Robotic Simulation with PLCSIM Advanced – SIMIT – NX-MCD

Information

SIMIT

https://support.industry.siemens.com/cs/ww/en/view/109795246

Siemens Industry Online Support

Legal information

Use of application examples

Application examples illustrate the solution of automation tasks through an interaction of several components in the form of text, graphics and/or software modules. The application examples are a free service by Siemens AG and/or a subsidiary of Siemens AG ("Siemens"). They are non-binding and make no claim to completeness or functionality regarding configuration and equipment. The application examples merely offer help with typical tasks; they do not constitute customer-specific solutions. You yourself are responsible for the proper and safe operation of the products in accordance with applicable regulations and must also check the function of the respective application example and customize it for your system.
Siemens grants you the non-exclusive, non-sublicensable and non-transferable right to have the application examples used by technically trained personnel. Any change to the application examples is your responsibility. Sharing the application examples with third parties or copying the application examples or excerpts thereof is permitted only in combination with your own products. The application examples are not required to undergo the customary tests and quality inspections of a chargeable product; they may have functional and performance defects as well as errors. It is your responsibility to use them in such a manner that any malfunctions that may occur do not result in property damage or injury to persons.

Disclaimer of liability

Siemens shall not assume any liability, for any legal reason whatsoever, including, without limitation, liability for the usability, availability, completeness and freedom from defects of the application examples as well as for related information, configuration and performance data and any damage caused thereby. This shall not apply in cases of mandatory liability, for example under the German Product Liability Act, or in cases of intent, gross negligence, or culpable loss of life, bodily injury or damage to health, non-compliance with a guarantee, fraudulent non-disclosure of a defect, or culpable breach of material contractual obligations. Claims for damages arising from a breach of material contractual obligations shall however be limited to the foreseeable damage typical of the type of agreement, unless liability arises from intent or gross negligence or is based on loss of life, bodily injury or damage to health. The foregoing provisions do not imply any change in the burden of proof to your detriment. You shall indemnify Siemens against existing or future claims of third parties in this connection except where Siemens is mandatorily liable.
By using the application examples you acknowledge that Siemens cannot be held liable for any damage beyond the liability provisions described.

Other information

Siemens reserves the right to make changes to the application examples at any time without notice. In case of discrepancies between the suggestions in the application examples and other Siemens publications such as catalogs, the content of the other documentation shall have precedence.
The Siemens terms of use (https://support.industry.siemens.com) shall also apply.

Security information

Siemens provides products and solutions with Industrial Security functions that support the secure operation of plants, systems, machines and networks.
In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.
Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the Internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.
For additional information on industrial security measures that may be implemented, please visit https://www.siemens.com/industrialsecurity.
Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.
To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed at: https://www.siemens.com/industrialsecurity.

Table of contents

1 Introduction

1.1 Overview

For simulation of machines its necessary to simulate all machine elements. This Application example is focused on simulation of Robots (6-Axis Kinematics).

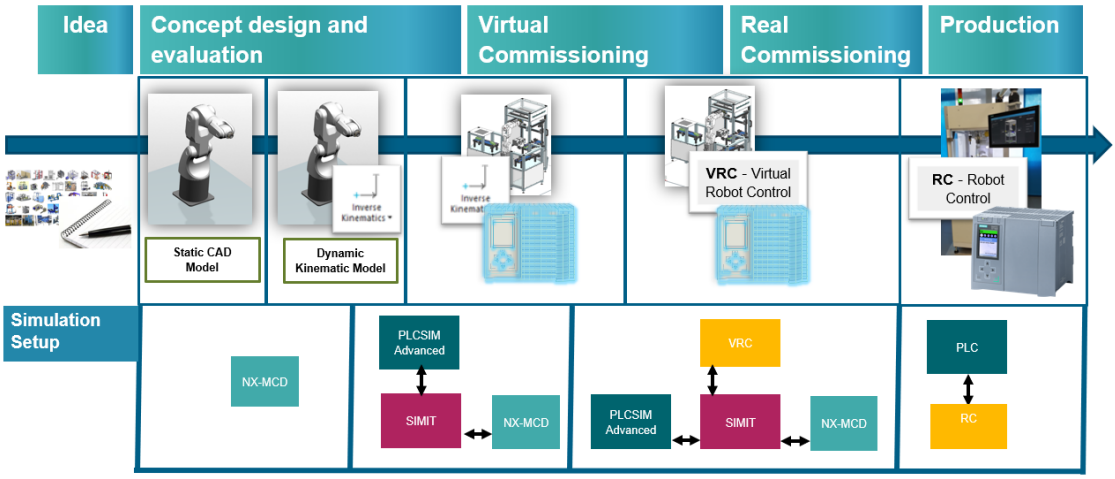
For vendor unspecific behavior we will use the "Inverse Kinematic functionalities" inside MCD (Setup with: PLCSIM Adv. – SIMIT– NX-MCD)

For vendor specific behavior we will connect additional software to our established Simulation Setup by couplings inside SIMIT towards robotic simulation software (coming from vendor side called VRC: Virtual Robot Controller, Setup: PLCSIM Adv. – SIMIT – VRC – NX-MCD)

Information

Working with Robotic Simulation during the engineering workflow has many different variants, depending on your actual engineering task.

