DART-Studio Pallet Path Generation Manual

Version 1.0.0.4

Contents

Preface

This User Manual introduces how to use DART-Studio Pallet Path Generation.

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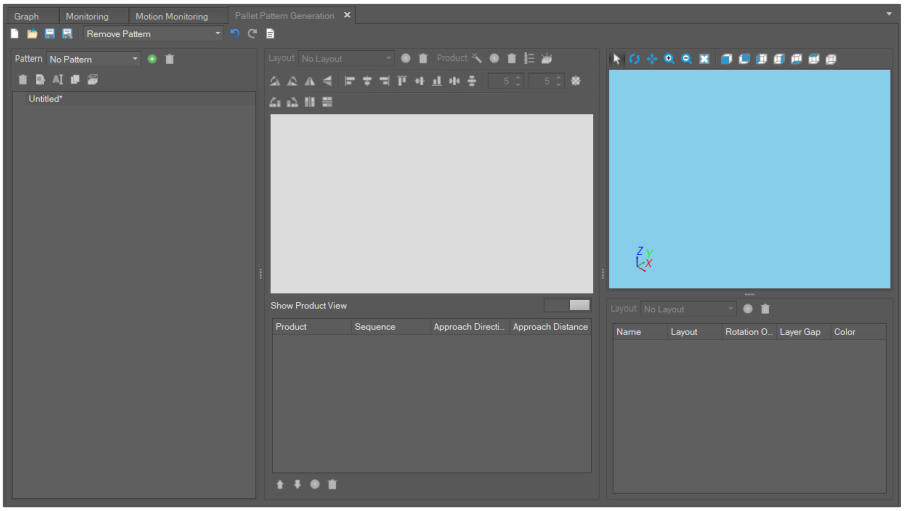
1 Create Pallet Path

1.1 Open Work Window

1. To use Pallet Path Creation, select **Util** from **Main** Menu, then click the **Pallet Path Generation** button.

2. The Path Creation window will be displayed as a tab on the right side, as shown below.



1.2 Create Project

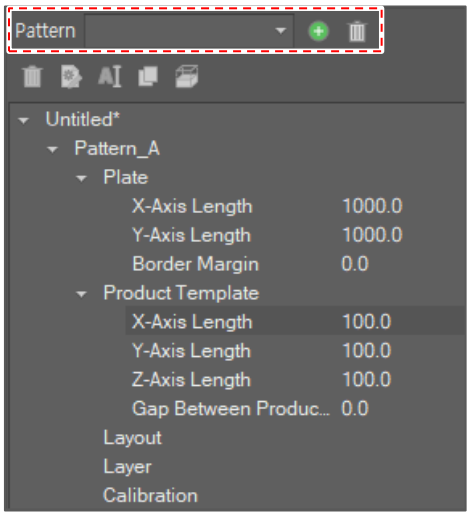
	Create Project	Create a new palletizing project
	Load	Load a saved project
	Save	Save the current project
	Save As	Save the current project under another name
	Task List	Select the task list currently being used or one used before
	Undo	Undo an action

	Redo	Reapply an action you have undone
	Start Code Generator	Run the palletizing code generator

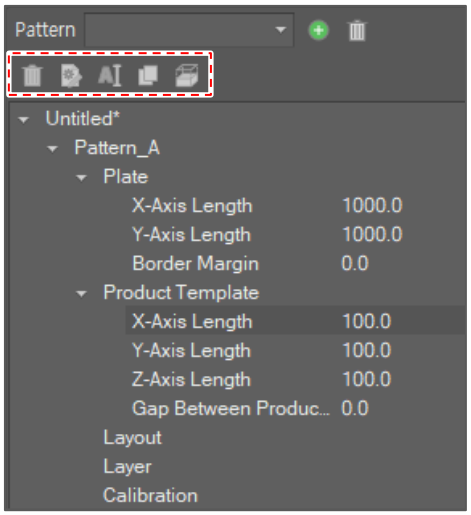
1.3 Create Pattern

1.3.1 Create Pattern main window

In the Create Pattern window, you will see ‘Create new pattern’, and ‘Set up plate’ (the location where a product is to be located) and ‘Product’. With this Pallet Path Creation program, you can set up only one plate and one product size per pallet.

