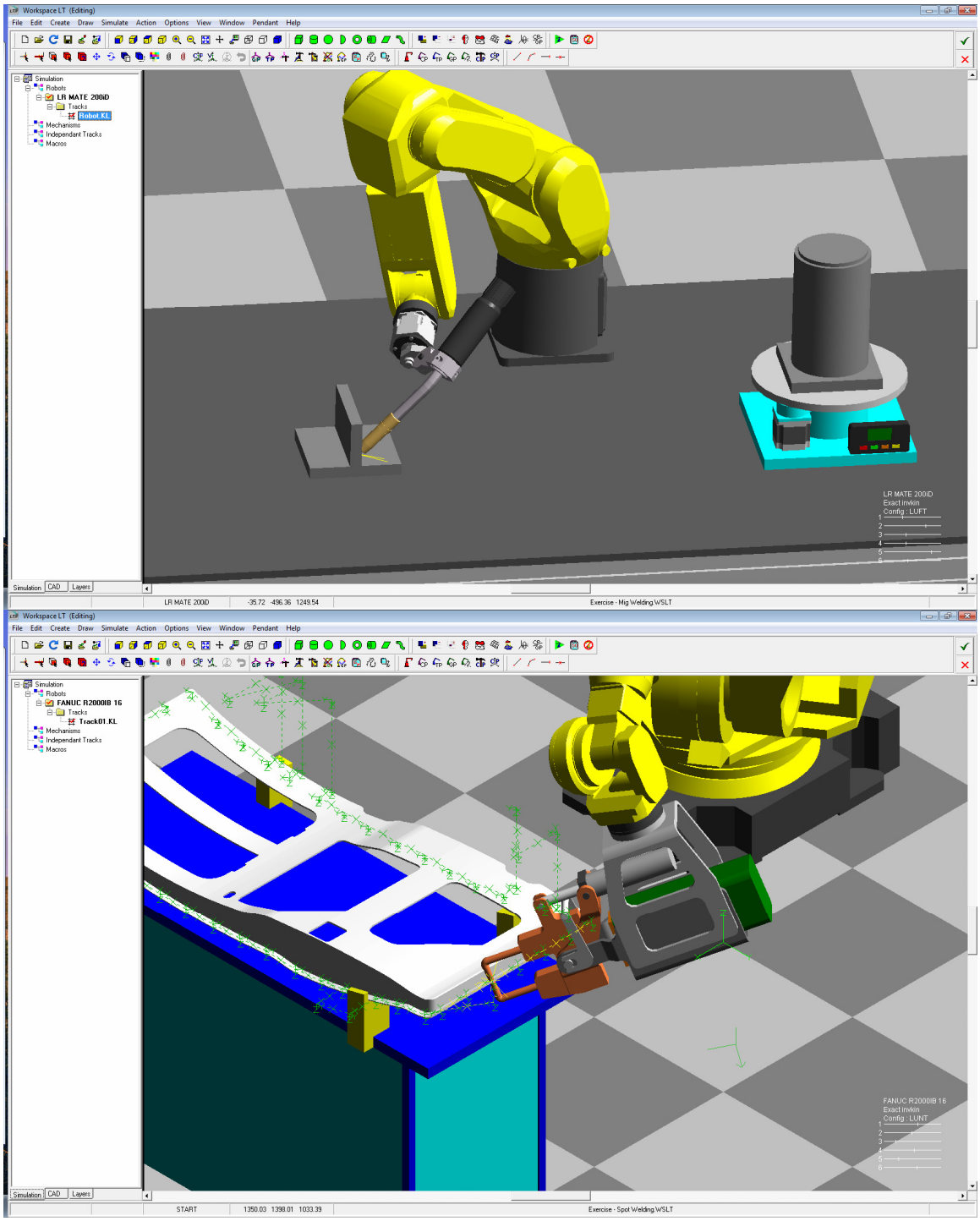
Workspace LT (Editing)
File Edit Create Draw Simulate Action Options View Window Pendant Help
Simulation
Robots
LR MATE 200iD
Tracks
Robot.KL
Mechanisms
Independant Tracks
Macros
Simulation CAD Layers
LR MATE 200iD
-35.72 -496.36 1249.54
Exercise - Mig Welding.WSLT
LR MATE 200iD
Exact inv kin
Config : LUFT
Workspace LT (Editing)
File Edit Create Draw Simulate Action Options View Window Pendant Help
Simulation
Robots
FANUC R2000iB 16
Tracks
Track01.KL
Mechanisms
Independant Tracks
Macros
Simulation CAD Layers
START
1350.03 1398.01 1033.39
Exercise - Spot Welding.WSLT
FANUC R2000iB 16
Exact inv kin
Config : LUNT

Exercise 9 - Welding

Objectives:

Part 1 - MIG Welding

- Create a "MIG welding" simulation.
- Use of an auxiliary axis controlled by the robot.
- Using a MIG torch.
- Optimizing the Robot path.
- Creating a Robotic simulation, avi.