Figure 1-1: Engineering Workflow for Robotic Simulation



1.2 Request for Application Example

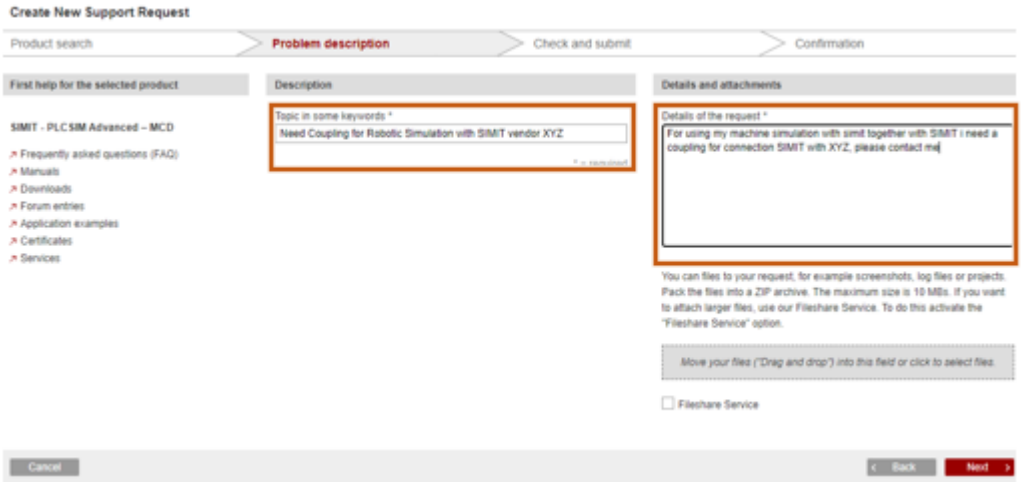
All couplings and Demo projects can be received by request. After Request, our Support Team will get in direct contact with you for individual support.

1. For this Request please go to Siemens Industrial Online Support and place a "Service Request".

   (weblink: https://support.industry.siemens.com/)

2. On Main Page select "Service Request"

3. Login with your SIOS (Siemens Industrial Online Support) credentials
4. Inside Product Search enter "SIMIT", and select "SIMIT-PLCSIM Advanced – MCD" under Virtual Commissioning
5. Fill out Description and add some specific details (short description of your use case, which robot vendor)



6. Press next for send and confirm your Request, now a Siemens expert will get in contact with you.

1.3 Mode of operation

Inside this Application example you will find a functional Demo showing a test setup for robotic simulation. This example is split into two versions, a generic example (vendor unspecific) and several vendors specific. Both examples are based on the same machine and same TIA Portal Project (with different ".gsdml" files).

Automation Task:

Robot will take Tray from left Conveyor and insert it into the Screw Assembly Machine, Afterwards Robot will take PLC Element from right Conveyor and put it on the Tray.

NOTE For simplify this example, Screw assembly machine is not automated with PLC control, it is completely controlled by sequences inside NX-MCD.

Figure 1-2: Machine for general example

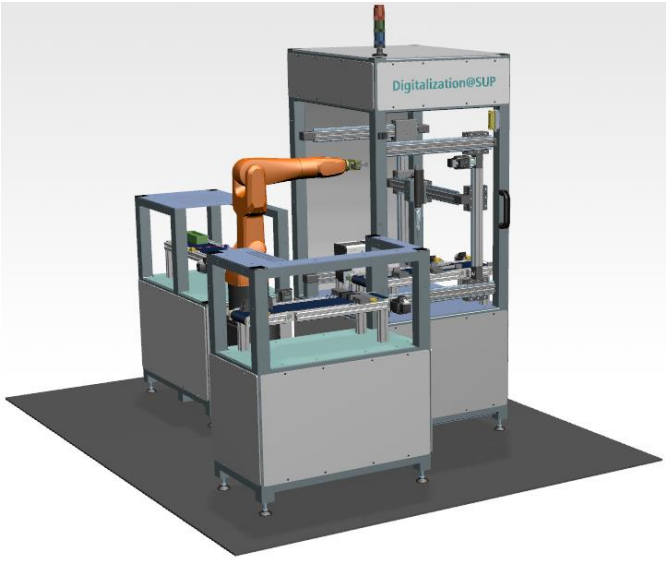
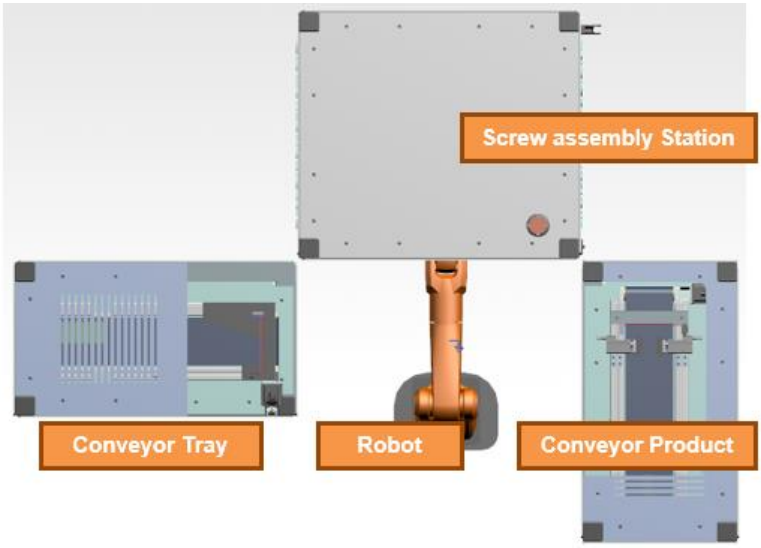


Figure 1-3: Top-View and Station names



1.4 Components used

This application example has been created with the following hardware and software components:

Table 1-1: Siemens Products

Component	Number	Article number	Note
TIA Portal V16	1	6ES78221AA050YA5	-
SIMIT 10.2	1	6DL8913-0BK00-0AB5	MLFB for SIMIT M, all sizes of SIMIT 10.1, should work with this example
NX MCD 1911	1	NX11113	NX-MCD also available as Player Version (NX-30124)
PLCSIM Advanced 2.1	1	6ES7823-1FA01-0YA5	-

Table 1-2: Additional Software

Component	Number	Version	Note
ABB Robot Studio	1	Version 2019.3 (64-bit) 7.0.8617.0559	Interface integrated in Product
KUKA Office Lite	2	8.6 or 8.5	Y200 interface must be installed
Universal Robots UR Sim	3	3.11.0.82155	Cost free simulation Software from UR (Linux VM Ware)
FANUC ROBOGUIDE	4	V9	Additional needed RobotInterface_Ver.3.0.0_(Runtime)

2 Example: TIA Portal, PLC and HMI

TIA Project

Machine sequence is controlled by PLC and can be operated by HMI.

Inside TIA Portal project you find a PLC SIMATIC S7-1516 and a TP900 Comfort Panel.

NOTE PLC will be simulated with PLCSIM Advanced, with PLCSIM Advanced you can simulate all SIEMENS PLC´s from SIMATIC S7-1500 PLC family.

Figure 2-1: TIA Portal Hardware Setup

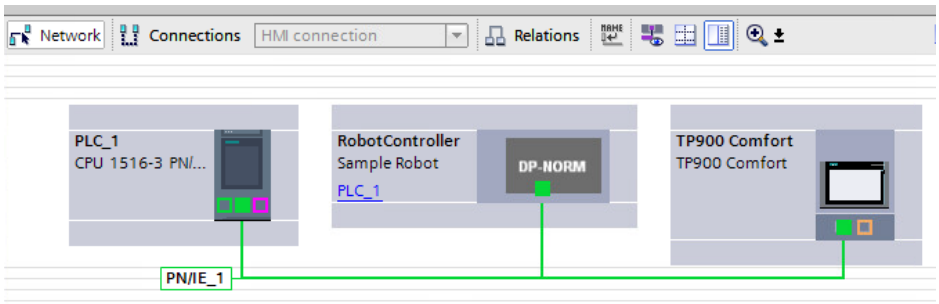


Figure 2-2: Signals exchanged between PLC and Machine (including Robot)

PLC tags

	Name	Tag table	Data type	Address	Comment
1	jobStart	Default tag table	Bool	%Q128.1	start job of robot
2	active	Default tag table	Bool	%I128.2	robot job active signal
3	jobID	Default tag table	Byte	%QB129	job Id for robot
4	jobDone	Default tag table	Bool	%I128.0	robot job done signal
5	convProductEnable	Default tag table	Bool	%Q130.0	conveyor product active
6	convTrayEnable	Default tag table	Bool	%Q130.1	conveyor tray active
7	convProductLblsActive	Default tag table	Bool	%I130.0	lightbeam of conveyor with product triggered
8	convTrayLblsActive	Default tag table	Bool	%I130.1	lightbeam of conveyor with tray triggered
9	machineRtr	Default tag table	Bool	%I130.2	machine is ready to receive
10	machineStart	Default tag table	Bool	%Q130.2	start machine
11	convProductClamp	Default tag table	Bool	%Q130.3	close clamp for product
12	powerOn	Default tag table	Bool	%Q131.0	power on robot
13	jobAbort	Default tag table	Bool	%Q131.1	abort job of robot
14	error	Default tag table	Bool	%I128.3	robot error signal
15	<Add new>				

The PLC is controlling the Interlocks and status of all three Machine elements (Conveyor Tray, Conveyor Product, Screw assembly Station, Robot), with four Function Blocks.

Process Sequence [FB6]:

Controlling the Machine Process and sending Commands towards Robot Controller.

ConveyorTray [FB3] & ConveyorProduct [FB2]:

For the conveyor stations.

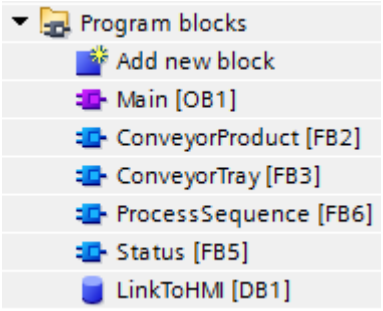
Status [FB5]:

Receiving Status from all stations.

LinkToHMI [DB1]:

Data Block, containing all variables shared with HMI.

Figure 2-3: Function and Data Block in TIA Portal



Inside TIA Portal Project you also find the HMI control screen.

The HMI is separated into manual and automatic areas.