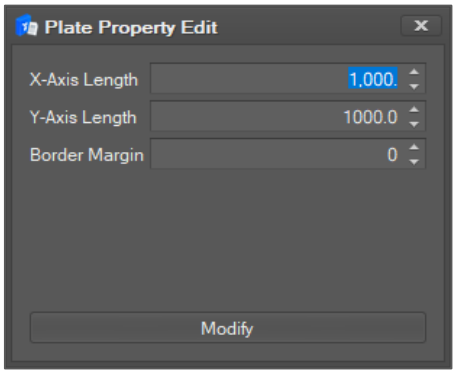


Pattern	Select Pattern	Select a pattern to modify
	Add New Pattern	Add a new pattern to create
	Delete Pattern	Delete the selected pattern



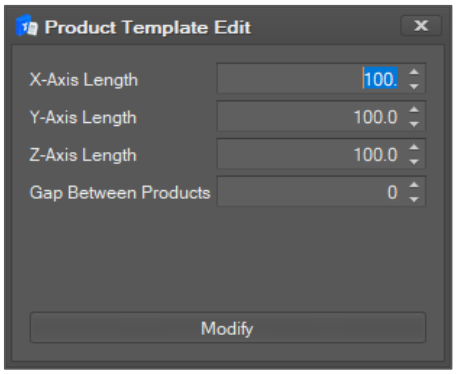
	Delete Item	Delete the selected item
	Change Attribute	Change the attributes of the plate and product templates. It is possible to change by right-button click at plate and product tab.
	Change Name	Change the name of the selected item. Change the name of the selected item
	Copy Layout	Copy the selected layout
	Start Calibration	Run the calibration menu to calibrate the currently created pattern

1.3.2 Plate setup



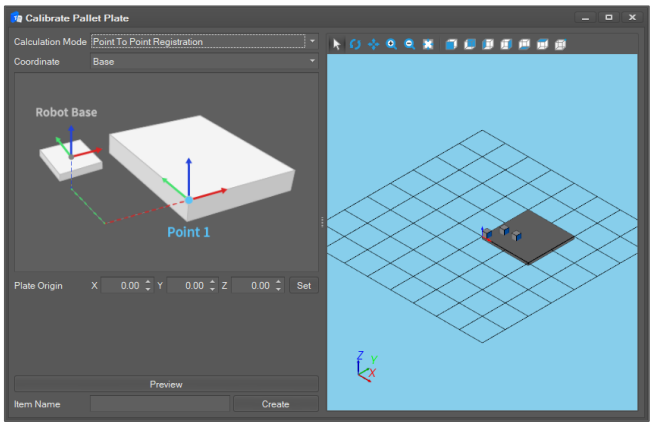
It is possible to add additional information about the plate size and border margin in the Plate Setup window. The plate border margin is the parameter that determines whether the product is exposed to the plate outline or not.

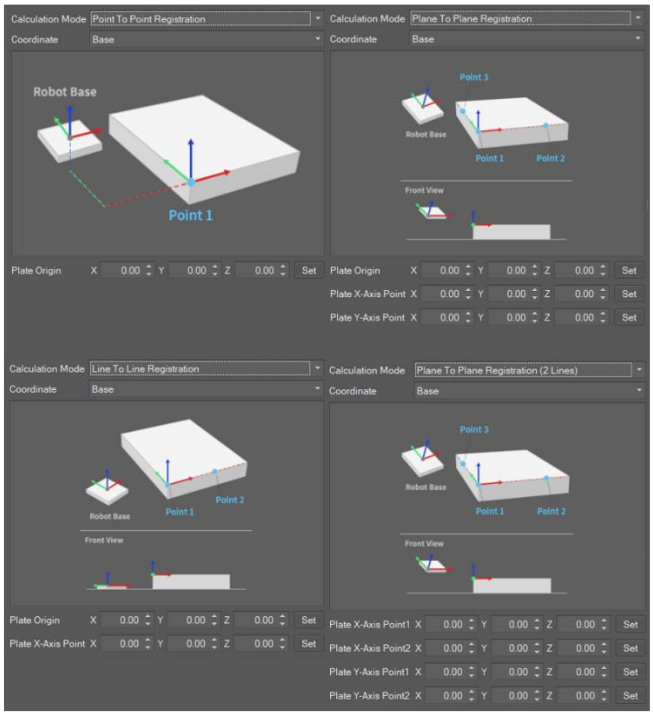
1.3.3 Product setup



It is possible to determine product size and setup distance between products in the Product Setup window.

