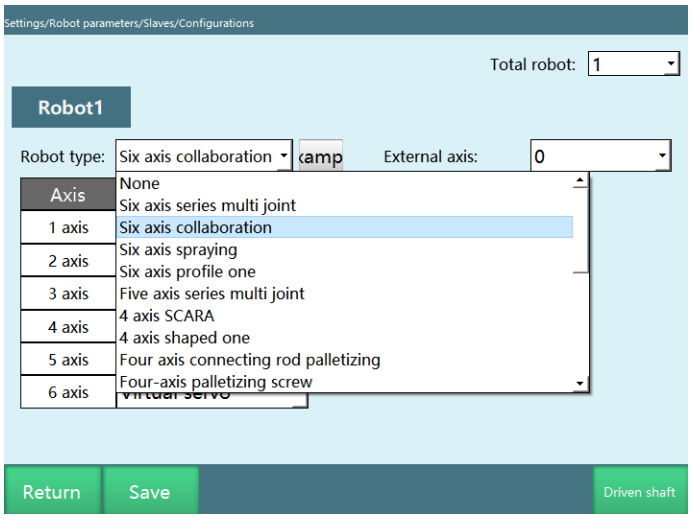
The original intention of collaborative robots is to realize human-robot collaboration, and achieve human-robot integration within a certain range without installing fences. Therefore, the emergence of collaborative robots has changed the production relationship and broken down the barriers between humans and robots.

First of all, from a business perspective, collaborative robots are the fastest growing category in the industrial robots market and have become a market pursuit with better performance than 6-axis robots and other traditional industrial robots. In addition, collaborative robots are more competitive than traditional industrial robots.

Besides, collaborative robots are humanoid robots whose purpose is to replace human hands. We can see that collaborative robots can achieve not only simple actions such as picking up cups, picking and placing materials, pressing buttons, but also pulling flowers and achieving a high degree of consistency in unattended retail areas such as coffee shops and milk tea stations. The existing collaborative robot product matrix is based on human design logic, including extreme motion and dynamics design, modular hardware structure design, flexible and reliable adaptation software, and multilingual combinations.

Slave configuration setting

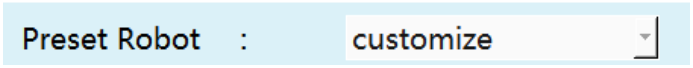
Enter the "Settings/Robot parameters/Slave configuration" interface, and select the "6-axis collaborative robot" from the "Robot type".



Parameters presetting

In the "DH parameters" interface, we provide the "Preset robot" function. If this drop-down list contains the robot model you are using, you can use this function to quickly and easily set up the parameters of your robot.

1.Click [Preset robot] in the upper left corner of the "DH parameters" interface, you can select the robot model that has already been adapted, and the DH parameters and joint parameters of the robot will be filled in automatically after the selection.

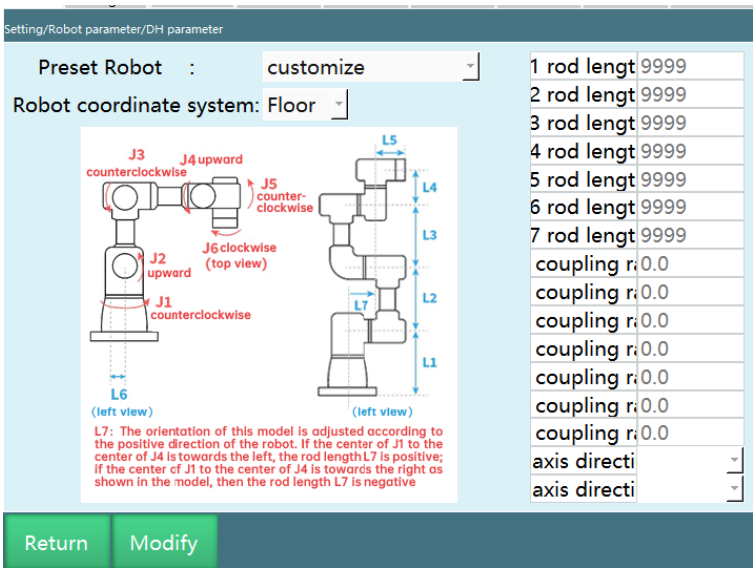


2.You need to modify the zero point manually after selecting the preset robot.

