SIMIT Executable 3D Model Flying Saw Advanced

SIMATIC S7-1500T / SIMATIC S7-PLCSIM Advanced V4.0 SP1 / SIMIT V10.3 HF2

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1 Introduction

1.1 Overview

This application example can be used to simulate the SIMATIC S7-1500T FlyingSawAdvanced standard application with SIMATIC S7-PLCSIM Advanced and SIMIT in combination with a 3D model.

1.2 Components used

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

Table 1-1 Software components

Component	Number	Article number	Note
STEP 7 Professional V15.1	1	6ES7822-1..05-..	
PLCSIM Advanced 4.0 SP1	1	6ES7823-1F.03-0Y.5	
SIMIT 10.3 HF2	1	6DL8913-0AK30-0AH5	
SIMIT-Unity coupling	1		

This application example consists of the following components:

Table 1-2 Project components

Component	File name	Note
Documentation	Manual_SIMIT_Executable_3D_Model_FlyingSaw_Advanced_V1_0.pdf	
STEP 7 project	TIA_Project_3D_Model_FlyingSaw_Advanced_V1_0.zap15_1	
SIMIT-Unity coupling	Simit-UnityCoupling.zip	Configuring the SIMIT-Unity coupling
SIMIT project	SIMIT_Project_3D_Model_FlyingSaw_Advanced_V1_0.simarc	Retrieve SIMIT project
3D model	Executable_3D_Model_FlyingSaw_Advanced_V1_0.zip	Executable 3D model
SIMIT component	ControlAdditionalAxes.zip	

2 Software Setup

After downloading the “SIMIT_Executable_3D_Model_FlyingSawAdv.zip”, it can be unzipped into a desired folder. All included files are shown in Table 1-2.

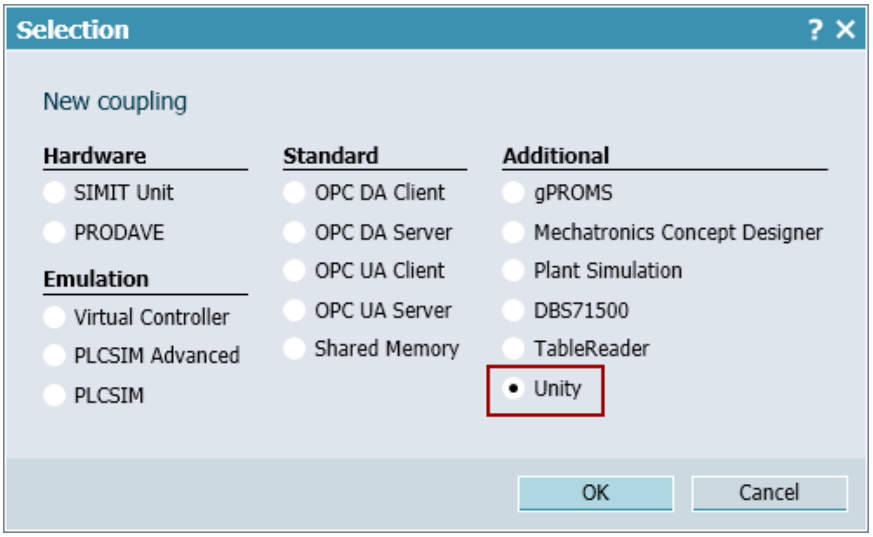
2.1 SIMIT

NOTICE	It is important, that firstly the SIMIT-Unity coupling is configured in SIMIT **before** the SIMIT project is retrieved and opened for the first time.

2.1.1 Configuring the SIMIT-Unity coupling

The SIMIT-Unity coupling is based on an external coupling for SIMIT and must be added manually. The required steps are described in the following table.

Table 2-1 Implementation of the SIMIT-Unity coupling in SIMIT

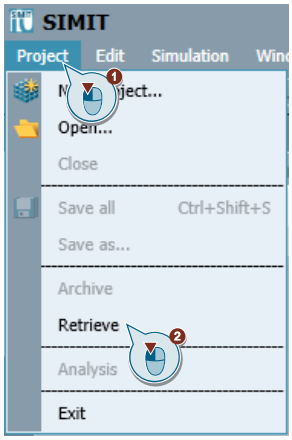
No.	Action
1.	Unzip „Simit-UnityCoupling.zip“ into a new folder “Unity” in the following directory: …\Siemens\Automation\SIMIT\SIMIT SF\couplings If the folder “couplings” does not exist yet, it needs to be created.
2.	Restart SIMIT to update the couplings dialogue. The new coupling “Unity” is visible in the coupling selection dialogue. 
3.	The SIMIT-Unity coupling was added correctly. The dialogue can be closed with clicking the “Cancel” button.