1.3.4 Calibration setup

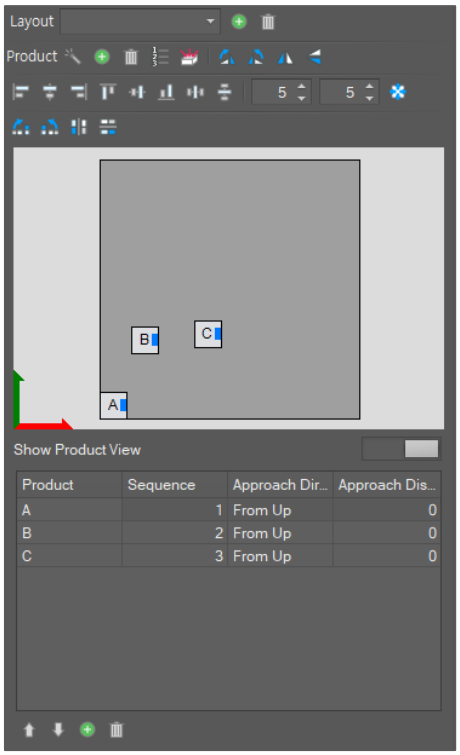




This is the setup window where the user can execute calibration of a user-created pattern. The calibration window supports 4 calculation modes: point-to-point, straight line-to-straight line, plane-to-plane and plane-to-plane (two straight lines). Depending on the calculation mode, the number of points the user needs to specify increases, but the calibration results become more accurate. It is possible to see a preview in the right-view window by pressing the Preview button. In addition, it is possible to save the calibration result by giving it a name and clicking Create.

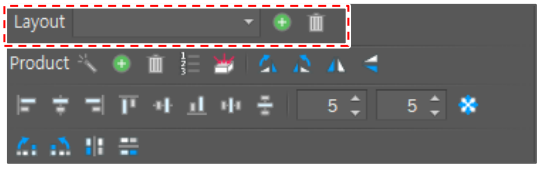
1.4 Layout Setup

1.4.1 Layout Main window



The Layout window is used to deploy products onto the plate area that were created in the Create Pattern window. It also is possible to set the direction and distance to/from the products when operating a robot. Products shown on the screen are displayed with capital letters in the alphabetical order of the products, and the forward direction of each product is marked with a blue box.

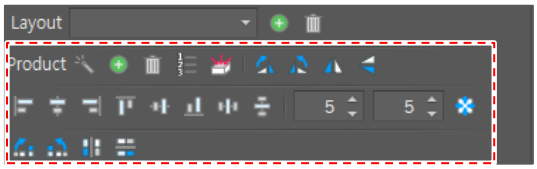
The layout toolbox is shown below.



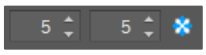
Layout	Select Layout	Select a layout to work with

	Add Layout	Add a layout
	Delete Layout	Delete the selected layout

The product toolbox is shown below.