Part 2 - Resistance Welding (Spot Welding)

- Create a "Resistance welding" simulation.
- Using a resistance weld gun.
- Optimizing the Robot path.
- Creating a Robotic simulation, avi.

Materials;

- Workspace LT© simulation software.
- Workspace LT© project file "Exercise 9A- MIG Welding.WSLT".
- Workspace LT© project file "Exercise 9B- MIG Welding.WSLT".
- Manual "Workspace LT© User Guide.pdf".

Helpful Hint;

Before starting this exercise, review previous exercises and the User Guide sections;

- 3.6 Simulation/CAD/Layers View.
- 4.20 Using Layers In Your Project.
- 5.5 Auxiliary Axes.
- 6.3 Comments and Workspace commands.
- 7. Karel Robot Movement Commands.
- 9.3 Execution Control.
- 9.3.1 Delay.

Part 1 - MIG Welding (Metal Inert Gas)

1) Procedure: Create tracks for Welding using an auxiliary axis.
   a) Open Workspace LT simulation software.
   b) Open the project file "Exercise 9A- MIG Welding.WSLT".
   c) Add a robot track "Robot.KL"
   d) Edit the robot track to include the following program;

```
PROGRAM Robot
--  Workspace LT KAREL 2 Program for LR MATE 200iD Robot

BEGIN
  $USEMAXACCEL=TRUE
  %INCLUDE Robot#
  $UTOOL=POS(-91.0389,-0.0907,255.2891,0,68,-180,'')
  $TERMTYPE=FINE
  $MOTYPE=Joint
  $SPEED=750
  MOVE TO HOME_01
  MOVE AUX TO PIPE_CLR TCP TO PIPE_CLR
  $SPEED=250
  $MOTYPE=LINEAR
  MOVE TO PIPEGP1
  DELAY 500
  --! ARCWELDON 100,25
  DELAY 500
  $AUXSPEED=75
  MOVE AXIS 7 BY 360.00
  DELAY 500
  --! ARCWELDOFF
  DELAY 500
  $MOTYPE=Joint
  $SPEED=750
  MOVE TO PIPE_CLR
  $MOTYPE=Joint
  $AUXSPEED=750
  MOVE AUX TO HOME_01 TCP TO HOME_01
  MOVE TO WELD_PNC1
  $MOTYPE=Linear
  $SPEED=750
  MOVE TO WELDGP1
  DELAY 500
  --! ARCWELDON 100,25
  DELAY 500
  $SPEED=75
  MOVE TO WELDGP2
  DELAY 500
  --! ARCWELDOFF
  DELAY 500
  WITH $MOTYPE=Joint, $TERMTYPE=FINE, $SPEED=500
    MOVE TO WELD_CLR1
  WITH $MOTYPE=Joint, $TERMTYPE=FINE, $SPEED=500
    MOVE TO WELD_PNC2
  WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=250
```

```
    MOVE TO WELDGP3
  DELAY 500
  --! ARCWELDON 100,25
  DELAY 500
  $MOTYPE=Linear
  $SPEED=75
  MOVE TO WELDGP4
  DELAY 500
  --! ARCWELDOFF
  DELAY 500
  $MOTYPE=Joint
  $SPEED=750
  MOVE TO WELD_CLR2
  MOVE TO WELD_CLR3
  MOVE TO HOME_01
END Robot
```

e) Run the simulation and correct any errors.
f) Optimize the robot program to increase efficiency and throughput.
g) Comment track programs for ease of understanding by others.
h) Save the project model.
i) Run the simulation and create an AVI.