2.1.2 Retrieve SIMIT project

Before retrieving the SIMIT project, the SIMIT-Unity coupling must be configured (2.1.1).

The SIMIT project is provided as a SIMIT archive. For retrieving the project following steps need to be done.

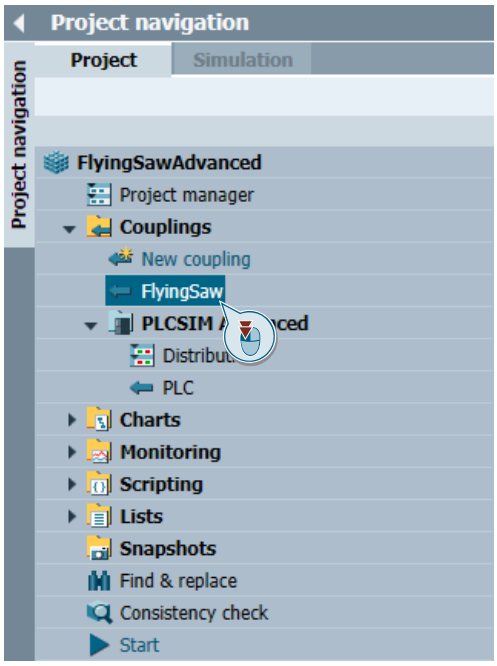
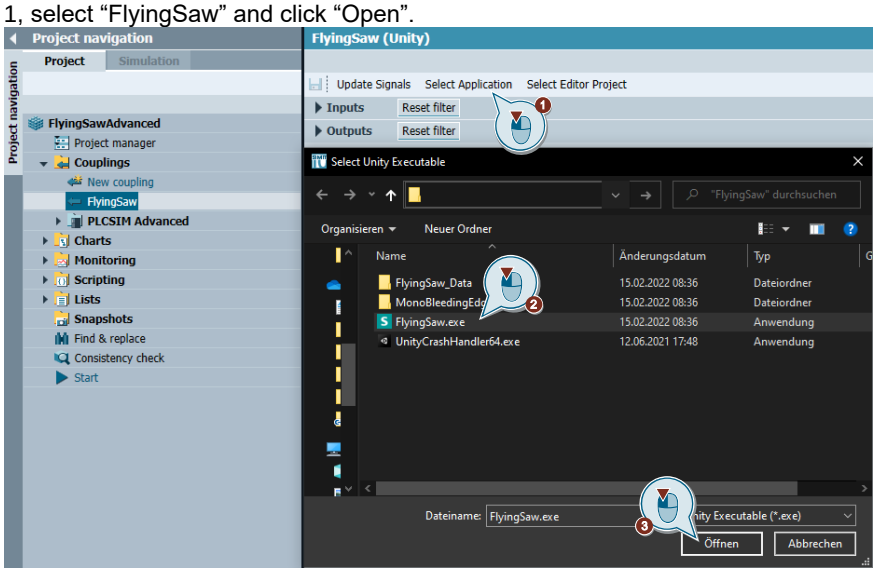
Table 2-2 Retrieving SIMIT project