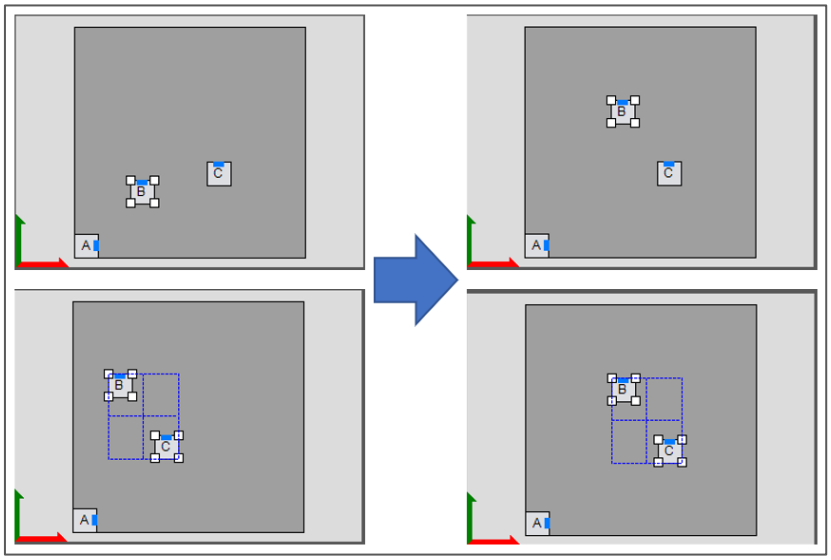


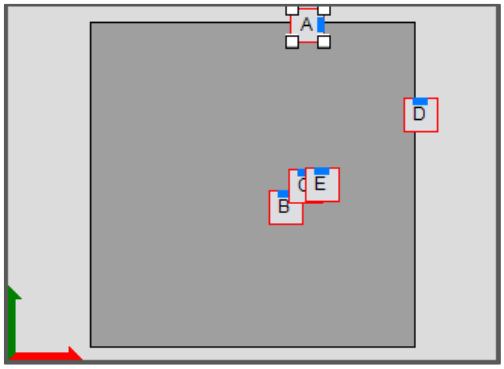
	Auto Create Product	Deploy products onto the current working layout automatically
	Add Product	Add a product to the current layout
	Delete Product	Delete the selected product
	Change Product Order	Change the order of products deployed on the current layout. Products are sorted in ascending order according to the order in which they were clicked.
	Change Approaching Properties	Set the approaching and retreating direction and distance to/from a product
	Rotate clockwise 90º	Rotate a single product clockwise 90º
	Rotate counterclockwise 90º	Rotate a single product counterclockwise 90º
	Flip Horizontal	Flip the a single product horizontally
	Flip Vertical	Flip the a single product vertically
	Align Left	Align the selected multiple products to the left
	Align Center	Align the selected multiple products to the center
	Align Right	Align the selected multiple products to the right
	Align Top	Align the selected multiple products to the top
	Align Bottom	Align the selected multiple products to the bottom
	Distribute Horizontally	Space the multiple products out horizontally with an equal distance

		between
	Distribute Vertically	Space the multiple products out vertically with an equal distance between
	Single Move	Move the selected (single, multiple) product(s) to the X- or Y-axis
	Rotate multiple products cloclwise 90º	Rotate multiple products clockwise 90º
	Rotate multiple products countercloclwise 90º	Rotate multiple products counterclockwise 90º
	Flip Horizontal - Multiple Products	Flip multiple products horizontally
	Flip Vertical - Multiple Products	Flip multiple products vertically

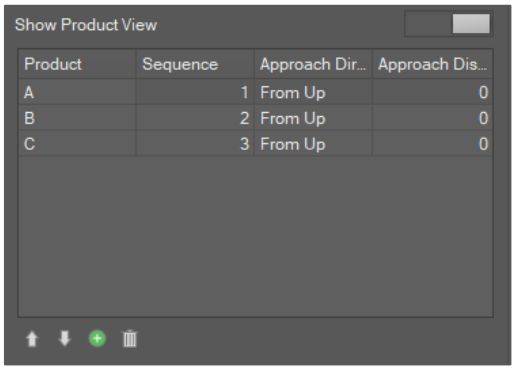
In the Product Layout screen, it is possible to select object(s) by clicking or dragging with the mouse. It is possible to move the selected object(s) by dragging them with the mouse. There are additional shortcuts available.

Mouse click + ctrl	Cancel Project Selection	Cancel the selection of the selected project
Mouse drag + alt	Copy Product	Copy the selected product



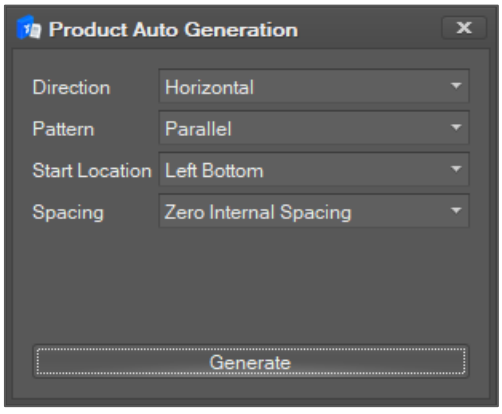


The Product layout screen has a function for detecting collisions. When product outlines overlap, their color changes to red.