Figure 2-4: HMI control screen for manual mode

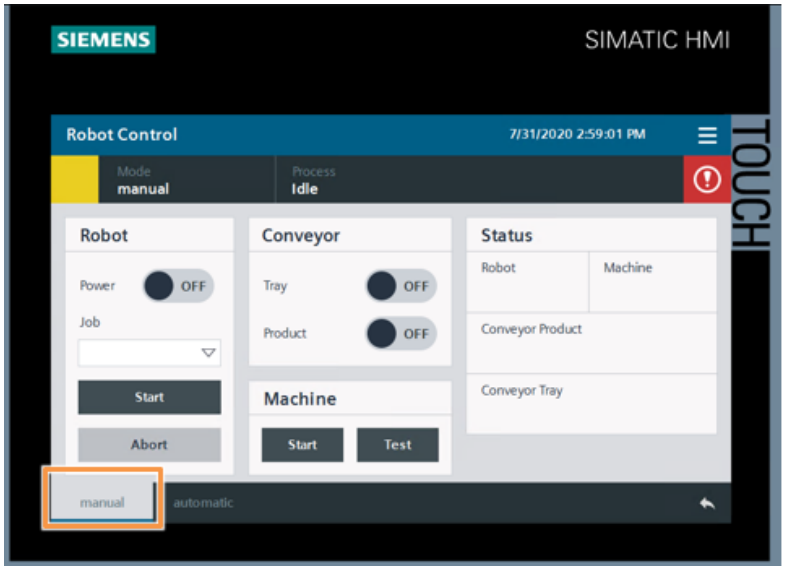
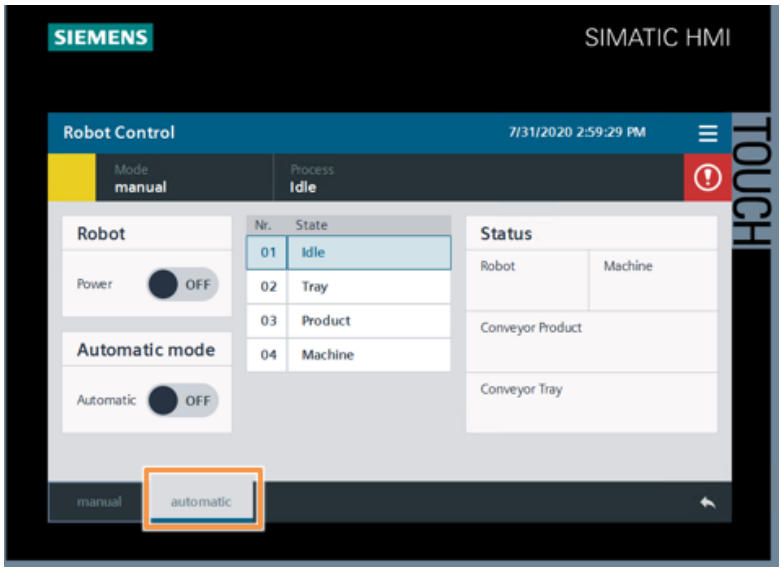


Figure 2-5: HMI control screen for automatic mode



3 Vendor specific examples

3.1 Setup for Vendor specific examples

Expanding the Example with a virtual Robot Controller (VRC, Software from Robot Vendor) for:

- Vendor specific behavior
- Using the same Code inside VRC and real Robot (offline/online programming)
- Access to all Kinematics supported by VRC

Figure 3-1: Simulation Setup

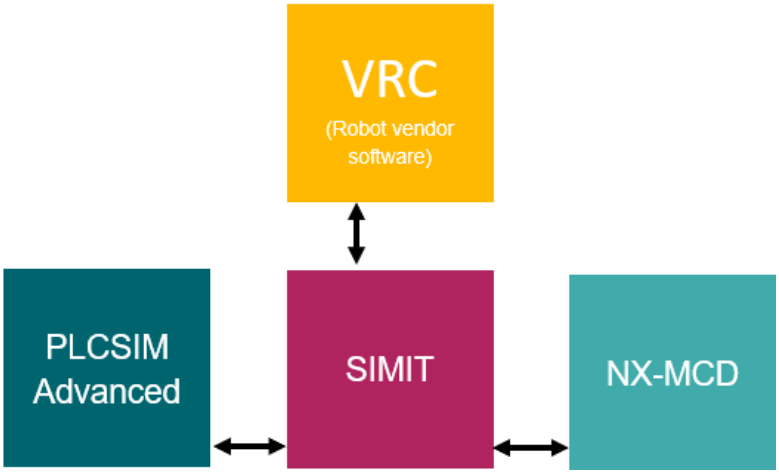
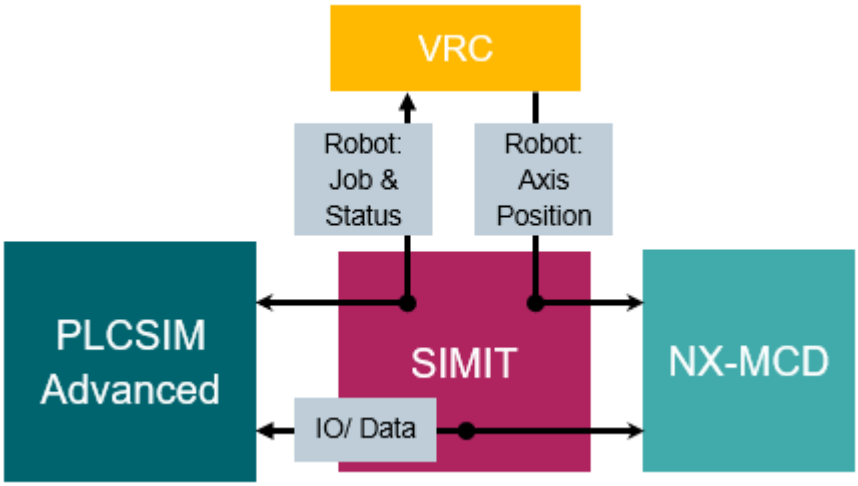


Figure 3-2: Signal exchange between Components



NOTE Both Examples using the same TIA project and same machine.