DH parameters setting

Enter the "Settings/Robot parameters/DH parameters" interface, and fill in the parameters of the robot, such as rod length, coupling ratio, axis 3 direction and axis 5 direction; these parameters will affect the linear motion and accuracy of the robot;

Note: After the DH parameters, joint parameters, etc. are set, power on and operate the robot to confirm whether the model orientation is correct.



6-axis collaborative robot

Parameter description

Preset robot

By importing the robot joint parameters and DH parameters into the controller in advance, you can eliminate the need to fill in the parameters repeatedly

Robot coordinate system

floor mounting

ceiling mounting

Note: The ceiling-mounted robots do not support recognition as well as collision detection.

Rod length

The control system needs to accurately model the robot in order to calculate the current coordinates of the end of the robot and the angle of rotation required for each joint axis as the robot moves from point A to point B.

Modeling the robot requires specifying the lengths of each part of the robot. These lengths are the rod length parameters, also known as DH parameters.

The rod length parameter should be filled in as shown in the model diagram on the "DH parameters" interface, inaccurate filling will affect the robot motion accuracy.

Coupling ratio

Some robot bodies are designed so that the motor spans many axes to drive a particular axis, which creates a coupling between the two axes. For example, if we rotate axis 2, axis 3 follows, which is axis coupling. To counteract this coupling effect, a coupling ratio is needed.

The calculation formula for the coupling ratio is:

$$\text{coupling ratio}=\frac{following\ axis\ rotation\ angle}{main\ axis\ rotation\ angle}$$

For example, if we rotate axis 2 by 10º and find that axis 3 follows the rotation by 15º, then the coupling ratio is

$$\frac{15}{10}=1.5$$

For detailed calculation method of coupling ratio, please refer to "NRC Debugging Manual"

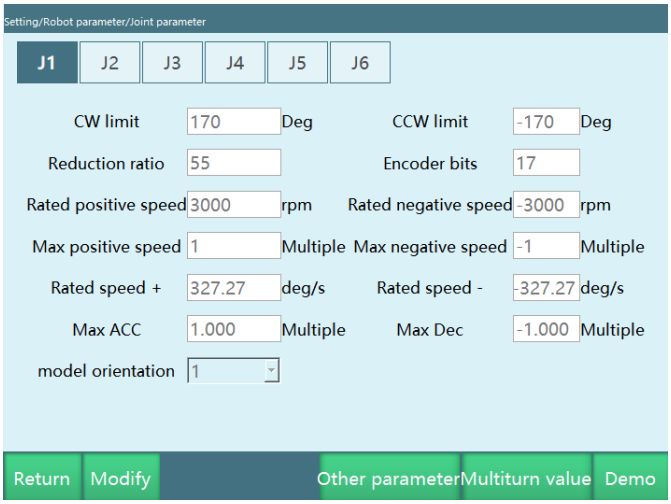
Axis 3 direction/Axis 5 direction

The axis 3 direction and axis 5 direction in 6-axis collaborative robot correspond to the two forms of collaborative robots.

Joint parameters setting

The setup procedure is the same as "Robot Parameter Debugging"

Note: Please do not power on and operate the robot until the DH parameters and joint parameters are set.



Meaning of each parameter

CW limit

The maximum range of the robot joints in the positive direction.

CCW limit

The maximum range of the robot joints in the reverse direction (This value must be negative)

Reduction ratio

The reduction ratio of the reducer.

Encoder bits

The number of bits of the encoder.

Rated positive RPM

The rated rotation speed of the motor in the positive direction.

Rated reverse RPM

The rated rotation speed of the motor in the reverse direction (This value must be negative)

Maximum positive RPM

The maximum rotation speed of the motor in the positive direction; its value is a multiple of the rated positive RPM. If the rated positive RPM is 3000 rpm and the maximum positive RPM needs to be 6000 rpm, then fill in 2 times here.

Maximum reverse RPM

The maximum rotation speed of the motor in the reverse direction; its value is a multiple of the rated reverse RPM. If the rated reverse RPM is -4000 rpm and the maximum reverse RPM needs to be -6000 rpm, then fill in -1.5 times here. (This value must be negative)

Rated positive speed

The rated positive speed of the robot joint; it is automatically calculated from the rated positive RPM, encoder bits and the reduction ratio, no need to fill in.