The Product Order window can be enabled using the View Product Order toggle button, and it is possible to modify currently deployed product(s). You can modify the order and approaching distance, and add or delete a product(s).

1.4.2 Auto Create Product



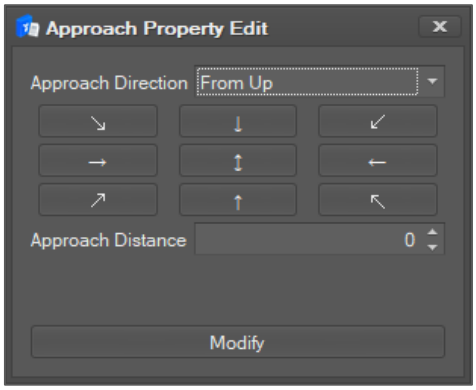
The Auto Create Product window automatically deploys products onto the selected plate(s). The deployment of products is applied to all plates, and there are four deployment rules.

Details of each item are given below:

Direction	Determines the creation direction of a pattern. There are Horizontal bases and Vertical bases. For Horizontal, the pattern is created from bottom left to bottom right, and for Vertical, from

	bottom left to top left.
Pattern	Determines the creation rule for a pattern. For Parallel, the same pattern is applied to all rows, and for Zigzag, the inverted pattern is applied to each row.
Start Position	Select start position. It is possible to start from the bottom left, top left, bottom right or top right.
Spacing Option	This option that is applicable when the total area of products to be deployed is small. If Medium is selected, the spacing between the products is equalized so that the plate can be filled.

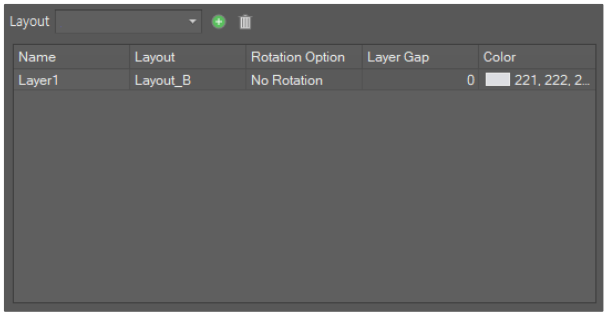
1.4.3 Approaching Property Setup



The Approaching property setup is used to issue a command to approach/retreat to a certain distance to prevent collision between products or outlines while palletizing products. From this window, it is possible to set up the approaching direction and distance. There are nine approaching directions, and approaching distance is the distance from the center of the object.

1.5 Layer Setup

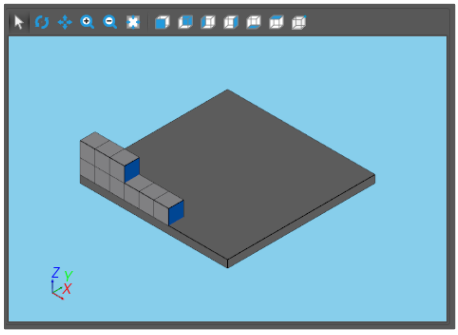
1.5.1 Layer Main Window



In this window, you can set up layers based on the prepared layout. When adding a new layer, it is possible to select the layout to be applied. It is possible to add/delete layer(s), and to rotate (right 90º, left 90º, right 180º) / flip (horizontally, vertically) currently created layer(s). In addition, there is the option to set a gap between layers so that it is possible to insert a shim paper. It is possible to assign a color to a layer, so that the layer can be distinguished from other layers on the 3D screen.

1.6 3D Screen Manipulation

1.6.1 3D Screen Manipulation Window



The created layer is displayed in the 3D Screen Manipulation window in real-time. The following options are available.