3.2 Install a new coupling inside SIMIT

Inside SIMIT SP it is possible to expand the couplings by installing additional ones. This method is called "external coupling". All External couplings are made by using of SIMIT API functionalities.

Installing a new external coupling is easily done by copy a new folder into the couplings folder inside the SIMIT installation folder.

3.3 Common description for robot couplings

All couplings are aligned with the robot vendors. The couplings are using the native available functionalities of the robot vendor software. All couplings and the corresponding communication technology are different.

NOTE In all robot couplings you will find an Import and Export functionality inside SIMIT. This functionality can be used for backup and workflow purposes.

4 Vendor Example: KUKA Connection

Interface Integration

Connection towards KUKA office Lite is realized by a customized Interface inside SIMIT using y200 Interface.

Figure 4-1: Simulation Setup for connecting KUKA Office Lite

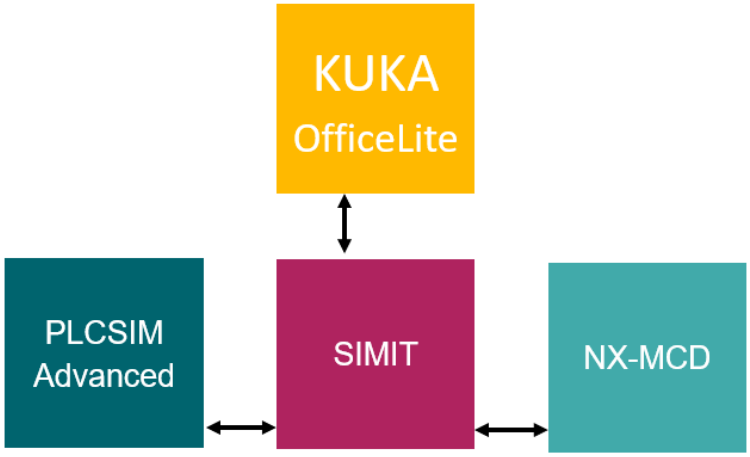
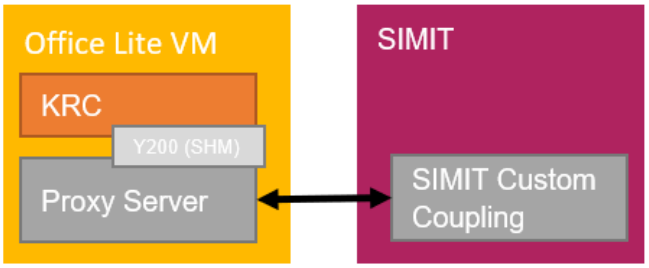


Figure 4-2: Mechanism for Data transfer between Office Lite and SIMIT



5 Vendor Example: ABB Connection

Interface integration

Connection towards ABB Robot Studio is realized with Shared Memory Coupling mechanism (SHM).

It´s a built-in functionality inside ABB Robot Studio to connect internal signals via SHM. Caused by Shared Memory technology this data exchange is performant, but SIMIT and ABB Robot Studio must be on the same PC.

NOTE An Information video can be found on YouTube inside ABB Video Channel: https://www.youtube.com/watch?v=Lh07B86eETo

Figure 5-1: Setup for simulating together with ABB Robot Studio

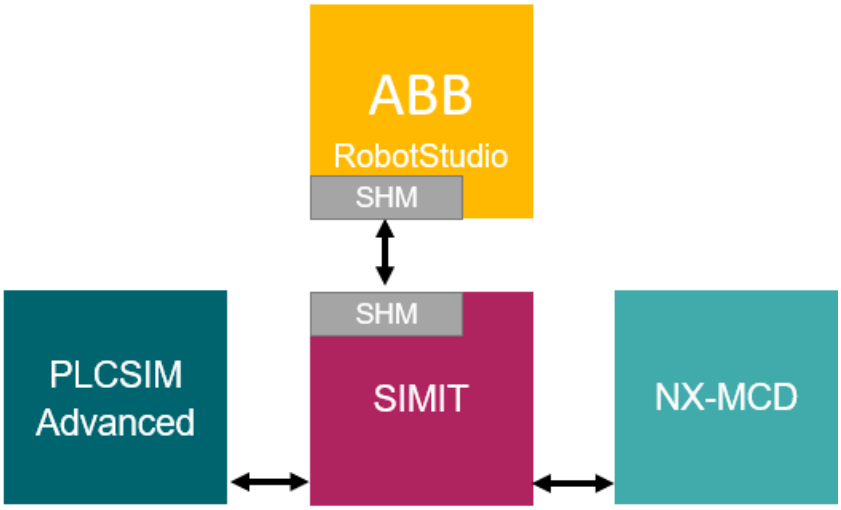
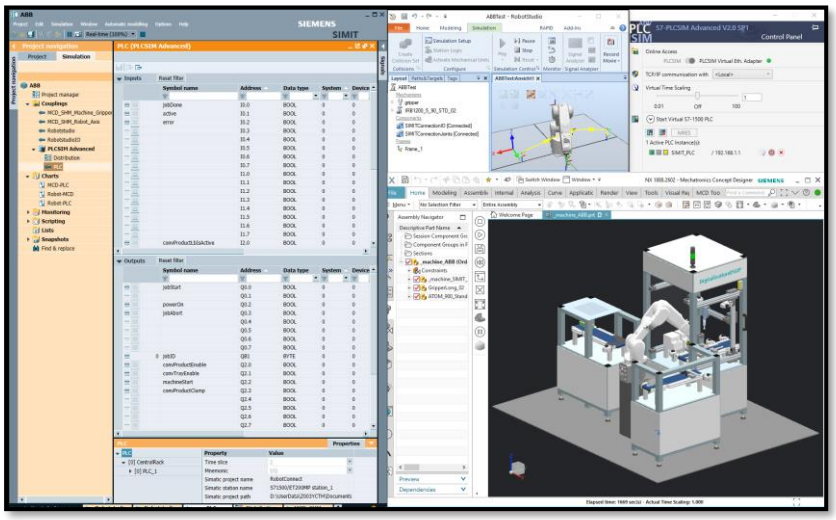


Figure 5-2: PLCSIM Advanced together with SIMIT, NX-MCD and ABB Robot Studio.



