



DOBOT

MG400 Training System Palletizing Demo Guide

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Preface

Purpose

This document describes coaxial and off-axis palletizing in MG400 training system, making it easy for users to fully understand and use MG400 training system.

Intended Audience

This document is intended for:

- Customer Engineer
- Sales Engineer
- Installation and Commissioning Engineer
- Technical Support Engineer

Change History

Date	Change Description
2023/01/06	Integrate coaxial and off-axis palletizing
2022/06/24	The first release

Symbol Conventions

The symbols that may be found in this document are defined as follows.

Symbol	Description
 DANGER	Indicates a hazard with a high level of risk which, if not avoided, could result in death or serious injury
 WARNING	Indicates a hazard with a medium level or low level of risk which, if not avoided, could result in minor or moderate personal injury and damage to the equipment
 NOTICE	Indicates a potentially hazardous situation which, if not avoided, can result in damage to the equipment, data loss, or unanticipated result
 NOTE	Provides additional information to emphasize or supplement important points in the main text

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1. Introduction

In a case in which the materials to be carried are arranged regularly and evenly spaced, teaching the position of each material one by one may lead to large error and low efficiency. Palletizing process can effectively solve such problems.

In the MG400 training system, you can set the palletizing parameters and call palletizing APIs to make MG400 quickly realize palletizing operations.

This document describes coaxial palletizing and off-axis palletizing. Coaxial palletizing means that the palletizing tool (sucker) is installed on the end of the robot, coaxial with J4.



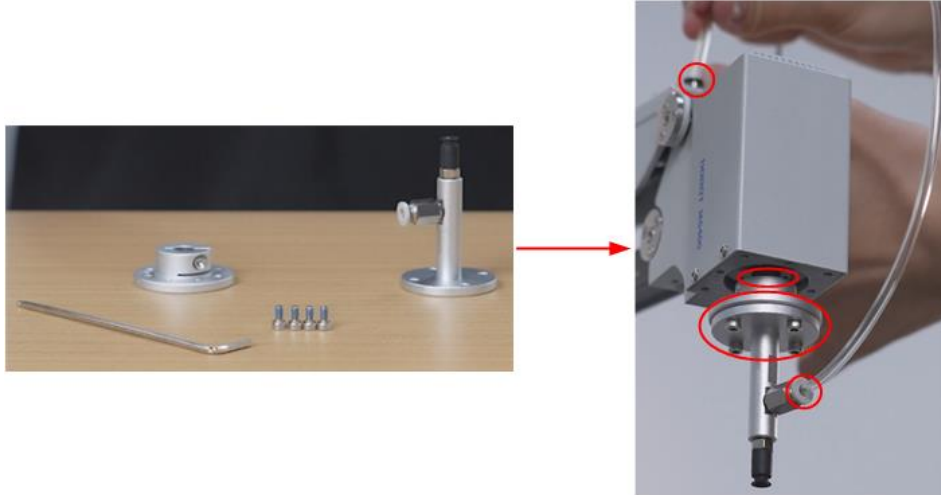
Off-axis palletizing means that the palletizing tool (sucker) is installed on the end of the robot arm through an eccentric flange, not coaxial with J4.



2. Coaxial Palletizing Demo

2.1 Hardware installation

Step 1 Install the coaxial sucker on the end of MG400. The red boxes below show the parts which need to be assembled.

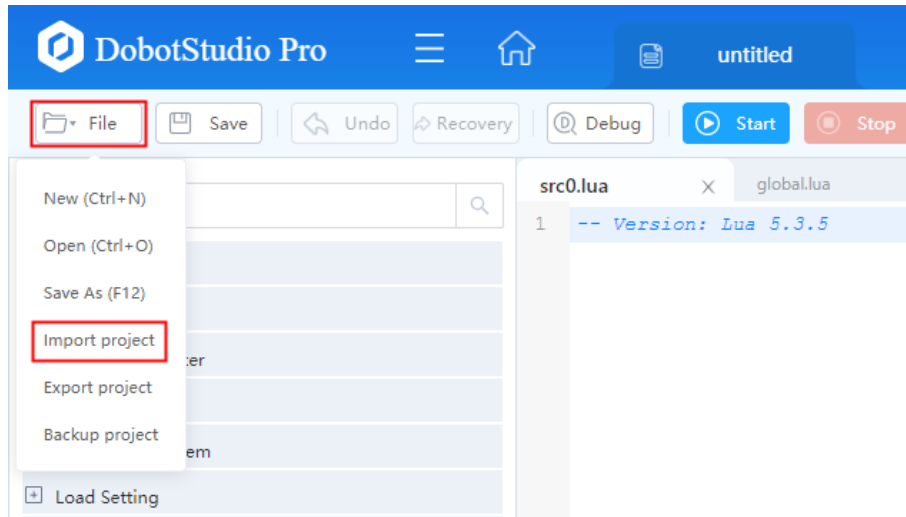


Step 2 Place the pallet on the conveyor and material on the pallet, as shown below.