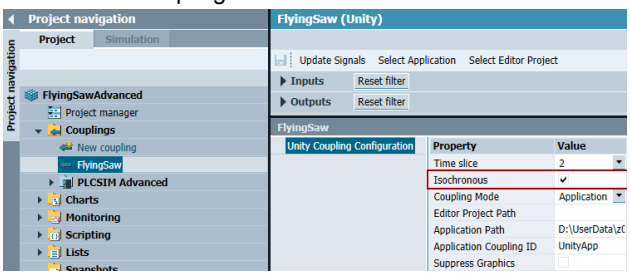
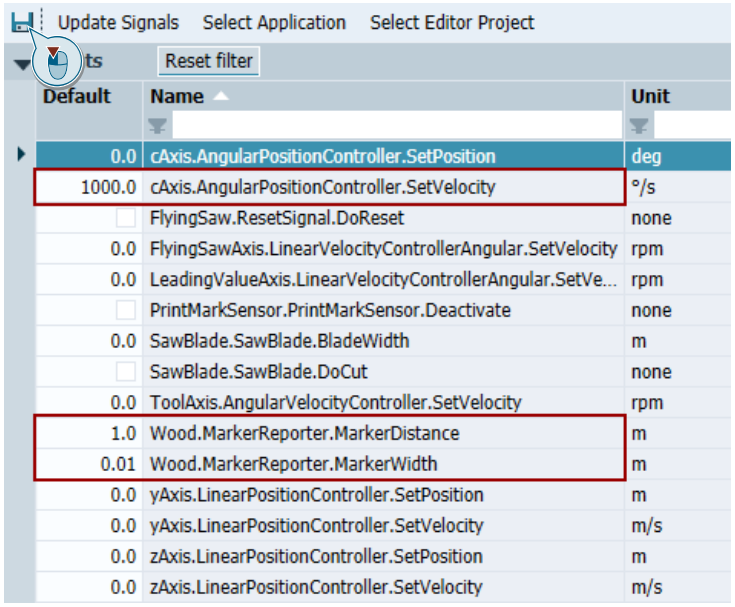
No.	Action
1.	
2.	Under “Archivename” navigate to “SIMIT_Project_3D_Model_FlyingSaw_Advanced_V1_0.simarc”. As “Target folder” a desired folder can be selected. 
3.	The following warning can be confirmed with clicking “Yes”.
4.	The project is retrieved.

2.1.3 Executable 3D model

For adding the 3D model into the project, the following steps need to be done.

Table 2-3 Adding 3D model

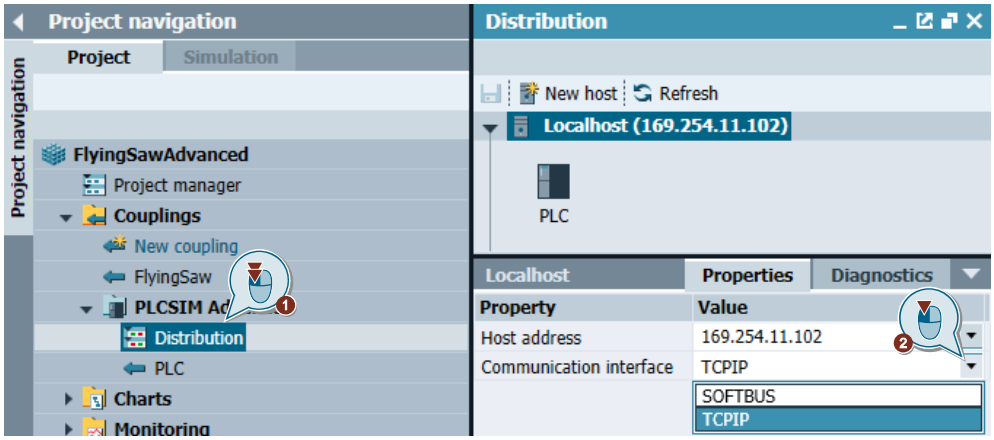
No.	Action
1.	Unzip “Executable_3D_Model_FlyingSaw_Advanced_V1_0.zip” into desired folder.
2.	Open existing coupling with double clicking “FlyingSaw”. 
3.	To add the executable, click “Select application”, navigate to the folder from step 1, select “FlyingSaw” and click “Open”. 
4.	Confirm the update of the signals with “Yes”.

No.	Action
5.	Check if the coupling is still defined as “Isochronous”. 
6.	Preset the signals: a. cAxis.AngularPositionController.SetVelocity b. Wood.MarkerReporter.MarkerDistance c. Wood.MarkerReporter.MarkerWidth as shown in the figure below and save the coupling. 

2.1.4 PLCSIM Advanced coupling

Depending on whether the PLCSIM Advanced Virtual Ethernet Adapter should be used or not, the communication interface in the PLCSIM Advanced coupling needs to be set to “SOFTBUS” (when the PLCSIM Advanced Virtual Ethernet Adapter is **not** used) or to “TCPIP” (when the PLCSIM Advanced Virtual Ethernet Adapter is used).

Figure 2-1 Communication interface



Typically, when TIA Portal and SIMIT run on the same system, “SOFTBUS” is used.