1.6.2 Screen Control

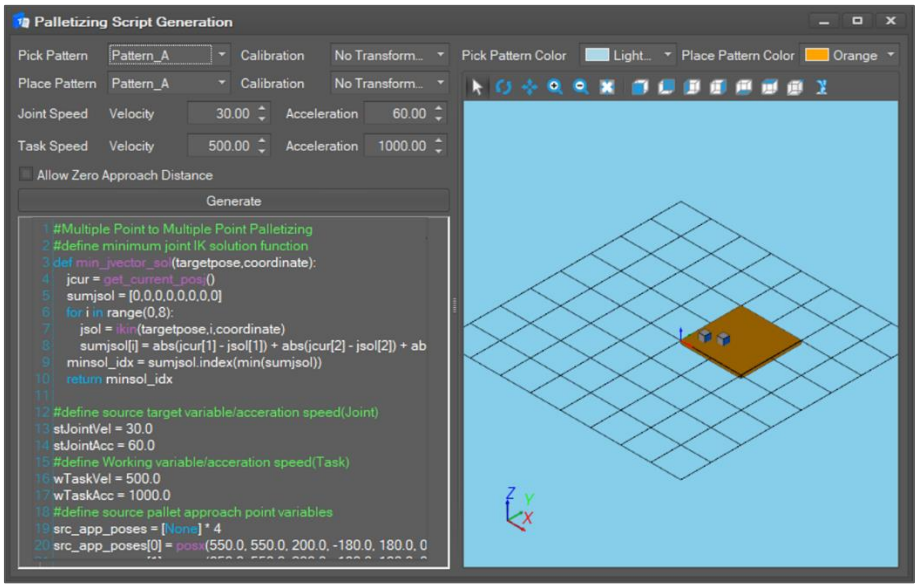
	Select	Select object(s) from the screen
	Rotate	Rotate the screen around the object
	Move	Move the screen along with mouse
	Zoom In	Enlarge the area where the mouse pointer is located
	Zoom Out	Shrink the area where the mouse pointer is located
	Screen Initialization	Resize the screen size so that the object fills the entire screen

1.6.3 Screen Viewpoint Setup

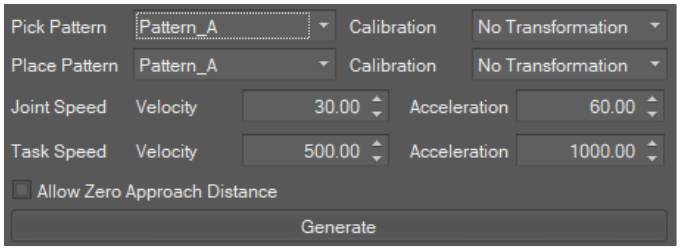
	View from -Y direction
	View from +Y direction
	View from -X direction
	View from +X direction
	View from -Z direction
	View from +Z direction
	View from -X, -Y, +Z direction
	View from -X, +Y, +Z direction
	View from +X, +Y, +Z direction
	View from +X, -Y, +Z direction
	View from -X, -Y, -Z direction
	View from -X, +Y, -Z direction
	View from +X, +Y, -Z direction
	View from +X, -Y, -Z direction

1.7 Create Pallet Path

1.7.1 Create Path



It is possible to create a path based on the created pattern and calibration. During creation, DRL code is generated as shown above. Select Grasp Pattern, Release Pattern and Calibrations as shown below.



The rate of movement between patterns can be configured with Joint Speed and Acceleration, and the working speed for gripping and releasing in the pattern varies according to the task speed.

The rate of movement between patterns can be configured with Joint Speed and Acceleration, and the working speed for gripping and releasing in the pattern varies according to the task speed.

It is possible to run the generated script by copying (CTRL+C) and pasting (CTRL+V) from **DRL editor** of the **Task Manager**. In addition, the DRL code can be directly applied to the Teach Pendant by inserting it into the custom code on the TB/TW using the **"Upload to Smart TP"** button in the **Task Manager**.