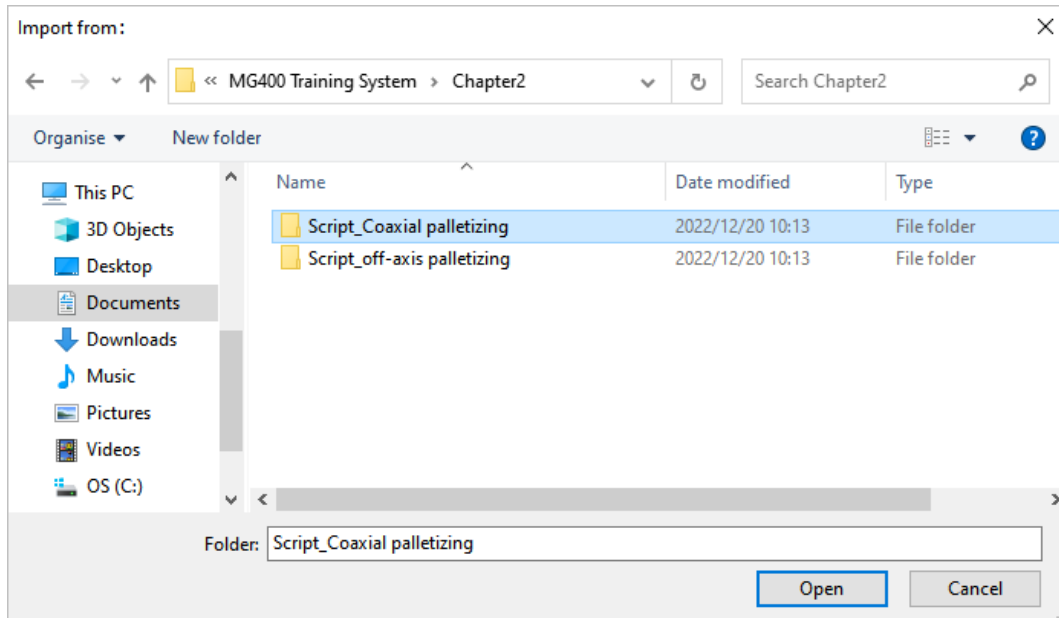


2.2 Import and configure palletizing project

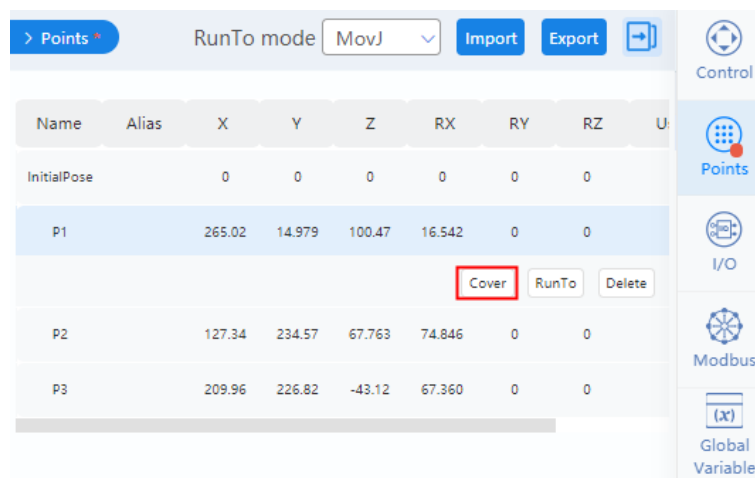
Step 1 Click  in DobotStudio Pro main page to enter Script page. Click **File > Import project**.



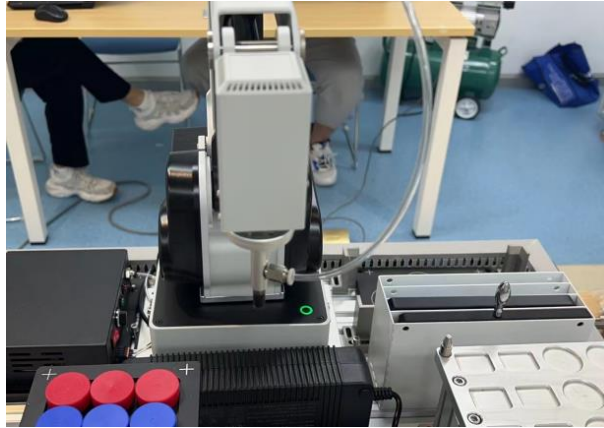
Step 2 Select “Script_Coaxial palletizing” file folder, and open it.



Step 3 Open Points panel. Drag or jog the robot to teach and cover the three points in turn.



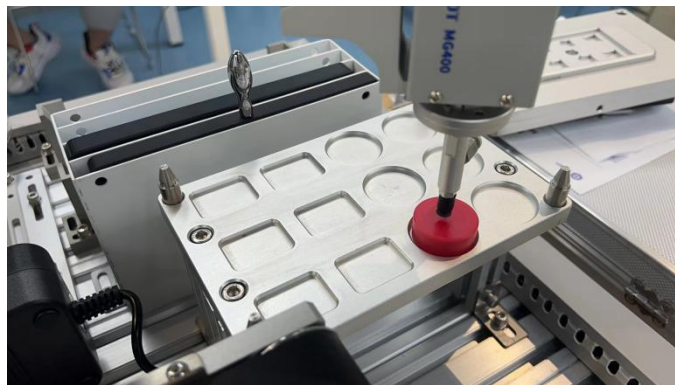
P1 (home point)



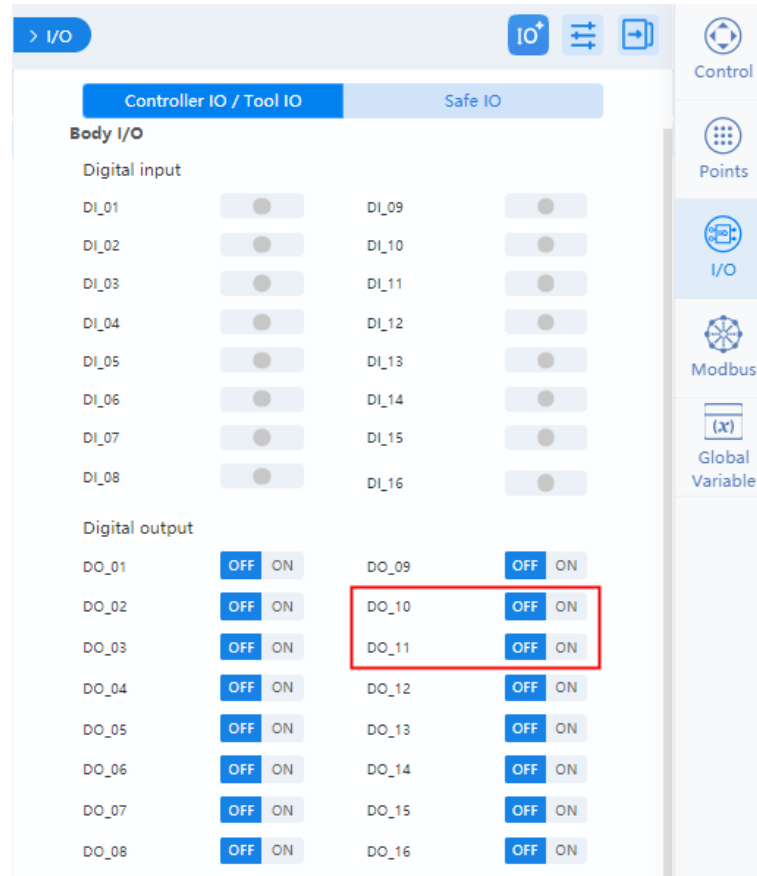
P2 (transition point)