2.1.5 Charts of the SIMIT project

The SIMIT simulation software maps the behavior of active components (e.g. of drives or valves). In SIMIT, you can simulate error scenarios to analyze the behavior of the machine in a virtual space. The required components are organized in individual charts.

Control additional axes

This chart includes a component, which is connected to the axes that are not controlled by the standard application. The following table describes the in-, outputs and the parameters of the component.

Table 2-4 Control additional axis component

Name	In-, Output or Parameter	Type	Function
cut	Input	Binary	Triggers step chain for movement of y-, z- and toolAxis
gap	Input	Binary	TRUE: “Creating a gap” is active
gapReached	Input	Binary	TRUE: Gap was created
yAxisActPosition	Input	Analog	Reads the actual position of y-Axis
yAxisActVelocity	Input	Analog	Reads the actual velocity of y-Axis
zAxisActPosition	Input	Analog	Reads the actual position of z-Axis
zAxisActVelocity	Input	Analog	Reads the actual velocity of z-Axis
yAxisSetPosition	Output	Analog	Write set point position to y-Axis
yAxisSetVelocity	Output	Analog	Write set point velocity to y-Axis
zAxisSetPosition	Output	Analog	Write set point position to z-Axis

Name	In-, Output or Parameter	Type	Function
zAxisSetVelocity	Output	Analog	Write set point velocity to z-Axis
toolAxisSetVelocity	Output	Analog	Write set point velocity to tool-Axis
cutDone	Output	Binary	TRUE: Start position of y-Axis is reached and z-Axis will move to start position
yAxisVelocity	Parameter	Analog	Set point velocity of y-Axis
yAxisGapPosition	Parameter	Analog	Position for where the saw pushes the wood for creating a gap
yAxisStartPosition	Parameter	Analog	Start position for movement of y-Axis
yAxisTargetPosition	Parameter	Analog	Target position for movement of y-Axis
zAxisVelocity	Parameter	Analog	Set point velocity of z-Axis
zAxisStartPosition	Parameter	Analog	Start position for movement of z-Axis
zAxisTargetPosition	Parameter	Analog	Target position for movement of z-Axis
toolAxisVeloctiy	Parameter	Analog	Set point velocity of tool-Axis

If the execution of the component is triggered by the input “cut”, the step chain for controlling the y-, z- and tool-Axis is started. Firstly, the tool-axis starts rotating with the definable “toolAxisVelocity”. After that, the z-Axis moves to the “zAxisTargetPosition” with the “zAxisVelocity”. Now the cut is executed. The y-Axis moves to its “yAxisTargetPosition” with the defined “yAxisVelocity”. After moving back to the “yAxisStartPosition”, “cutDone” is set. After that, the z-Axis moves to “zAxisStartPosition” and “cutDone” is reset. Now the step chain can be triggered again.

Additionally, the function “Creating a gap” can be activated in the SIMATIC application. If that is done, the input “gap” is set to TRUE. In contrast to the step chain before, after the cut is done, the y-Axis does not move back to “yAxisStartPosition”, but to “yAxisGapPosition”. The axis stays in this position until the creation of the gap is done (gapReached is set to TRUE). After that, the y-Axis moves to “yAxisStartPosition” and subsequently the z-Axis moves to “zAxisStartPosition”. Now the step chain can be triggered again.

FlyingSawAxis

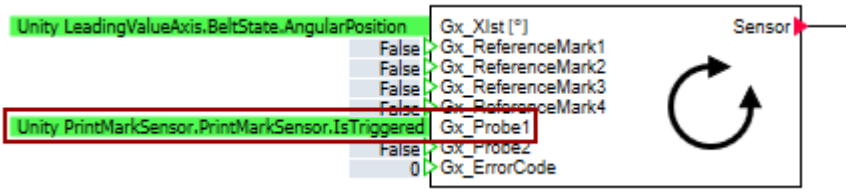
For cyclic data exchange between the PLC and the drive, PROFIdrive telegram 105 is set up in this chart.

LeadingValueAxis

For cyclic data exchange between the PLC and the drive, PROFIdrive telegram 105 is set up in this chart.

In this chart the print mark sensor signal is read and transmitted via the telegram to the configured measuring input in the PLC.

