

Exercise 1 - Create a Robot Program

Objectives:

- Create basic robot programs in simulation.
- Become familiar creating and using tool frames (TCP).
- Understand and use different types of robot motion types example linear, joint and circular.
- Understand and use different types of robot motion properties example velocities acceleration, deceleration, termination type and zoning or cornering.
- Create and utilize geometric points, referred to as GP's.




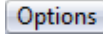

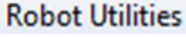


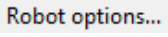

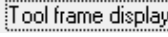

Materials;

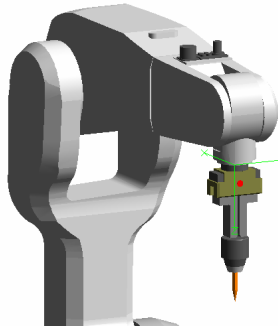
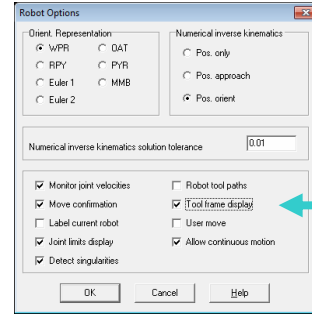
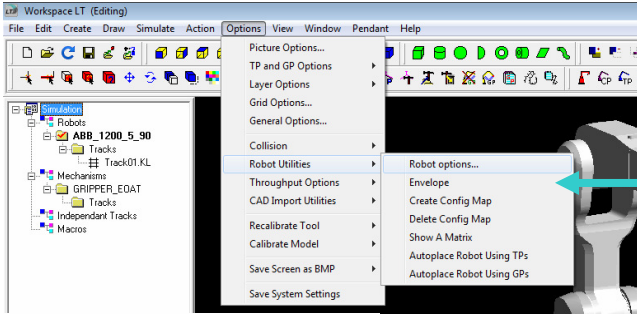
- Workspace LT[®] simulation software.
- Workspace LT[®] project file "Exercise 1 - Create a Track.WSLT"
- Manual "Workspace LT[®] User Guide.pdf".

Helpful Hint; Before starting this exercise, review the User Guide sections;

- 3 - Workspace Lt Basics.
- 5.1 - Robot Languages.
- 5.8 - Using Geometry Points (GP's).
- 5.9 - Using GP Paths.
- 5.11 - Movement Types.

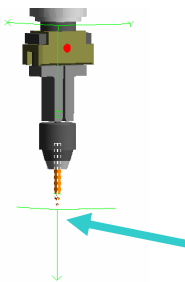
1) Procedure:

- a) Open Workspace LT simulation software. 
- b) Open  the project file "Exercise 1 - Create a Track.WSLT".
- c) Visually determine where the tool frame or TCP is located. Activate the "Tool Frame Display". On the tool bar and using the mouse  select , from the drop down menu. Using the mouse  select  , from the slide out menu, using the mouse  select , Set the   and accept .

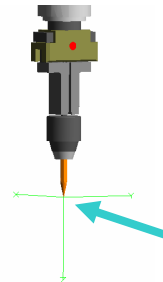


Current TCP position is displayed by the "green arrows" on the face plate indicating "X", "Y" and "Z" direction

- d) The language Karel II uses "U-Tool" to define the tool frame. The U-Tool is a reference point from the center of the robot face plate. This point is used to calculate the movement of the robot with respect to a Teach Point (TP) or in simulation, a Geometric Point (GP).
- e) Place the U-Tool at the end of the pencil being held by the gripper or commonly referred to as the "End Of Arm" (EOAT).
 - i) Place the mouse over the object labeled "PENCIL" and press the left button twice, this will select the pencil and is now active.
 - ii) The "Current Position" (CP) will be displayed at the end of the pencil with the Z direction of the CP pointing downward away from the face plate.
 - iii) Located on the tool bar, Select the icon "Place U-Tool at CP" function.
 - iv) The U-Tool is now located at the end of the pencil and in the same orientation as the CP.






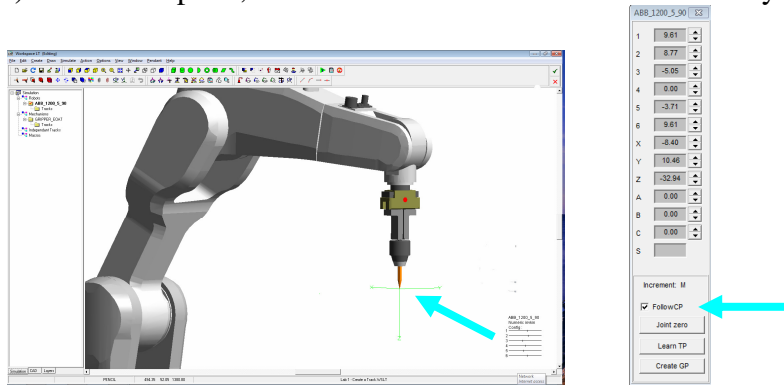
CP position is displayed by the "green arrows" on the face plate indicating the "Z", direction.