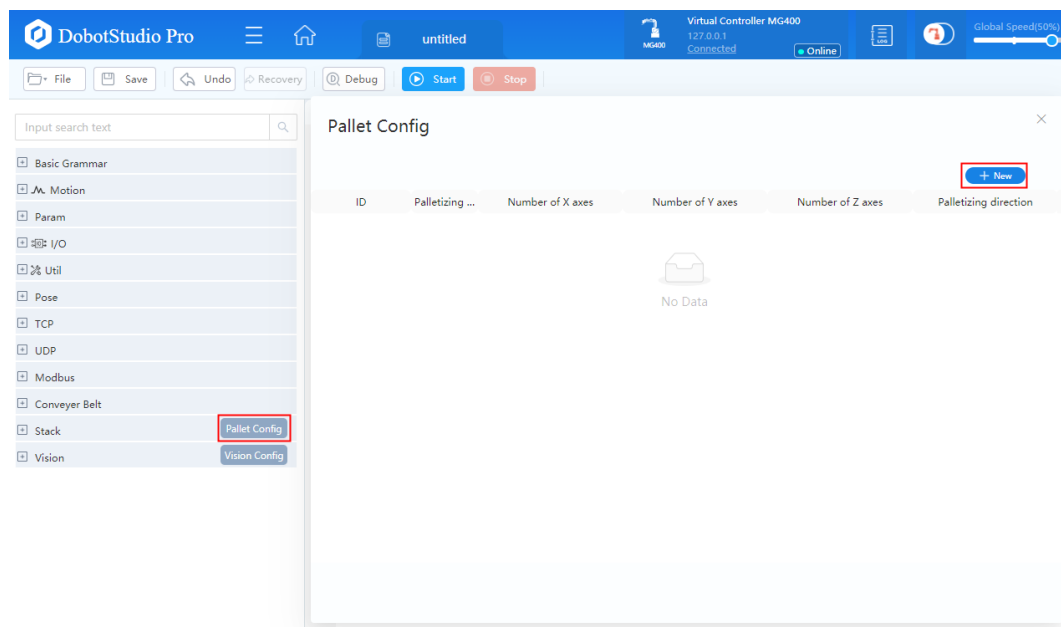
P3 (Point for placing materials): According to the demo, you need to set P3 to the position in the figure below, and the block is recommended to be suspended. In actual operation, if the block cannot fall into the slot smoothly, please adjust the suspended height appropriately.



When the air pump box is set to Auto mode, you can turn on DO10 in I/O interface to control the sucker to suck the material, and turn off DO10 and turn on DO11 to place the material.

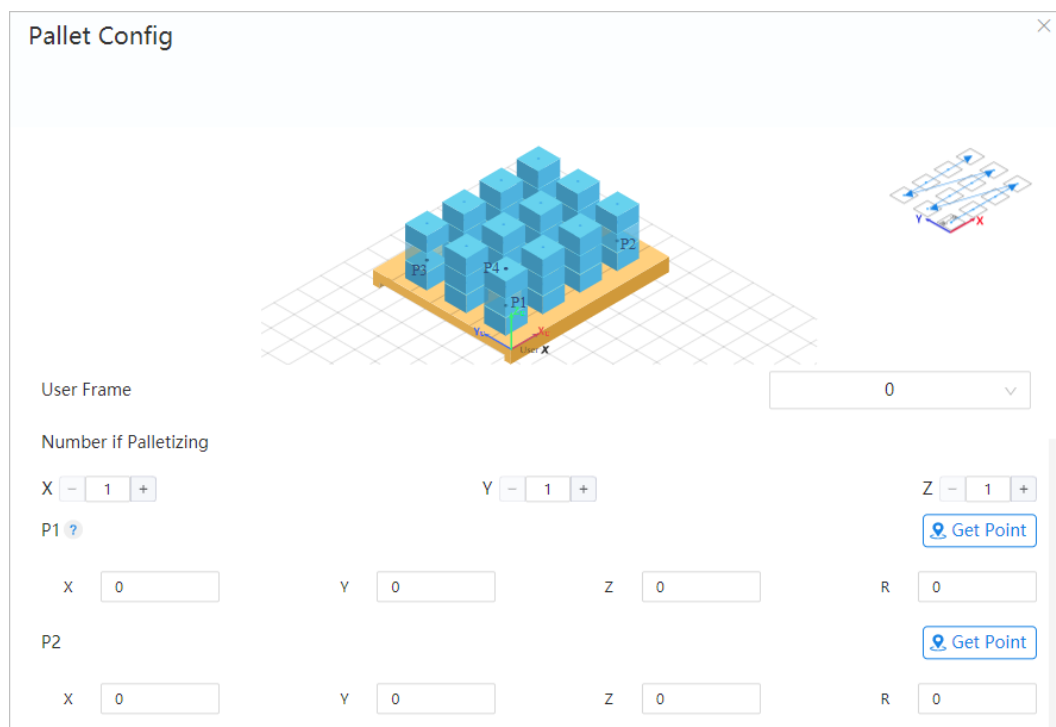


Step 4 Click **Pallet Config** > **New** (you can click **Modify** if there is an established pallet).