6 Vendor Example: Stäubli Connection

Interface Integration

Connection between SIMIT and Stäubli Robotic Suite is realized, based on a API (SOAP) connection.

Figure 6-1: Setup for Simulation with Stäubli Robotics Suite

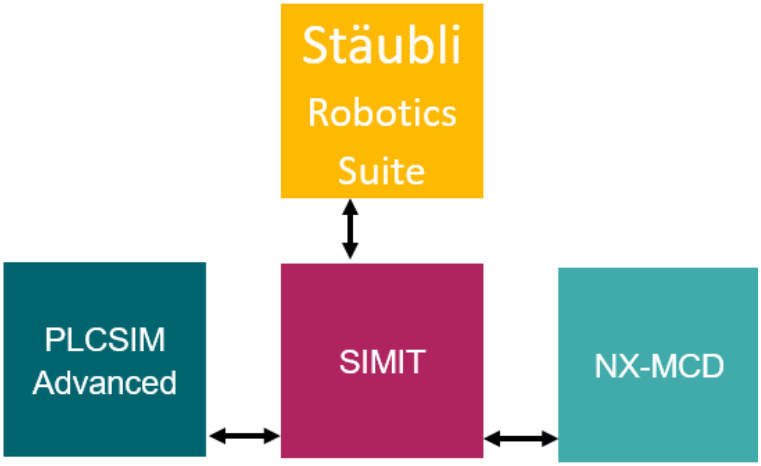
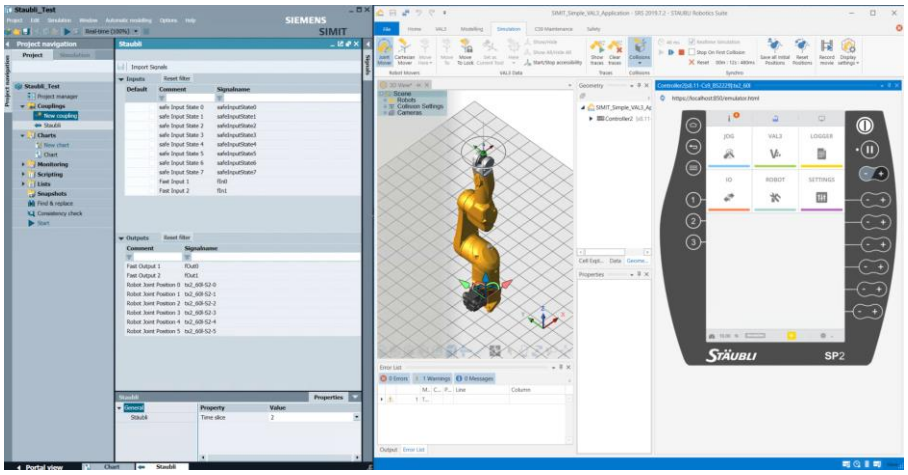


Figure 6-2: SIMIT together with Stäubli Robotics Suite.



7 Vendor Example: Fanuc Connection

Interface integration

Connection between SIMIT and Fanuc ROBOGUIDE is realized through the FANUC Robot Interface (FRRJIF.DLL).

NOTE For using ROBOGUIDE together with SIMIT you need to install FANUC RobotInterface (Runtime), for this example we tested with RobotInterface_Ver.3.0.0_(Runtime).