Figure 2-2 Print mark sensor signal

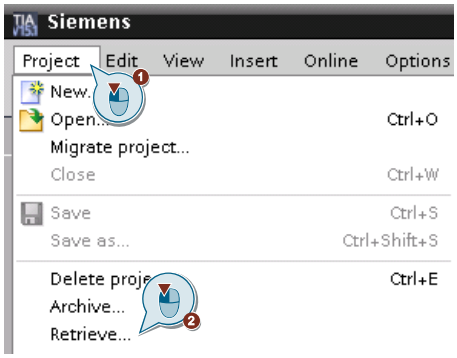


2.2 TIA Portal

2.2.1 Preparing the TIA Portal project

To prepare the provided TIA Portal compressed project for the simulation, the following steps need to be done.

Table 2-5 Prepare TIA Portal project

No.	Action
1.	Start TIA Portal, click “Project” and “Retrieve”. 
2.	Browse to the provided TIA Portal compressed project. Define a desired target folder.
3.	Start simulation of HMI.

2.2.2 Differences to the standard application

Function block “LFS_TestFlyingSaw”

This is an additional function block for testing the application with the 3D model. Among other tasks, the function block handles the binary signals for controlling the additional axes for the 3D model (Table 2-4).

Tag table “Control Additional Axes”

This tag table includes the In- and Outputs that are relevant for controlling the additional axes.

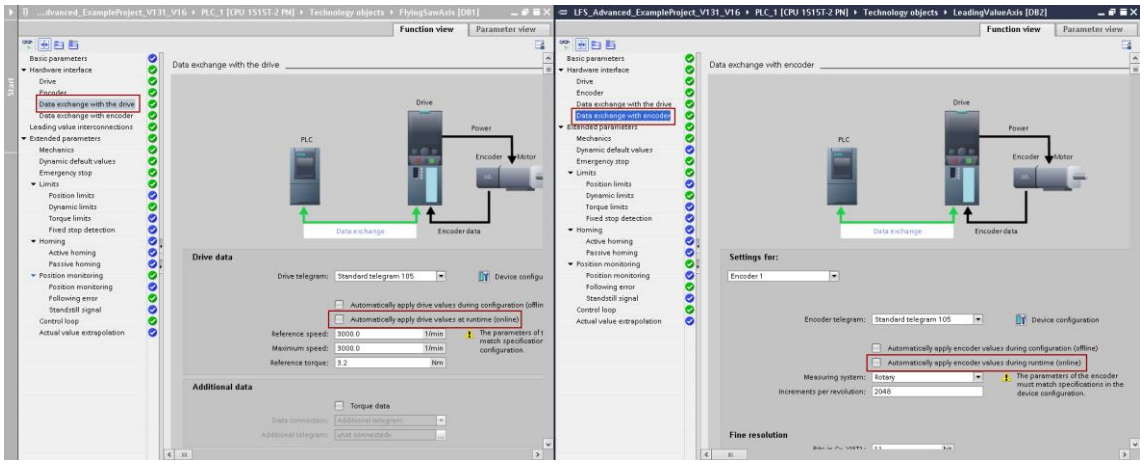
Organization block “LFS_Startup”

The function block is adapted for the example machine in the 3D model (e.g. “Distance to Sensor”).