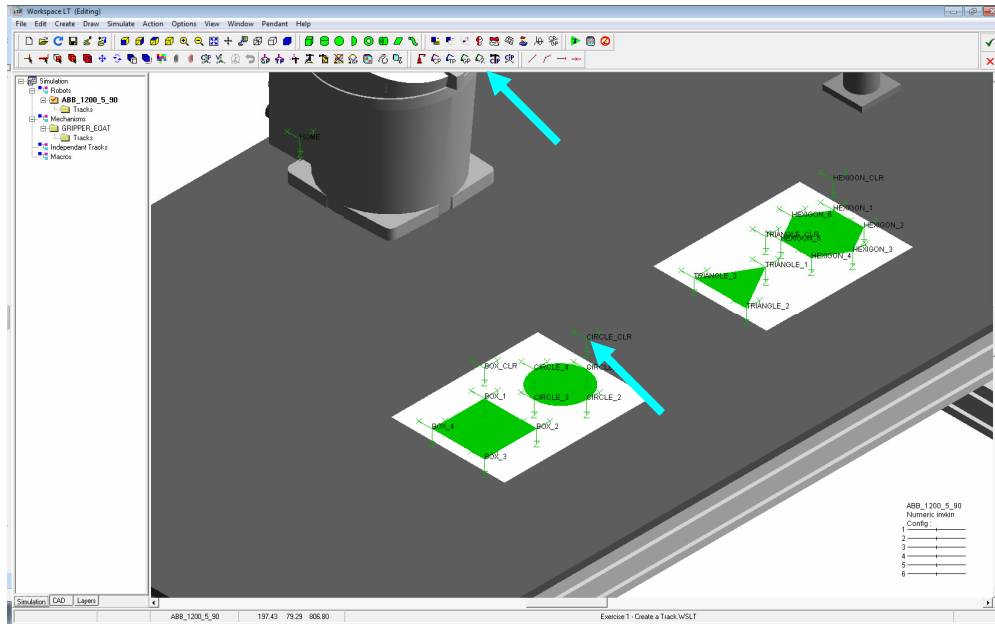
The new U-Tool position displayed by the "green arrows" on the Pencil indicating the "X", "Y" and "Z" direction

- f) Test the tool frame by moving the robot using the follow CP Function.
 - i) Open the pendant by selecting the function **Pendant** located on the tool bar. The Pendant menu will appear.

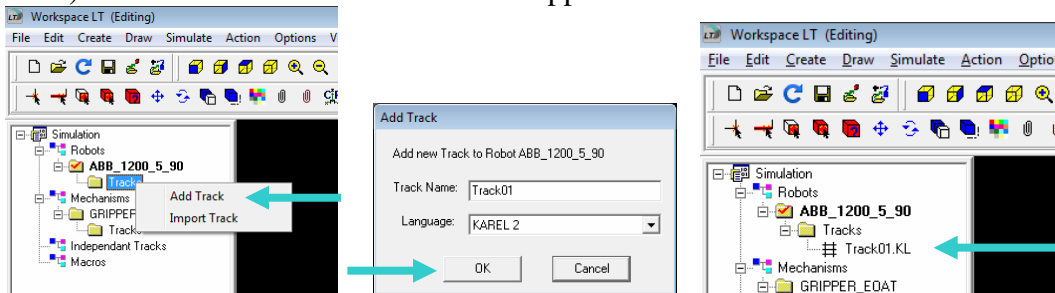
- ii) Using the mouse  select the check box labeled FollowCP .
- iii) Move the robot by placing the CP in front of the robot. Do this by placing the mouse  near the EOAT gripper and clicking the left mouse button.
- iv) The CP jump to this position and the Robot will follow placing the U-Tool at the new CP position.
- v) Once complete, remove the check from the check box by using the mouse .



- g) Select the GP labeled "CIRCLE_CLR"
 - i) Moving the mouse  close to the GP labeled "CIRCLE_CLR" found above the circle shaded green located on the table.
 - ii) Pressing the  Ctrl key + the center wheel of the mouse. This will select the GP and it will become active.
 - iii) This GP is at the beginning of a "GP Path". More information on GP Paths can be found in the Workspace LT - User Guide manual, section 5.8 - Using Geometry Points (GP's) and section 5.9 - Using GP Paths.
 - iv) Use the function "Move Along GP Path" by selecting the  icon found on the tool bar. The robot will follow the circle pattern using the created U-Tool as a reference.



- h) Add a track (Robot program) using the default "Track Name" and "Language".
 - i) Hover the mouse over the **Tracks** folder below the robot name **ABB_1200_5_90** in the **Simulation** window. Press the right mouse key.
 - ii) A user menu will appear, using the mouse select **Add Track**.
 - iii) A user menu will appear **Add Track**. Use the default values for "Track Name", "Track01" and "Language", "KAREL 2".
 - iv) Using the mouse select **OK**.
 - v) A new track **Track01.KL** will appear.



