

ZuKa Documentation

Application of Industrial Robotic Arm in 3–Dimensional Milling (ZuKa)

Steering Control for Autonomous Path Tracking

Dr.Ing. Mohammed Nour* Ahmad Saeed Ahmed Emam
Dua'a Samir Donna Mustafa Hoda Mahmoud
Reeham M. Ibrahim



last revision April 3, 2017

*corresponding author: Zagazig University, Faculty of Engineering, Computer and Systems Dept., Zagazig, Egypt, mahmed@eng.zu.edu.eg

Abstract

This report presents the derivation, design, and implementation of the ZUKA project.

Contents

I. KUKA.Sim Pro	4
1. Overview	5
2. Requirements	5
3. Installaion	5
4. License Types	6
4.1. Stand-alone License	6
4.2. Network License	6
4.2.1. Installing the license server	6
4.2.2. Manual Licensing	7
II. WorkVisual and LAN connection between KRC4 and the KUKA-PC	9
5. Introduction	10
6. Hardware Requirements	10
7. Software Requirements	11
8. LAN connection	11
8.1. To obtain and/or change IP values for the PC	11
8.2. LAN Configuration steps	12

Part I.

KUKA.Sim Pro

1. Overview

KUKA.Sim Pro is used for the complete offline programming of KUKA robots. This product allows the analysis of cycle times and the generation of robot programs. It also enables a real-time connection to the virtual KUKA robot controller (KUKA.OfficeLite). KUKA.Sim Pro is additionally used for building parametric components and defining kinematic systems, which can also be used in KUKA.Sim Layout and KUKA.Sim Tech. KUKA.OfficeLite is included in the KUKA.Sim Pro package. CAD importers are available as an option. This requires a purchasable license for each import interface.

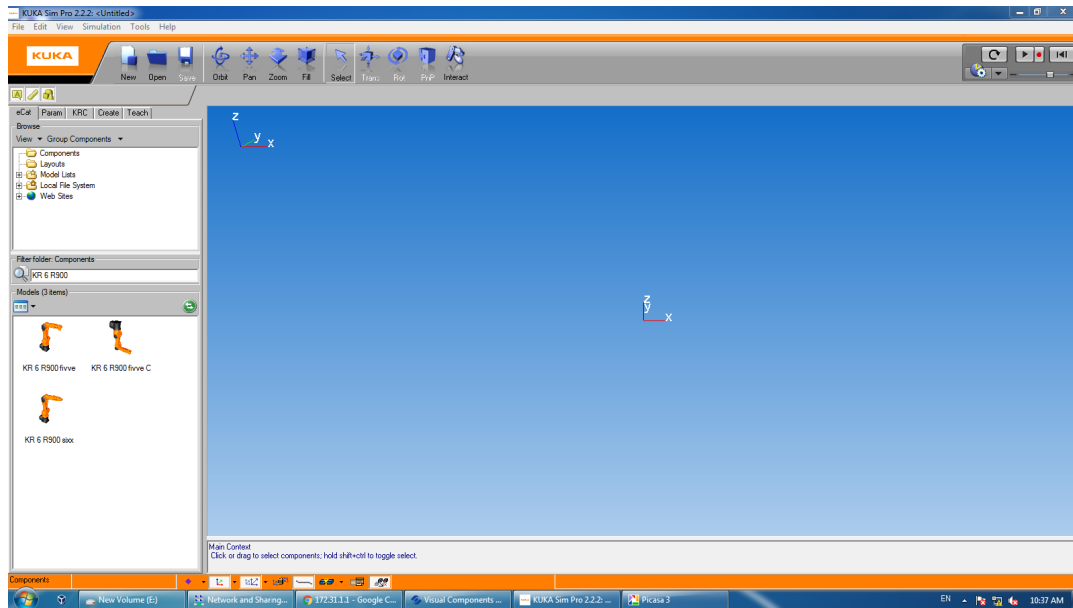


Figure 1: KUKA.Sim Pro

2. Requirements

- The minimum requirements for the computer are a 2 GHz CPU and 2 GB RAM, and an OpenGL capable graphics card with at least 512 MB RAM and a resolution of 1024×768 pixels or a similarly specified notebook.
- Supported operating systems are WIN XP - 32-bit or WIN 7 - 32/64-bit.