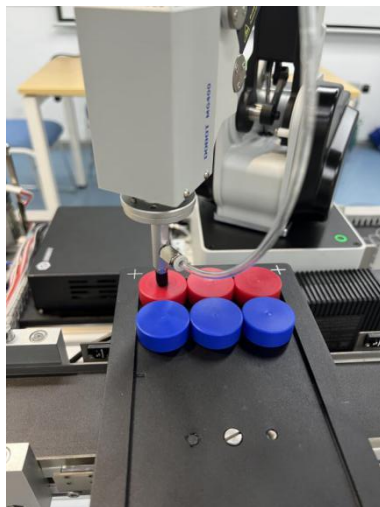
Step 5 Set relevant parameters in Pallet Config page.

Enter pallet name and pallet number (taking 2*3 palletizing as an example).

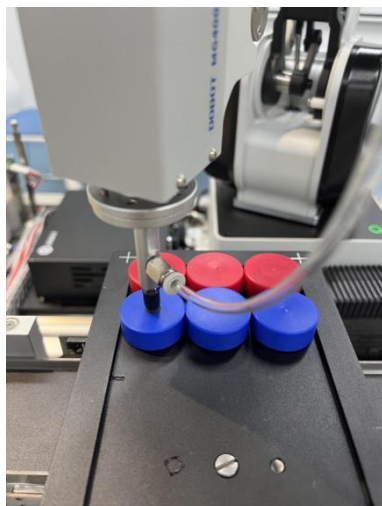


Teach point P1~P4 in turn.

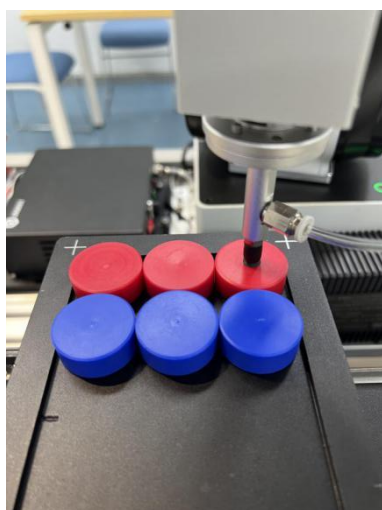
P1: The first picking point



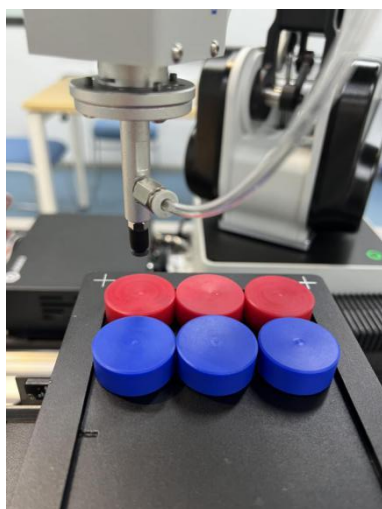
P2: Picking point along X axis



P3: Picking point along Y axis

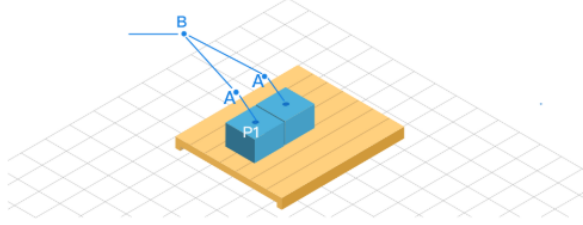


P4: As there is only one layer in this example, point P4 can be set to any point over P1.



Step 6 After saving all the points, click **Next step**. Teach the preparation point and transition point.

Pallet Config
×



Prepared Point (A) ?

Get Point

X

0

Y

0

Z

0

R

0

Safe Point (B) ?

Get Point

X

0

Y

0

Z

0

R

0

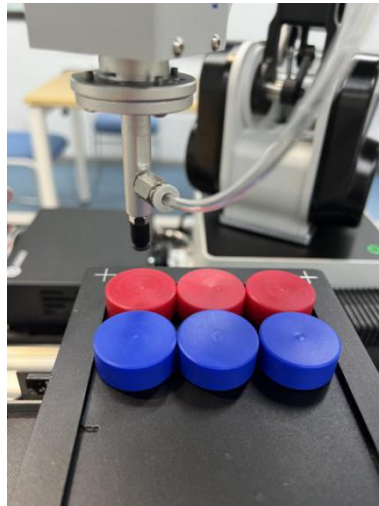
☒ The height of the transition point varies with the height of the story

Cancel

Last step

Save

Preparation point (A): Point over the picking point



Transition point (B)



Step 7 Modify the pallet index in the script, as shown below. (e.g. the pallet index here is 0)

src0.lua
global.lua
+

```

1 local MPpick = MatrixPallet(0, "IsUnstack=false Userframe=0") --// Define a pallet
2 local x = 0
3 local y = 0
4

```

Pallet Config

+ New

ID	Palletizing ...	Number of X axes	Number of Y axes	Number of Z axes	Palletizing direction
0	Coaxial_pal...	2	3	1	X->Y->Z

Step 8 Click **Save**. Enter a project name (such as “Coaxial_palletizing”) and click **OK**.

Step 9 Click **Start** to run the program.

 DobotStudio Pro

File

Save

Undo

Recovery

Debug

Start

Stop

Coaxial_palletizing

Input search text

Basic Grammar

Motion

Param

I/O

Util

Pose

TCP

src0.lua

global.lua

+

```

1 -- Version: Lua 5.3.5
2 local MPpick = MatrixPallet(0, "IsUnstack=false Userframe=0") --// Define a pallet
3 local x = 0 --//Define X-axis offset variable
4 local y = 0 --//Define Y-axis offset variable
5
6 Go(P1)
7 Reset(MPpick) --//Initialize pallets
8 while true do
9 MoveIn(MPpick,"velAB=90 velBC=50") --//Start moving
10 DO(10,1)

```

2.3 Demo description

This section mainly describes the key script. For complete script, see the project.