Figure 7-1: Setup for Simulation with ROBOGUIDE

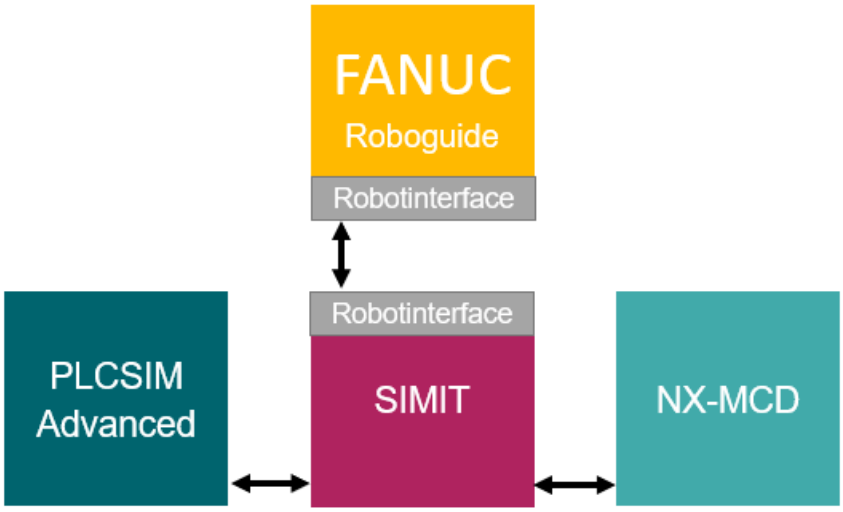
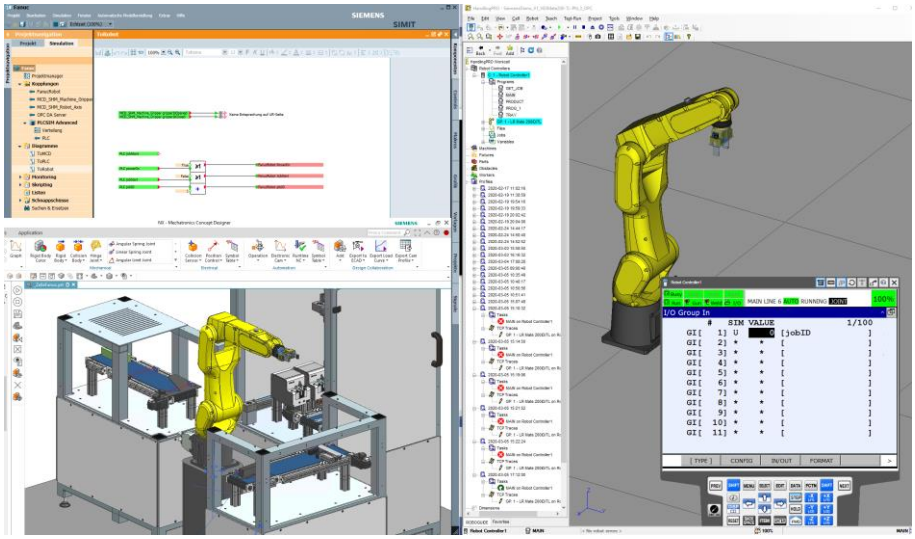


Figure 7-2: Simulation Setup with SIMIT, NX MCD and ROBOGUIDE.



8 Vendor Example: UR Connection

Interface integration

Connection between SIMIT and URSim is realized through RTDE Coupling.

RTDE is a real-time interface to Universal Robot Controllers (virtual or machine) using a TCP/IP connection on port 30004. However, the live Robot will be controlled via PROFINET and SIMIT will use the same registers for read and write to the virtual robot controller through the RTDE interface.

Figure 8-1: Setup for Simulation with URSim

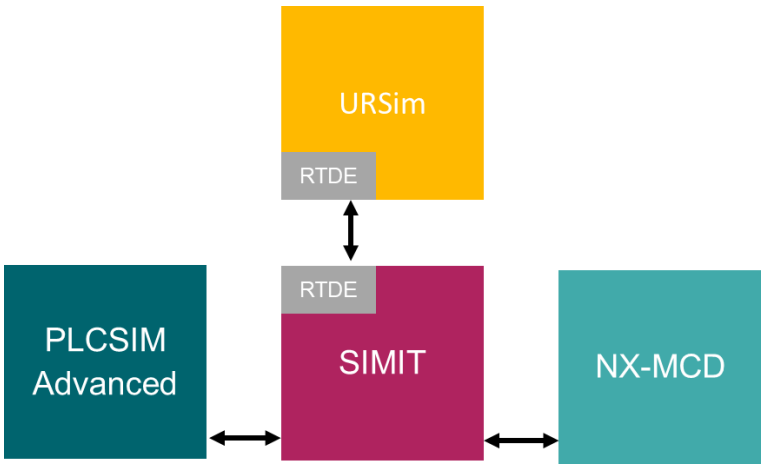
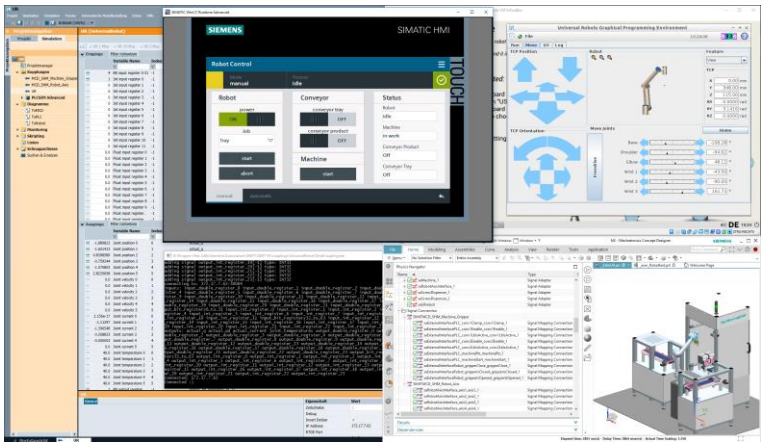


Figure 8-2: Simulation Setup, SIMIT, NX-MCD and URSim.