3. Installaion

Detailed installation steps can be found in the manual (KUKA.Sim 2.2 - Installation-en), starting page 9.

4. License Types

There are different types of licensing for the KUKA software. License types are determined and verified in accordance with the purchase made from KUKA Roboter GmbH. The software licensing concerning the KUKA arm at Zagazig university is an educational bundle license. The serial number for the license is found in the booklet of the KUKA.Sim Pro CD. Information about different licensing bundles are obtained by contacting KUKA Roboter GmbH by email simulation@kuka-roboter.de. Further details about the steps of obtaining the serial key, for different commercial bundles, are found on page 13 of (KUKA.Sim 2.2- Installation-en) manual.

The serial number associated with this purchase is: K5P22-N174H-AW7KY-9

4.1. Stand-alone License

The license is on the PC on which KUKA.Sim is used. The license key is then valid for this PC only. It can also be transferred to a different PC, but cannot be used on a two different PCs at the same time, or when either of the two PCs is off.

4.2. Network License

Network licenses provide a flexible way of using KUKA.Sim on more than one PC. When a license is requested by a PC, this license is then allocated to this PC. When KUKA.Sim is closed, the license becomes available again and can be accessed by other PCs. A license server is required to manage the network licenses. When KUKA.Sim Pro is started, the computer's identity (IP address, please refer to **LAN connection** in manual Section "WorkVisual & LAN connection") is required occasionally, however, KUKA.Sim Pro needs to check with the local license server to make sure that KUKA.Sim Pro and server are on the same PC, which is required in the network license configuration.

4.2.1. Installing the license server

- Requirements: "Microsoft Management Console" (MMC) must be installed on the license server. The software can be downloaded from the Microsoft website. In addition, ".NET framework 3.5" or higher should be installed.

After following the installation steps, specified on page 17 of the (**KUKA.Sim _2.2_ Installation_en**) manual, there are a few steps required for activation of the serial number for the PC-Robot network.

For network licensing, an account linked with the purchase is created on the Visual Components website <http://www.visualcomponents.com/>. In the specified Customer portal <https://portal.visualcomponents.net/website/Login.aspx> sign in with the email hodaeltahawy@gmail.com and password [quails@123](#).

In **My Products keys** tab, you will find the product key for KUKA.Sim Pro on the KUKA-PC device, at the Mechatronics lab. The license **is already activated** and will only require renewal after a period of 400 days starting 3-12-2016, which is on **7-1-2018**.

4.2.2. Manual Licensing

Manual licensing is performed in case there was no internet connection available. All details about manual licensing is mentioned on page 21 of the (KUKA.Si_2.2 _Installation_en) manual.

Steps:

1. Start the installation of KUKA.Sim Pro
2. Enter the license key
3. Select “Activate manually” and save the request file
4. Go to the Visual components customer portal and use the given email and password, mentioned in the previous section, to login.
5. On the website, choose Manual Licensing, upload the request file and confirm.