1. In this demo, the robot arm first move to the HOME point (P1), and then pick up the material according to the configured palletizing type. After teaching the points according to the method described above, the robot will start picking the blocks in the order of red, blue, red... from the first picking point. After picking the material, it moves to the configured transition point.

```
Go(P1)
Reset(MPpick) --//Initialize pallets
while true do
MoveIn(MPpick,"velAB=90 velBC=50") --//Start palletizing
DO(10,1)
Wait(500)
MoveOut(MPpick)
```

2. Then the robot arm will calculate the placing point corresponding to each material according to the distance between the first placing point (P3) and each placing point, move to the placing point through the transition point (P2), place the material, and then return to the HOME point.

```
--//Place
Go(P2)
Go(RP(P3, {40*x,40*y,30,0}),"SYNC=1")
Move(RP(P3, {40*x,40*y,0,0}),"SYNC=1")
DO(10, 0)
DO(11, 1)
Wait(50)
DO(11, 0)
Move(RP(P3, {40*x,40*y,30,0}),"SYNC=1")
Go(P2)
x=x-1
if x== -3 then
x=0
y=y+1
end
```

3. Repeat the steps above until all the materials are palletized.

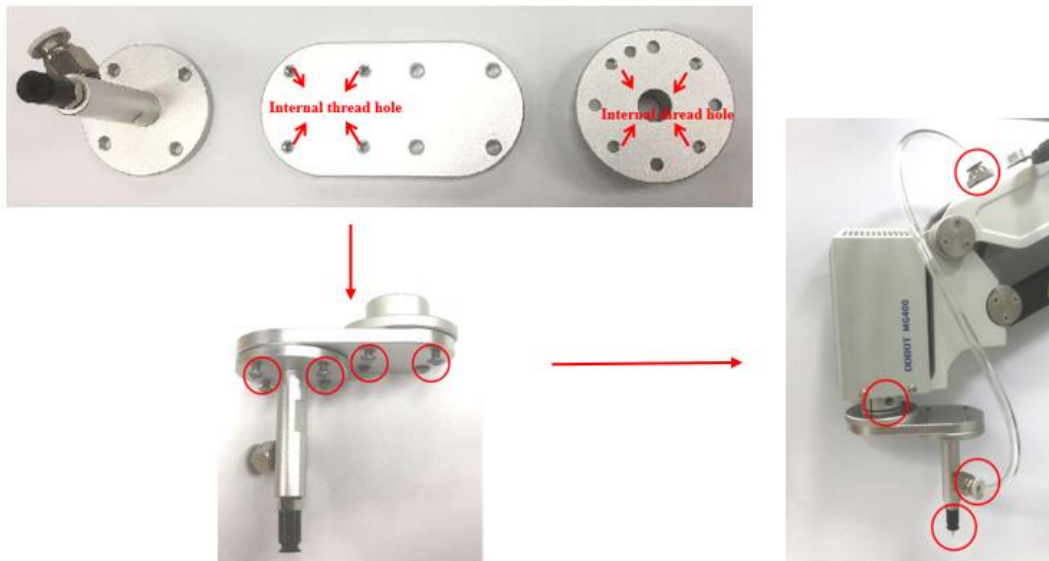
3. Off-axis Palletizing Demo

3.1 Hardware installation

Install an off-axis sucker at the end of the robot arm. The red box below shows the parts which need to be assembled. The calibration needle is used to calibrate the point when you establish the coordinate system, which needs to be removed after calibration.

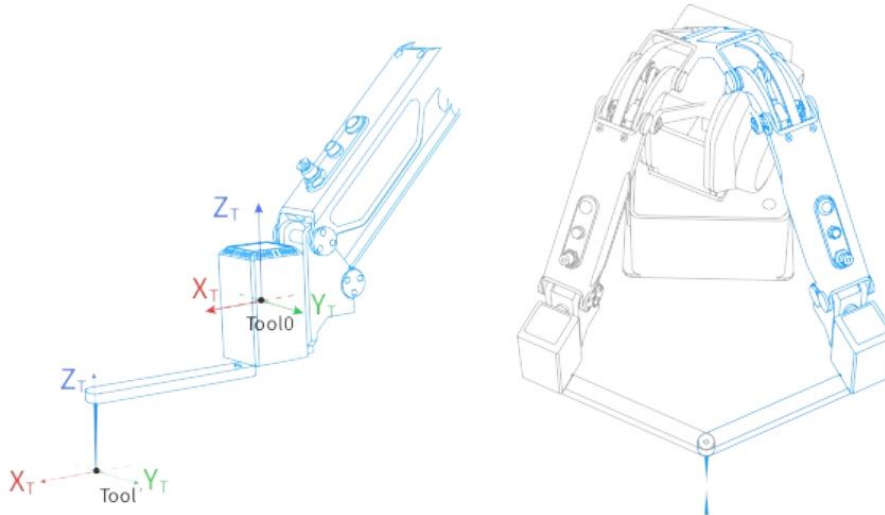
NOTE

If you need to remove the air pipe, press and hold the spring piece at the air pipe interface before removing the air pipe.



3.2 Establish tool coordinate system

The Tool coordinate system is generated by the two-point calibration method. After installing an end effector on MG400, adjust the pose of the tool so that the TCP (Tool Center Point) aligns with the same point (reference point) in space with two different poses, obtain the position offset of the tool, and generate the tool coordinate system, as shown in the figure below.



Step 1 Enter DobotStudio Pro. Click **Settings** > **Coordinate System** > **Tool Frame**.

Step 2 Select a Tool coordinate system (take No. 1 as an example). Then click **Modify** to update the coordinate system (if there is only No. 0, you can click **Add** to add a coordinate system).