Technology objects

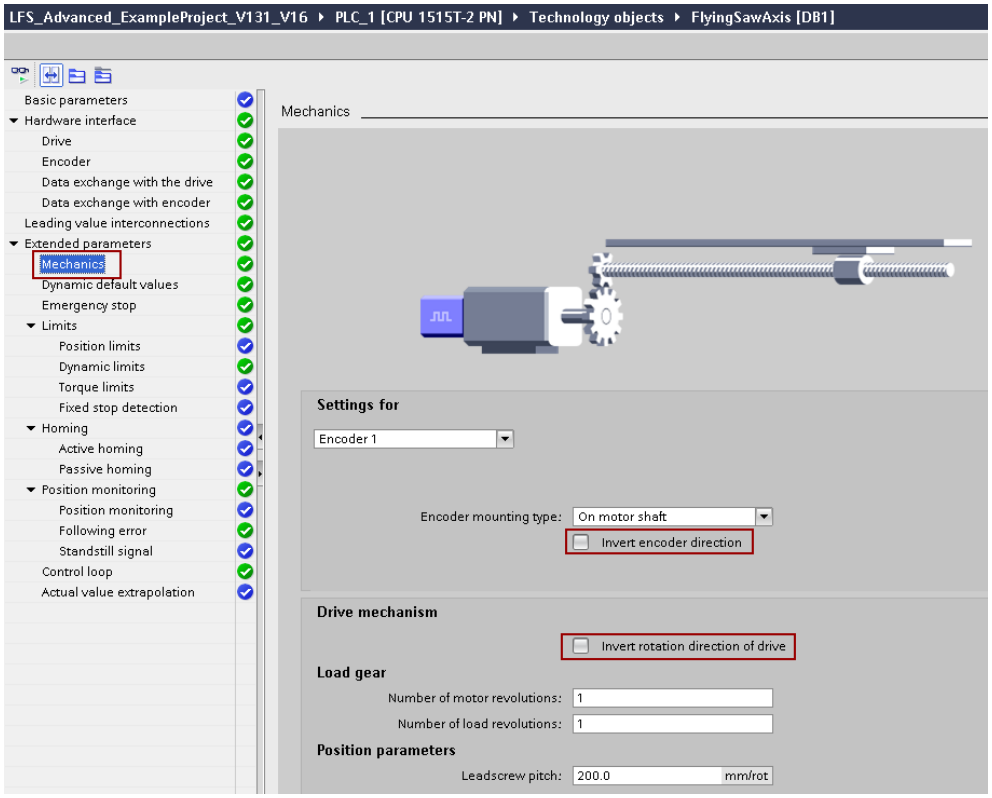
The data exchange with the drive and the encoder is deactivated for the “FlyingSawAxis” and the “LeadingValueAxis”.

Figure 2-3 Data exchange with the drive / encoder



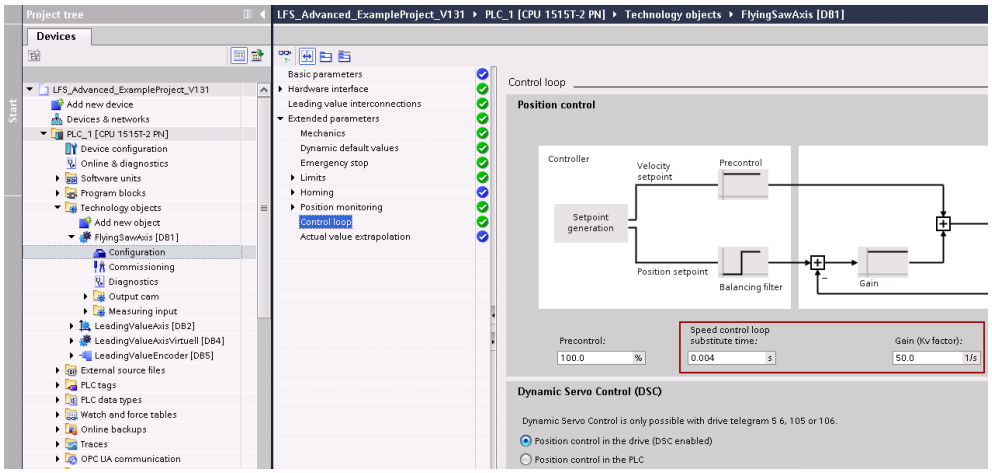
For the “FlyingSawAxis” the check boxes for the inversion of the motion direction is deselected.

Figure 2-4 FlyingSawAxis mechanics



The proportional gain (Kv factor) is for both axes is set to 50.0 1/s. Additionally, for both axes the speed control loop substitute time is set to 0.004s