1.7.2 Analyze Generated Code

The code below is a sample code generated as the result of pallet path creation. It is a palletizing task for moving three products.

```
tp_log('data = palletsim, action = simstart')
#Multiple Point to Multiple Point Palletizing
#define minimum joint IK solution function
def min_jvector_sol(targetpose,coordinate):
    jcur = get_current_posj()
    sumjsol = [0,0,0,0,0,0,0,0]
    for i in range(0,8):
        jsol = ikin(targetpose,i,coordinate)
        sumjsol[i] = abs(jcur[1] - jsol[1]) + abs(jcur[2] - jsol[2]) + abs(jcur[4] -
jsol[4])
    minsol_idx = sumjsol.index(min(sumjsol))
    return minsol_idx

#define source target variable/acceration speed(Joint)
stJointVel = 30.0
stJointAcc = 60.0
#define Working variable/acceration speed(Task)
wTaskVel = 500.0
wTaskAcc = 1000.0
#define source pallet approach point variables
src_app_poses = [None] * 3
src_app_poses[0] = posx(272.6, 461.4, 170.7, -180.0, 180.0, 0.0)
src_app_poses[1] = posx(456.2, 457.0, 170.7, -180.0, 180.0, 0.0)
src_app_poses[2] = posx(715.6, 519.0, 170.7, -180.0, 180.0, 0.0)
#define source pallet target point variables
src_job_poses = [None] * 3
```

```
    src_job_poses[0] = posx(201.9, 461.4, 100.0, -180.0, 180.0, 0.0)
    src_job_poses[1] = posx(385.4, 457.0, 100.0, -180.0, 180.0, 0.0)
    src_job_poses[2] = posx(644.9, 519.0, 100.0, -180.0, 180.0, 0.0)
    #define source pallet retract point variables
    src_ret_poses = [None] * 3
    src_ret_poses[0] = posx(201.9, 461.4, 200.0, -180.0, 180.0, 0.0)
    src_ret_poses[1] = posx(385.4, 457.0, 200.0, -180.0, 180.0, 0.0)
    src_ret_poses[2] = posx(644.9, 519.0, 200.0, -180.0, 180.0, 0.0)
    #define target pallet approach point variables
    tar_app_poses = [None] * 3
    tar_app_poses[0] = posx(120.7, 50.0, 170.7, -180.0, 180.0, 0.0)
    tar_app_poses[1] = posx(220.7, 50.0, 170.7, -180.0, 180.0, 0.0)
    tar_app_poses[2] = posx(320.7, 50.0, 170.7, -180.0, 180.0, 0.0)
    #define target pallet target point variables
    tar_job_poses = [None] * 3
    tar_job_poses[0] = posx(50.0, 50.0, 100.0, -180.0, 180.0, 0.0)
    tar_job_poses[1] = posx(150.0, 50.0, 100.0, -180.0, 180.0, 0.0)
    tar_job_poses[2] = posx(250.0, 50.0, 100.0, -180.0, 180.0, 0.0)
    #define target pallet retract point variables
    tar_ret_poses = [None] * 3
    tar_ret_poses[0] = posx(50.0, 50.0, 200.0, -180.0, 180.0, 0.0)
    tar_ret_poses[1] = posx(150.0, 50.0, 200.0, -180.0, 180.0, 0.0)
    tar_ret_poses[2] = posx(250.0, 50.0, 200.0, -180.0, 180.0, 0.0)

    #robot motion
    for i in range(0, 3):
        #go to source approach position
        src_app_sol = min_jvector_sol(src_app_poses[i],DR_BASE)
        movejx(src_app_poses[i],        vel=stJointVel,        acc=stJointAcc,
sol=src_app_sol)
        #go to source working pose
        movel(src_job_poses[i], vel=wTaskVel, acc=wTaskAcc)
        #do gripper grasp action
        #code here
        tp_log('data = palletsim, action = grasp, objectno = {}'.format(i))
        #go to source retract pose
        movel(src_ret_poses[i], vel=wTaskVel, acc=wTaskAcc)
        #go to target approach position
        tar_app_sol = min_jvector_sol(tar_app_poses[i],DR_BASE)
        movejx(tar_app_poses[i],        vel=stJointVel,        acc=stJointAcc,
sol=tar_app_sol)
        #go to target working position
        movel(tar_job_poses[i], vel=wTaskVel, acc=wTaskAcc)
        #do gripper release action
        #code here
        tp_log('data = palletsim, action = release, objectno = {}'.format(i))
        #go to target retract position
        movel(tar_ret_poses[i], vel=wTaskVel, acc=wTaskAcc)

tp_log('data = palletsim, action = simend')
```