 **Settings**

Common

MG400

Basic

Communication settings

Coordinate System

Load Params

Motion Parameter

Security Setting

Remote Control

Firmware Update

Home Calibration

User Frame

Tool Frame

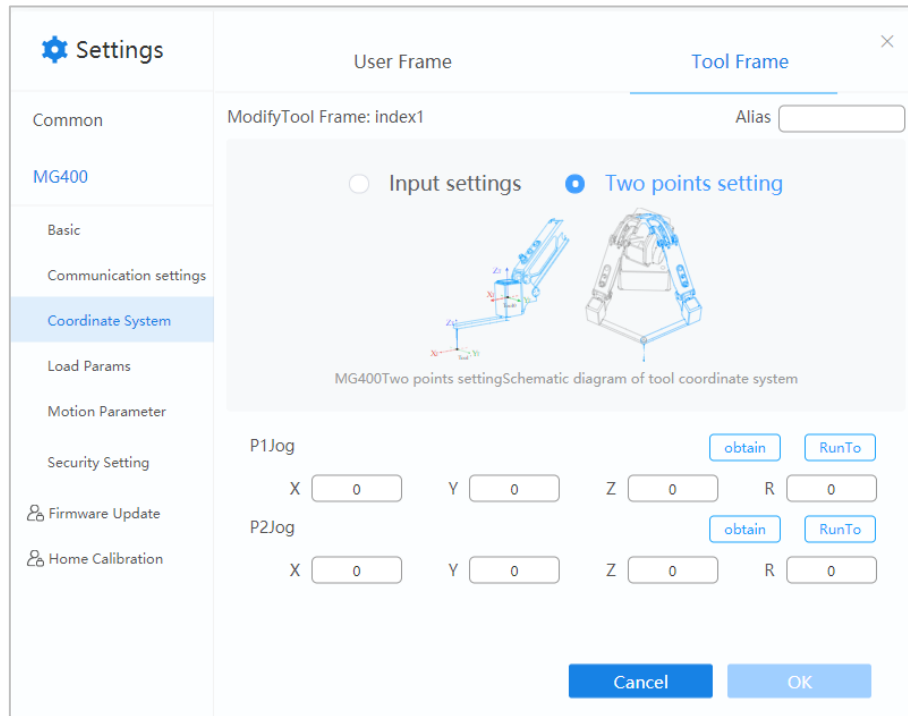
copy

Modify

Add

index	Alias	X	Y	Z	R
☐ 0		0.000	0.000	0.000	0.000
☒ 1		0.000	0.000	0.000	0.000
☐ 2		0.000	0.000	0.000	0.000

Step 3 Click **Two points setting**.



Step 4 Place the calibration tool on the conveyor. Jog MG400 to align the needle at the end of the robot with the calibration needle on the conveyor. Then click **obtain** on P1 panel.

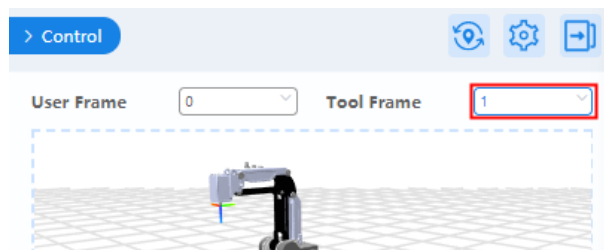


Step 5 Jog MG400 to change its posture while keeping the needle at the end of the robot aligned with the calibration needle on the conveyor. Then click **obtain** on P2 panel.



Step 6 Click **OK**. The Tool coordinate system 1 is updated.

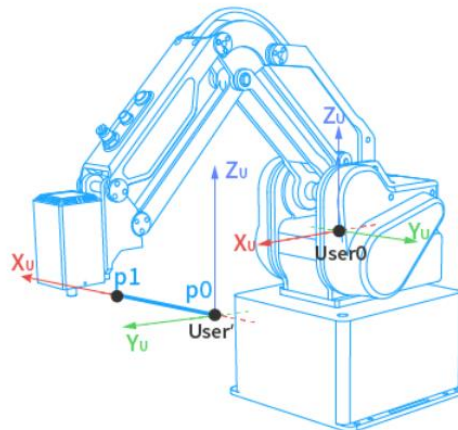
Step 7 Modify the **Tool Frame** on the Control panel to **1**.



3.3 Establish user coordinate system

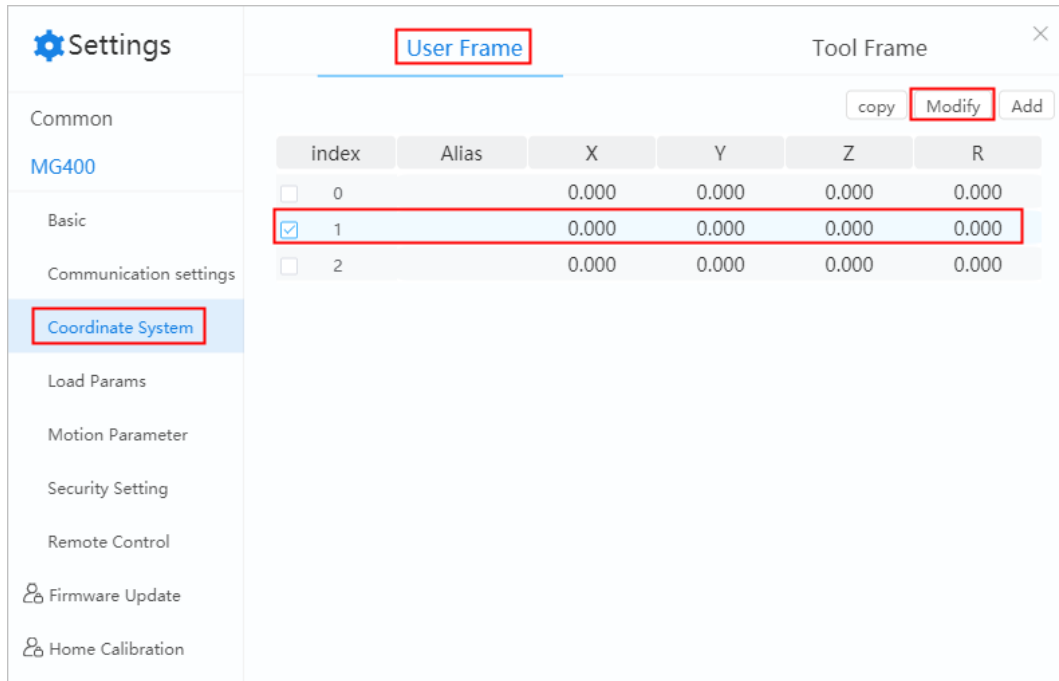
When the position of workpieces is changed or a robot program needs to be reused in multiple processing systems of the same type, you can create coordinate systems on the workpiece so that all trajectory can update which simplifies the programming. DobotStudio Pro supports 10 user coordinate systems, of which User coordinate system 0 is defined as the base coordinate system by default and cannot be changed.