Rated reverse speed

The rated reverse speed of the robot joint; it is automatically calculated from the rated reverse RPM, encoder bits and the reduction ratio, no need to fill in. (This value must be negative)

Maximum acceleration

The maximum acceleration of the robot joint movement; its value is a multiple of the rated positive (reverse) speed. If the rated positive speed is 300 degrees/s, the maximum acceleration needs to be 1500 degrees/s^2, then fill in 5 times here.

Maximum deceleration

The maximum deceleration of the robot joint movement; its value is a multiple of the rated positive (reverse) speed. If the rated positive speed is 300 degrees/s, the maximum acceleration needs to be 1200 degrees/s², then fill in -4 times here. It is recommended that the maximum acceleration and maximum deceleration values be the same. (This value must be negative)

Model direction

The model direction should be set by referring to the joint positive direction diagram below, and the direction of the jogging "+" key of each axis should be the same as the joint positive direction diagram (choosing 1 for the same and -1 for the opposite)

Actual joint direction

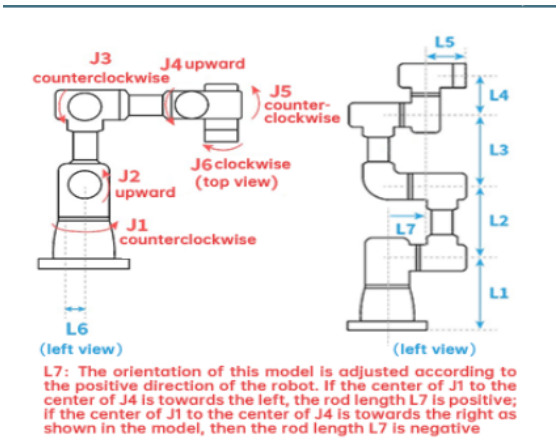
The default option is 1.

Gear backlash

The angle to compensate for the filled value whenever the joint moves in the opposite direction, not filled by default

Robot type	Axis	Positive direction (top view or left view)
6-axis collaborative robot	J1	anticlockwise
	J2	upward
	J3	anticlockwise
	J4	upward
	J5	anticlockwise
	J6	clockwise (top view)

Joint positive direction diagram

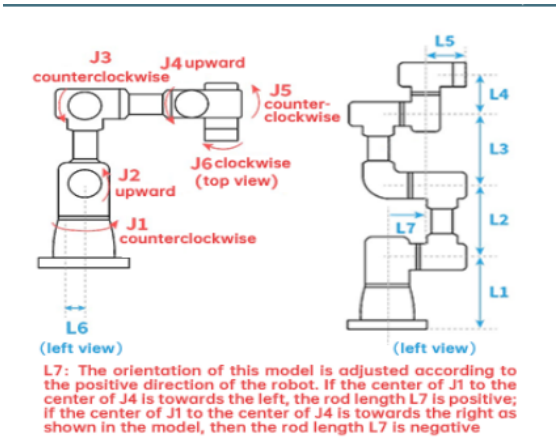


Note: Please do not power on and operate the robot until the positive direction of the joint has been set.

Zero calibration

If the robot zero position is a non-standard zero position, users can align the robot according to the robot's alignment hole, and then set the current robot position coordinates to the zero position on the robot zero position interface.

The schematic diagram of the zero point position of the 6-axis collaborative robot is as follows (here are the two forms of the zero point model respectively). The model direction of the left form is adjusted on the left side of the robot; the model direction of the right form is adjusted in the positive direction of the robot, if the center of J1 to the center of J4 is towards the left, the rod length L7 is positive; if the center of J1 to the center of J4 is towards the right as shown in the model, then the rod length L7 is negative:



Make sure the robot is in this position and click "Set all joints to zero".

Note: Please do not power on and operate the robot before DH parameters and joint parameters are set.

Notes

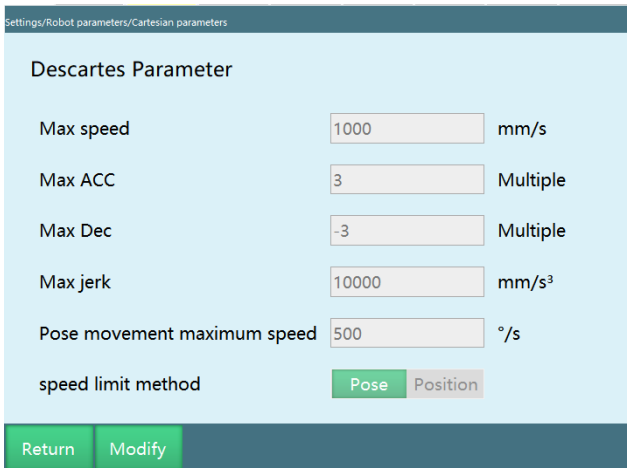
If the robot is not origin position calibrated, you can not return it to the zero point