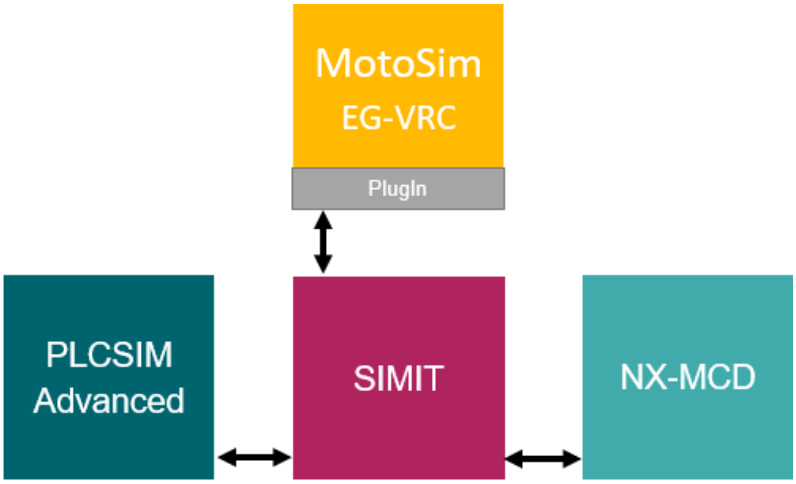


9 Vendor Example: YASKAWA Connection

Interface Integration

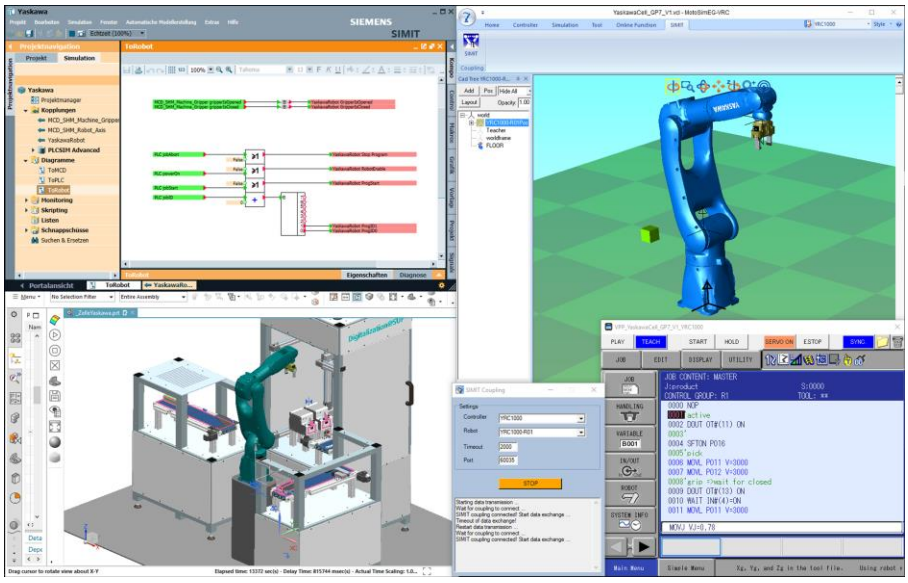
Connection between SIMIT and Yaskawa MotoSim EG-VRC is realized through a Plug-In.

Figure 9-1: Setup for Simulation with MotoSim EG-VRC



The general structure is depicted in Figure 9-1. Figure 9-2 shows a screenshot with the running components (without PLCSIM Advanced)

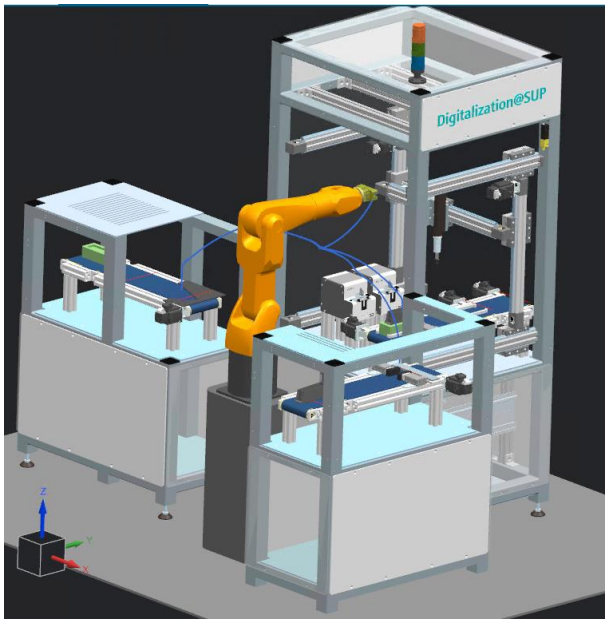
Figure 9-2: Overview of Simulation Setup with SIMIT, NX MCD and MotoSim with SIMIT Coupling Plug-In



10 MCD Standalone

This example is created for usage without SIMIT nor PLCSIM Advanced, all Movements and logic is implemented in NX-MCD. Robot Movements are generated by using "Inverse Kinematics" Element inside NX-MCD and not controlled by a vendor specific Robot controller.

Figure 10-1: MCD-Standalone example



11 Appendix

11.1 Service and support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks:

support.industry.siemens.com

Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts.

Please send queries to Technical Support via Web form:

support.industry.siemens.com/cs/my/src

SITRAIN – Digital Industry Academy

We support you with our globally available training courses for industry with practical experience, innovative learning methods and a concept that's tailored to the customer's specific needs.

For more information on our offered trainings and courses, as well as their locations and dates, refer to our web page:

siemens.com/sitrain

Service offer

Our range of services includes the following:

- Plant data services
- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts

You can find detailed information on our range of services in the service catalog web page:

support.industry.siemens.com/cs/sc

Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" app. The app is available for iOS and Android:

support.industry.siemens.com/cs/ww/en/sc/2067

11.2 Industry Mall

The Siemens Industry Mall is the platform on which the entire siemens Industry product portfolio is accessible. From the selection of products to the order and the delivery tracking, the Industry Mall enables the complete purchasing processing – directly and independently of time and location:
mall.industry.siemens.com

11.3 Links and literature

Table 11-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to this entry page of this application example https://support.industry.siemens.com/cs/ww/en/view/109795246
\3\	

11.4 Change documentation

Table 11-2

Version	Date	Modifications
V1.0	04/2021	First version (internal)