The user coordinate system is generated by the two-point calibration method. Move the robot to two points: $P_0(x_0, y_0, z_0)$ and $P_1(x_1, y_1, z_1)$. Point P_0 is defined as the origin and the line from point P_0 to point P_1 is defined as the positive direction of X-axis. Then the Y-axis and Z-axis can be defined based on the right-hand rule, as shown below.

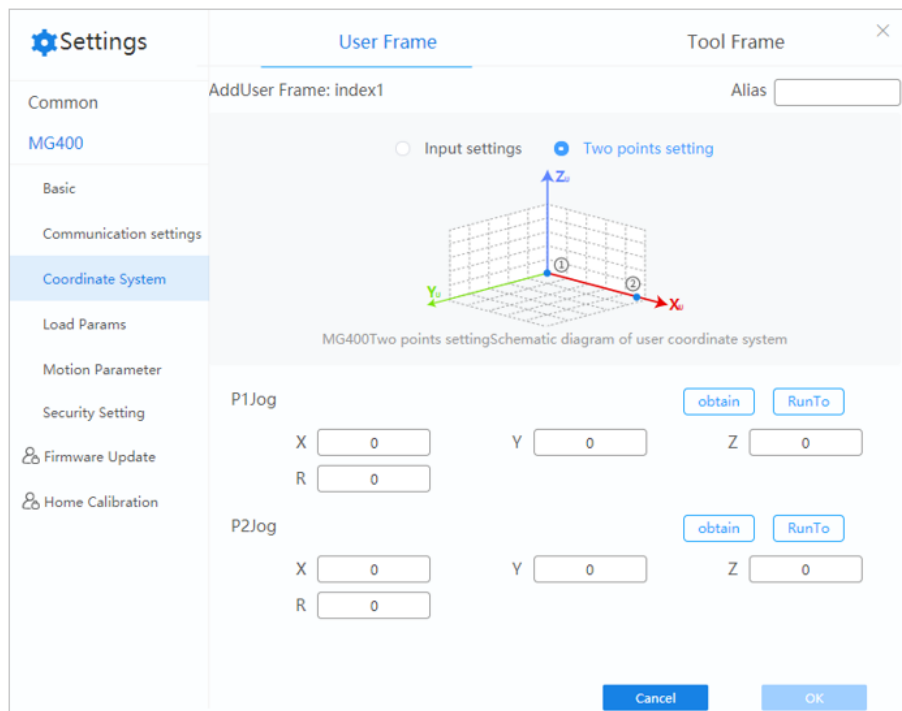


Step 1 Click **Settings** > **Coordinate System** > **User Frame**.

Step 2 Select a User coordinate system (take No. 1 as an example). Then click **Modify** to update the coordinate system (if there is only No. 0, you can click **Add** to add a coordinate system).

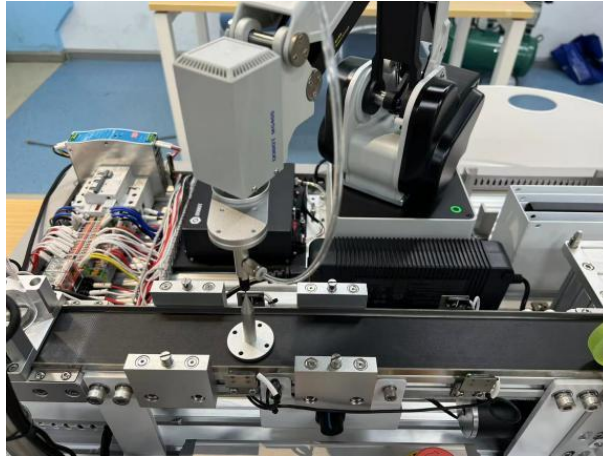


Step 3 Select **Two points setting** in “Add User Frame: index1” page.

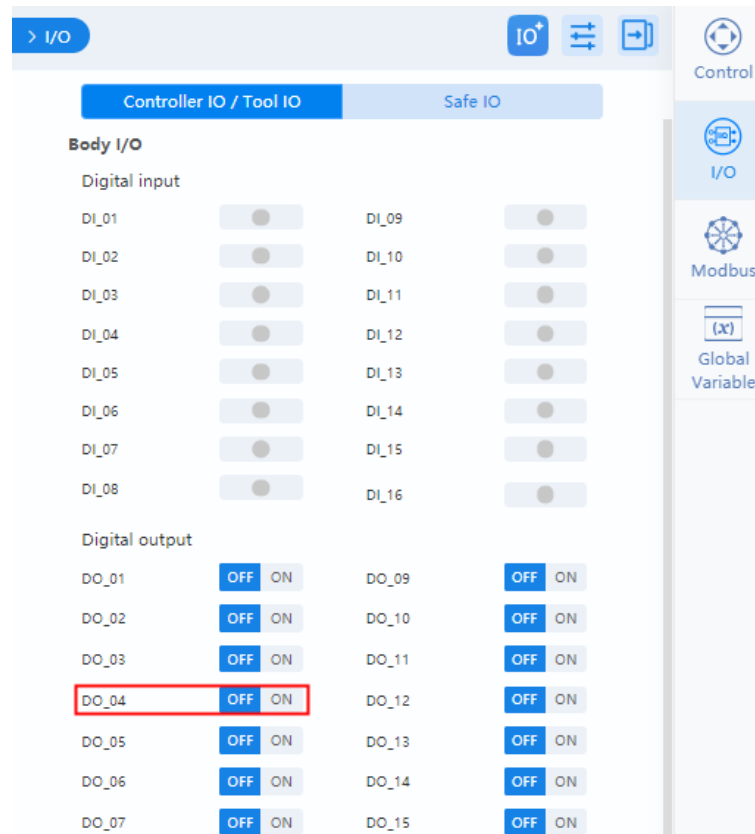


Step 4 Place the calibration tool on the conveyor. Jog MG400 to align the needle at the end