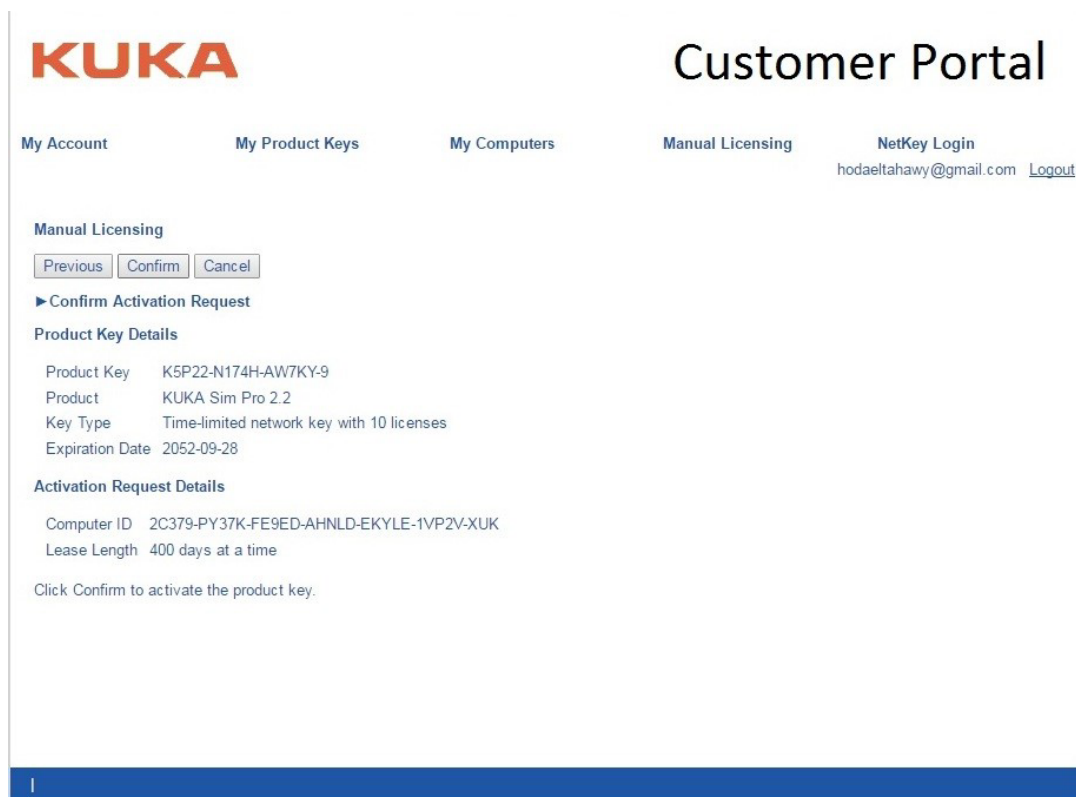


Figure 2: Kuka Customer portal

6. The license should be activated
7. Download the license (.dat) file and click Finish.
8. The license (.dat) file should be loaded into the license server, not the KUKA.Sim Pro interface, in order to complete the activation process.

9. After this process is completed, the network server interface should appear as shown in Figure.9

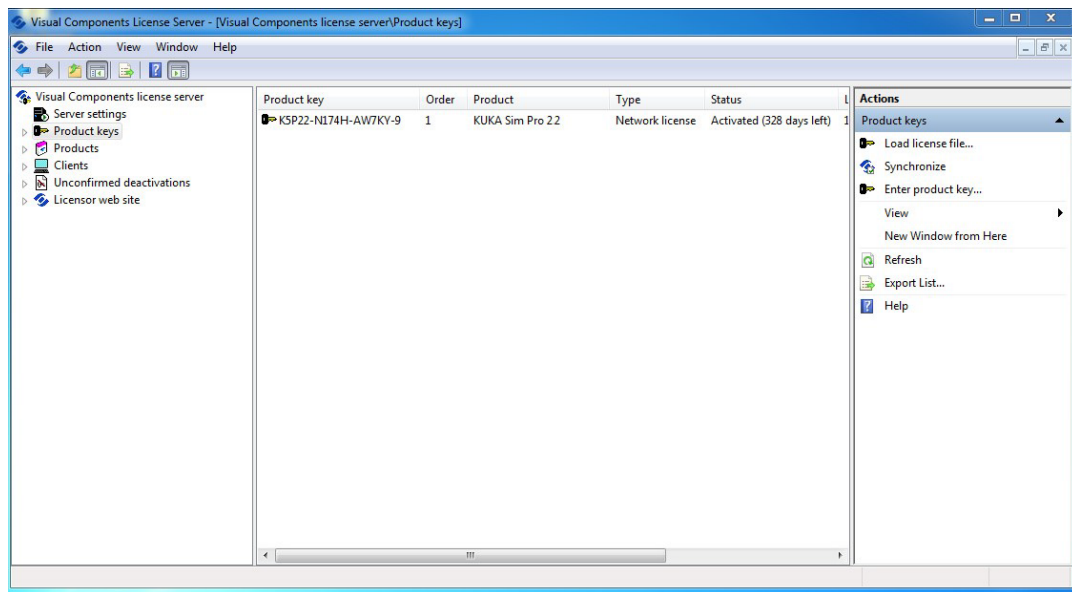


Figure 3: Kuka network license server interface

Part II.