- i) Record a Track.
 - i) Using the mouse select the newly created track and press the right mouse button to open the track edit dialogue box. Select **Active** to activate **Track01.KL**.
 - ii) Repeat the mouse actions again to open the dialog box a second time.
 - iii) Using the mouse select **Record Track**.
 - iv) A warning message will open suggesting you save your model, select **Yes**, the project model will be saved.

- v) After the model has been saved, the **Action** menu will appear, select **Begin**. The **Action** menu box will change presenting more options.
- j) Using the mouse, Select the Pencil at the end of the robot to begin the procedure of record the U-Tool previously created.
- i) Select **Variables** to open the **Variables** Menu box.
- ii) Select **Place \$UTOOL at CP**. The tool frame will be recorded into your track and will be used to calculate robot positioning going forward.
- k) From the **Action** dialogue box select **Robot Move Commands** functions.
- i) As previously completed, select the GP labeled "Circle_CLR".
- ii) From the **Robot Move Commands** menu box, select **Move Along GP Path**. The robot will move along the path outlining the circle.
- iii) From the "Action" menu box select **End**. This will end the recording of the "Track01.KL" program.
- l) Save the project model.
- m) Review the newly recorded track
- i) Using the mouse select the track **Track01.KL** twice, the text editor will open with the recorded track included.




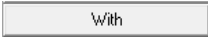
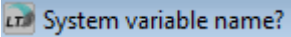
```

Workspace LT Editor - ABB_1200_5_90::Track01.KL (KAREL 2)
File Edit Search Options
PROGRAM Track01
-- Workspace LT KAREL 2 Program for ABB_1200_5_90 Robot

BEGIN
  $USEMAXACCEL=TRUE
  %INCLUDE Track01#
  $UTOOL=POS(0,0,208,0,0,0,')
  WITH $MOTYPE=Joint, $STERMTYPE=FINE, $SPEED=100
    MOVE TO CIRCLE_CLR
  WITH $MOTYPE=Linear, $STERMTYPE=FINE, $SPEED=100
    MOVE TO CIRCLE_1
  WITH $MOTYPE=Circular, $STERMTYPE=FINE, $SPEED=100
    MOVE TO CIRCLE_3 VIA CIRCLE_2
  WITH $MOTYPE=Circular, $STERMTYPE=FINE, $SPEED=100
    MOVE TO CIRCLE_1 VIA CIRCLE_4
  WITH $MOTYPE=Linear, $STERMTYPE=FINE, $SPEED=100
    MOVE TO CIRCLE_CLR
END Track01
Line: 1 Column: 1 Insert Mode

```

- n) Explanation of the code:
- i) `$UTOOL=POS(0,0,208,0,0,0,')`
 The UTOOL is positioned with respect to the robot face plate as;
 X=0mm, Y=0mm, Z=208mm and Roll=0°, Pitch=0°, Yaw=0°.
 Note: Role, Pitch and Yaw is the same attitude as an aircraft while in flight.
- ii) `WITH $MOTYPE=Joint, $STERMTYPE=FINE, $SPEED=100`
`MOVE TO CIRCLE_CLR`
- The motion type is "Joint". This is considered the fastest motion type. It follows the easiest path for the robot to follow and is based on axis angles. This motion will not result in a straight line and is only used in open space. Caution must be taken when using Joint type motions.

- The termination type is "Fine". The robot will position the U-Tool in the exact position of the GP.
 - The speed of the robot is set at 100. representing 100 mm per second along its path.
 - The "MOVE TO" followed by the GP's name. The robot will place the U-Tool at the same position as the GP.
- iii) WITH \$MOTYPE=Linear, \$TERMTYPE=FINE, \$SPEED=100
MOVE TO CIRCLE_1
- The motion type is "linear". This is the most accurate motion of the robot's Tool Frame between two points.
 - The robot path of the Tool Frame will be a straight linear line from the starting point to the final destination point.
 - The robot will error out in the event the straight line cannot be completed.
 - This motion type is used in areas of congestion, example close proximity to tooling and or fixtures.
 - All other information is similar to the previous line.
- iv) WITH \$MOTYPE=Circular, \$TERMTYPE=FINE, \$SPEED=100
MOVE TO CIRCLE_3 VIA CIRCLE_2
- The motion type is "circular". The robot will move the U-Tool coordinates in a circular path.
 - The robot controller will determine the path using the current position as the start of the arc, the first listed GP as the end of the arc and the "VIA" position used to determine the arc radius.
 - Circular motions should be restricted to no greater than 180° to prevent unwanted errors or mishaps.
- o) Replay the track observing the motion of the pencil. Press the  "Run Simulation" menu button found at top right of the tool bar.
- p) To complete this exercise, repeat the previous steps to create a second track and include tracing all the shapes.
- q) When recording the robot's move commands use only .
- r) Set motion type, motion term and speed before . This is completed using the  function opening the  menu box.