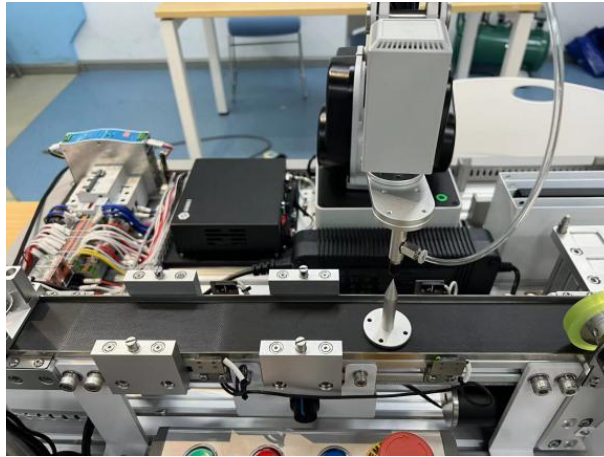
of the robot with the calibration needle on the conveyor. Then click **obtain** on P1 panel.



Step 5 Turn on DO4 on I/O panel to make the calibration tool move some distance with the conveyor. Then turn off DO4.

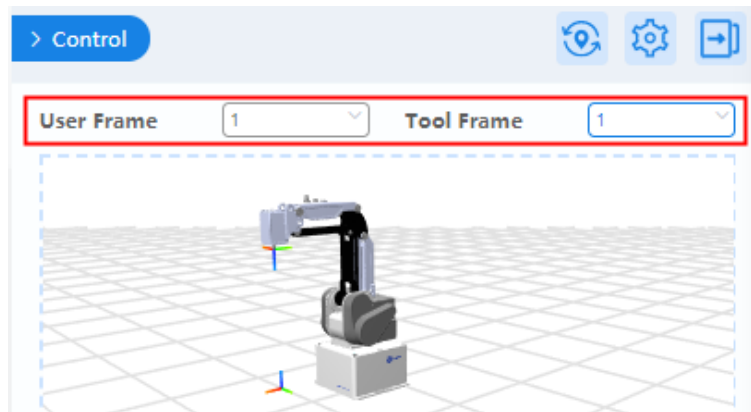


Step 6 Jog MG400 to align the needle at the end of the robot with the calibration needle on the conveyor again. Then click **obtain** on P2 panel.



Step 7 Click **OK**. The User coordinate system 1 is updated. After calibration, remove the calibration needle from the sucker.

Step 8 Modify the **User Frame** on the Control panel to **1**.



3.4 Place pallet and material

Place the pallet on the conveyor, and put the material on the pallet, as shown below.



3.5 Import and configure palletizing project

- Step 1** Click  in DobotStudio Pro main page to enter Script page. Click **File > Import** project.
- Step 2** Select “Script_off-axis palletizing” file folder, and open it.
- Step 3** Open Points panel. Drag or jog the robot to teach and cover the three points in turn.

> Points *		RunTo mode		MovJ	Import	Export	
Name	Alias	X	Y	Z	R	User	Tool
InitialPose		350	0	0	0	0	0
P1	Home	209.18	28.525	10.094	-2.691	1	1
					Cover	RunTo	Delete
P2	Take	29.473	81.674	-32.11	-46.51	1	1
P3	Transition	299.68	88.480	16.729	12.744	1	1
P4	Place	367.76	187.25	-96.29	49.207	1	1

P1 (home point)



P2 (first picking point): You can control the sucker through DO10 on I/O panel to suck the material.



P3 (transition point)



P4 (Point for placing materials): It is recommended to move to the suspended position over the slot after picking up the material. Then turn off DO10 and turn on DO11 to place the material to confirm whether it can be placed in the slot accurately.)



Step 4 Click **Save**. Enter a project name (such as “off_axis_palletizing”) and click **OK**.

Step 5 Click **Start** to run the program.

3.6 Demo description

MG400 I/O description

DI	Description	DO	Description
DI2	Start	DO2	Enable the push motor
DI3	Stop	DO3	Direction of push motor
DI4	Reset	DO4	Conveyor moves forward
DI5	/	DO5	Conveyor moves backward
DI6	Detect whether there are blocks in the material bin	DO6	Green LED light + green button light
DI7	Photo detection	DO7	Yellow LED light + yellow button light
DI8	In-place detection	DO8	Red LED light + red button light
DI9	Front stop of push motor	DO9	Buzzer
DI10	Back stop of push motor	DO10	Vacuum pumping
DI16	Emergency stop	DO11	Vacuum breaking

This section mainly describes the key script. For complete script, see the project. In this demo, the robot arm calculates the picking point and placing point for each material based on the taught picking point (P2) and placing point (P4) and the distance between the materials.

1. The robot arm first moves to the HOME point (P1), and then moves to the first picking point to suck the material.

Go(P1)

```
Go(RP(P2, {20*x,-28*y,30,0}),"SYNC=1")  
Move(RP(P2, {20*x,-28*y,0,0}),"SYNC=1")  
DO(10, 1)  
Wait(100)
```

2. The robot arm moves through the transition point (P3) to the placing point to place the material, and then return to the transition point.

```
Move(RP(P2, {20*x,-28*y,30,0}),"SYNC=1")  
Go(P3)  
Sync()  
local Offset={10,10,10,0}  
RelPoint(P1, Offset)  
Go(RP(P4, {40*x,-40*y,30,0}),"SYNC=1")  
Move(RP(P4, {40*x,-40*y,0,0}),"SYNC=1")  
DO(10, 0)  
DO(11, 1)  
Wait(500)  
DO(11, 0)  
Move(RP(P4, {40*x,-40*y,30,0}),"SYNC=1")  
Go(P3)
```

3. Repeat the steps above until all materials are palletized.