**WorkVisual and LAN connection
between KRC4 and the KUKA-PC**

5. Introduction

The WorkVisual software package is the engineering environment for KR C4 controlled robotic cells. It offers the following functionalities:

- Configuring and connecting field buses
- Programming robots offline
- Configuring machine data
- Configuring RoboTeams offline
- Editing the safety configuration
- Transferring projects to the robot controller
- Loading projects from the robot controller
- Comparing a project with another project and accepting differences where necessary
- Managing long texts
- Managing option packages
- Diagnostic functionality
- Online display of system information about the robot controller
- Configuring traces, starting recordings, evaluating traces (with the oscilloscope)

6. Hardware Requirements

Minimum requirements

- PC with Pentium IV processor, min. 1500 MHz
- 512 MB RAM
- DirectX8-compatible graphics card with a resolution of 1024x768 pixels

Recommended specifications

- PC with Pentium IV processor and 2500 MHz
- 1 GB RAM
- DirectX8-compatible graphics card with a resolution of 1280x1024 pixels

7. Software Requirements

- Windows 7 9Both the 32-bit version and the 64-bit version can be used)
- Or: Windows XP (32-bit version, with at least Service Pack 3, the 64-bit version cannot be used)

If the following software are not already installed on the PC, the installation wizard automatically starts their installation before preceding with the WorkVisual installation.

- .NET Framework 2.0, 3.0 and 3.5
- SQL Server Compact 3.5
- Visual C++ Runtime Libraries
- WinPcap

8. LAN connection

In order to start file sharing process and to be able to use all functions of WorkVisual, a PC-Controller connection must be established. There are several ways to connect the KRC4 and KUKA-PC, one of which is setting up a local network for the connection of between several devices. This can be done by either setting static IPs for the connected devices and connecting them physically using a specified Ethernet cable, or by using a network router and assign dynamic IPs starting from a specified value, with specified number of connected devices.

8.1. To obtain and/or change IP values for the PC

1. Open "Network and sharing center"
2. Choose "Change adapter settings"
3. Right click "Ethernet connections"
4. Choose "Internet protocol version 4 (TCP/IPv4)"
5. Choose "Properties"
6. Next you either set static IPs or choose dynamic IPs to be set, in our case by the router.

address ranges used

The following address ranges are used by default by the robot controller for internal purposes. IP addresses from this range must not therefore be assigned by the user.

- 192.168.0.0 ... 192.168.0.255
- 172.16.0.0 ... 172.16.255.255
- 172.17.0.0 ... 172.17.255.255

8.2. LAN Configuration steps

1. Connect the PC and the KRC4 to the router using regular Ethernet cables.
2. Access the router configuration page using the given data on the back of the router. (the router used in our case is TP-LINK, with username and password both being **admin**)
3. In the Interface setup change the LAN settings to your preferred values
4. It is preferred to set the starting IP address similar to that of the KRC4 (172.31.147) to avoid conflicts. Network gateway value is (172.31.1.1) and subnet mask (255.255.0.0), all other settings shall remain unchanged.

TP-LINK® 4-port ADSL2/2+ Ethernet Router

Interface Quick Start **Interface Setup** Advanced Setup Access Management Maintenance Status Help

Internet LAN

Router Local IP

IP Address : 172.31.1.1
 IP Subnet Mask : 255.255.0.0
 Dynamic Route : RIP2-B Direction : None
 Multicast : IGMP v2
 IGMP Snoop : ☐ Disabled ☒ Enabled

DHCP

DHCP : ☐ Disabled ☒ Enabled ☐ Relay

DHCP Server

Starting IP Address : 172.31.1.147 [Current Pool Summary](#)
 IP Pool Count : 101
 Lease Time : 259200 seconds (0 sets to default value of 259200)

DNS

DNS Relay : Use Auto Discovered DNS Server Only
 Primary DNS Server : N/A
 Secondary DNS Server : N/A

SAVE CANCEL

Figure 4: Router LAN Configuration

5. After changing these values, the IP address used to access the router settings will change from (192.168.1.1) to the set gateway value (172.31.1.1) but with the same user name and password.
6. The connection is now established and can be verified by checking the router LEDs

TP-LINK®		
DHCP IP Pool Summary		
Host Name	IP Address	MAC Address
kuka-PC	172.31.1.147	90-2B-34-06-DA-1E
WINDOWS-QMMEB5J	172.31.1.148	90-1B-0E-1D-ED-5B

Figure 5: IP address used to access the router settings