Part 2 - Resistance Welding (Spot Welding)

2) Procedure: Create tracks for Welding using an auxiliary axis.
   a) Open Workspace LT simulation software.
   b) Open the project file " Exercise 9B - Resistance Welding".
   c) Add a robot track "Robot.KL"
   d) Edit the robot track to include the following program;

```
PROGRAM Track01
--  Workspace LT KAREL 2 Program for FANUC R2000IB 16 Robot

BEGIN
  $USEMAXACCEL=TRUE
  %INCLUDE Track01#
  $UTOOL=POS(549.275,-0.0001,318.5998,0,0,0,")
  --! USENAMEDVIEW Begin
  WITH $MOTYPE=Joint, $TERMTYPE=FINE, $SPEED=500
    MOVE TO START
  WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
    MOVE TO WELD1GP
  --! SPOTWELD 45,45
  WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
    MOVE TO WELD2GP
  --! SPOTWELD 45,45
```

```
--! USENAMEDVIEW Right
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD3GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD4GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD5GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD6GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD7GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD8GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD9GP
--! SPOTWELD 45,45
--! USENAMEDVIEW Bottom
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO GP1
WITH $MOTYPE=Joint, $TERMTYPE=COARSE, $SPEED=500
  MOVE TO GP2
WITH $MOTYPE=Joint, $TERMTYPE=COARSE, $SPEED=500
  MOVE TO GP3
WITH $MOTYPE=Joint, $TERMTYPE=COARSE, $SPEED=500
  MOVE TO GP4
WITH $MOTYPE=Joint, $TERMTYPE=FINE, $SPEED=500
  MOVE TO GP5
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD10GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD11GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD12GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD13GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
```

```
  MOVE TO WELD14GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD15GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD16GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD17GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=COARSE, $SPEED=500
  MOVE TO GP6
WITH $MOTYPE=Joint, $TERMTYPE=COARSE, $SPEED=500
  MOVE TO GP7
WITH $MOTYPE=Joint, $TERMTYPE=COARSE, $SPEED=500
  MOVE TO GP8
WITH $MOTYPE=Joint, $TERMTYPE=COARSE, $SPEED=500
  MOVE TO PP9
WITH $MOTYPE=Joint, $TERMTYPE=FINE, $SPEED=500
  MOVE TO GP10
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD18GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO GP10
WITH $MOTYPE=Joint, $TERMTYPE=COARSE, $SPEED=500
  MOVE TO PP9
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO GP11
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO GP12
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO GP13
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD19GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD20GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD21GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD22GP
--! SPOTWELD 45,45
```

```
--! USENAMEDVIEW Left
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD23GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD24GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD25GP
--! SPOTWELD 45,45
WITH $MOTYPE=Joint, $TERMTYPE=FINE, $SPEED=500
  MOVE TO GP14
WITH $MOTYPE=Joint, $TERMTYPE=FINE, $SPEED=500
  MOVE TO GP15
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD26GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD27GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD28GP
--! SPOTWELD 45,45
WITH $MOTYPE=Joint, $TERMTYPE=COARSE, $SPEED=500
  MOVE TO GP16
WITH $MOTYPE=Joint, $TERMTYPE=COARSE, $SPEED=500
  MOVE TO GP17
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD29GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD30GP
--! SPOTWELD 45,45
--! USENAMEDVIEW Back
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD31GP
--! SPOTWELD 45,45
WITH $MOTYPE=Joint, $TERMTYPE=COARSE, $SPEED=500
  MOVE TO GP18
WITH $MOTYPE=Joint, $TERMTYPE=COARSE, $SPEED=500
  MOVE TO GP19
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD32GP
--! SPOTWELD 45,45
WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  MOVE TO WELD33GP
```

```
  --! SPOTWELD 45,45
  WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
    MOVE TO WELD34GP
  --! SPOTWELD 45,45
  WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
    MOVE TO WELD35GP
  --! SPOTWELD 45,45
  WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
    MOVE TO WELD36GP
  --! SPOTWELD 45,45
  WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
    MOVE TO WELD37GP
  --! SPOTWELD 45,45
  WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
    MOVE TO WELD38GP
  --! SPOTWELD 45,45
  WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
    MOVE TO WELD39GP
  --! SPOTWELD 45,45
  WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
    MOVE TO WELD40GP
  --! SPOTWELD 45,45
  WITH $MOTYPE=Joint, $TERMTYPE=COARSE, $SPEED=500
    MOVE TO GP20
  WITH $MOTYPE=Joint, $TERMTYPE=COARSE, $SPEED=500
    MOVE TO GP21
  WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
    MOVE TO WELD41GP
  --! SPOTWELD 45,45
  WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
    MOVE TO WELD42GP
  --! SPOTWELD 45,45
  WITH $MOTYPE=Linear, $TERMTYPE=FINE, $SPEED=500
  --! USENAMEDVIEW Begin
    MOVE TO WELD43GP
  --! SPOTWELD 45,45
  WITH $MOTYPE=Joint, $TERMTYPE=FINE, $SPEED=500
    MOVE TO START
END Track01
```

e) Run the simulation and correct any errors.
f) Optimize the robot program to increase efficiency and throughput.
g) Comment track programs for ease of understanding by others.
h) Save the project model.
i) Run the simulation and create an AVI.