For systems that use multiple robots, each robot must perform origin position calibration

When there is a coupling relationship between joint axes, such as the common coupling relationship between the fifth axis and the sixth axis of a robot, the fifth axis must be at the zero position, then the zero data recorded for the sixth axis will be valid, otherwise, the zero data recorded for the sixth axis will be invalid. So the zero data of the sixth axis must be recorded with the fifth axis at the zero position. If there is no coupling relationship, each axis can calibrate the zero position individually, and the respective zero position will not affect the zero position of other joints

Cartesian parameters setting

Cartesian parameters can use default values directly.



Meaning of each parameter

Maximum speed

The maximum linear speed of the robot during operation. (The inserted instructions that require V parameter are subject to Cartesian parameters)

Maximum acceleration

The maximum acceleration of the robot during operation; its value is a multiple of the maximum speed. If the maximum speed is 1000mm/s and the maximum acceleration needs to be 3000mm/s², then fill in 3 times here.

Maximum deceleration

The maximum deceleration of the robot during operation; its value is a multiple of the maximum speed. If the maximum speed is 1000 mm/s and the maximum deceleration needs to be -3000 mm/s², then fill in -3 times here. It is recommended that the maximum acceleration and maximum deceleration values be the same and the same as the maximum acceleration and maximum deceleration in the joint parameters. (This value must be negative)

Maximum jerk

This parameter is a reserved parameter and is currently invalid.

Pose movement maximum speed

The maximum speed of the robot during operation, if the instruction speed exceeds this value, it will be decelerated.

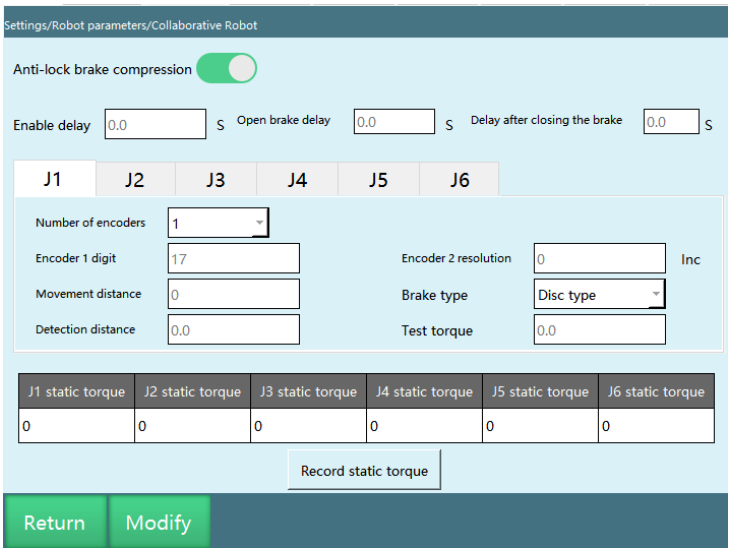
Speed limit method

Pose: The linear interpolation motion of the robot is limited by the maximum speed and the pose movement maximum speed.

Position: The linear interpolation motion of the robot is limited only by the maximum speed.

6-axis collaborative robot parameter setting

This interface is the parameter setting interface for 6-axis collaborative robots, other types of robots do not need to set.



Detailed usage of collaborative robot parameters

Enable delay

The delay time after pressing the enable key before issuing the enable instruction to the servo

Brake open delay

The delay time after issuing the enable instruction before issuing the brake open instruction to the servo

Delay after the brake is closed

The delay time elapsed from the closing of the brake until the servo responds to the next operation

Number of encoders

The number of encoders in single joint

Encoder 1 bits

The same as the encoder bits in the joint parameters

Encoder 2 resolution

The inc value of another encoder in single joint

Movement distance

The jogging distance of the joint before the brake is opened, generally 20

Brake type

Brake disc brake and pin-type brake

Detection distance

The joint movement distance used to detect whether the brake is open after opening the brake

Detection torque

After opening the brake, if the torque exceeds the detection torque when the joint runs detection distance, it is considered that the brake has failed to open