Figure 2-5 Control loop

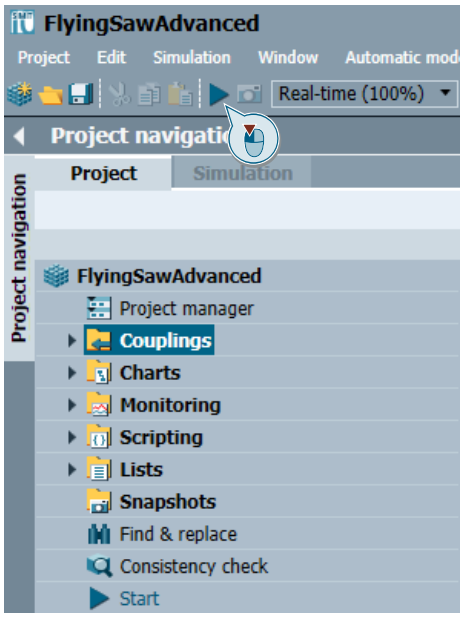
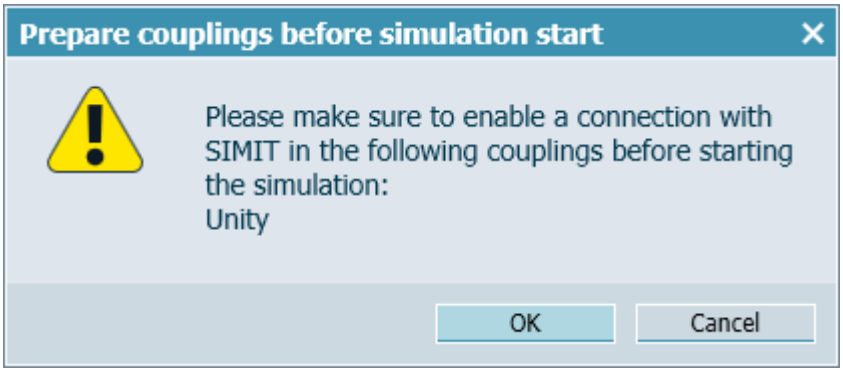


3 Operating the digital twin

3.1 Starting the simulation

To start the simulation, following steps need to be done.

Table 3-1 Starting the simulation

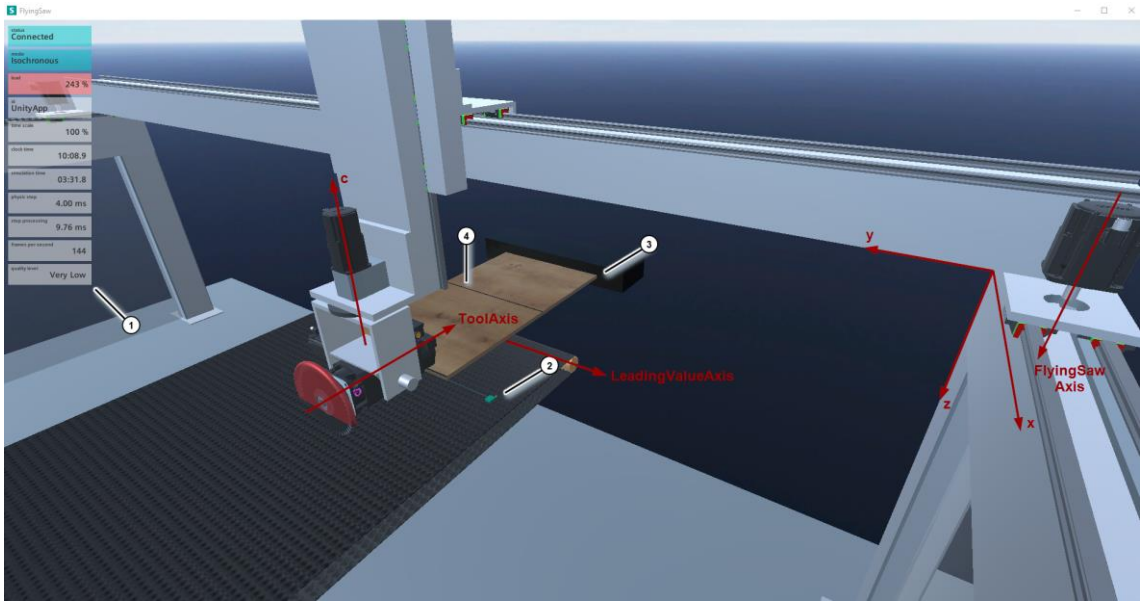
No.	Action
1.	Click „Start“ in SIMIT. 
2.	Confirm the appearing warning with “Ok”. 
3.	Simulation starts with following steps: 1. Starting the S7-PLCSIM Advanced instance 2. Opening and connecting the 3D model 3. Establishing HMI connection
4.	Digital twin is ready for operation.

3.2 Overview of the 3D model

In the top left corner status information about the connection to SIMIT can be found (1). The LeadingValueAxis drives the belt on which the material lies that should be cut. The material is generated, depending on the velocity of the LeadingValueAxis,

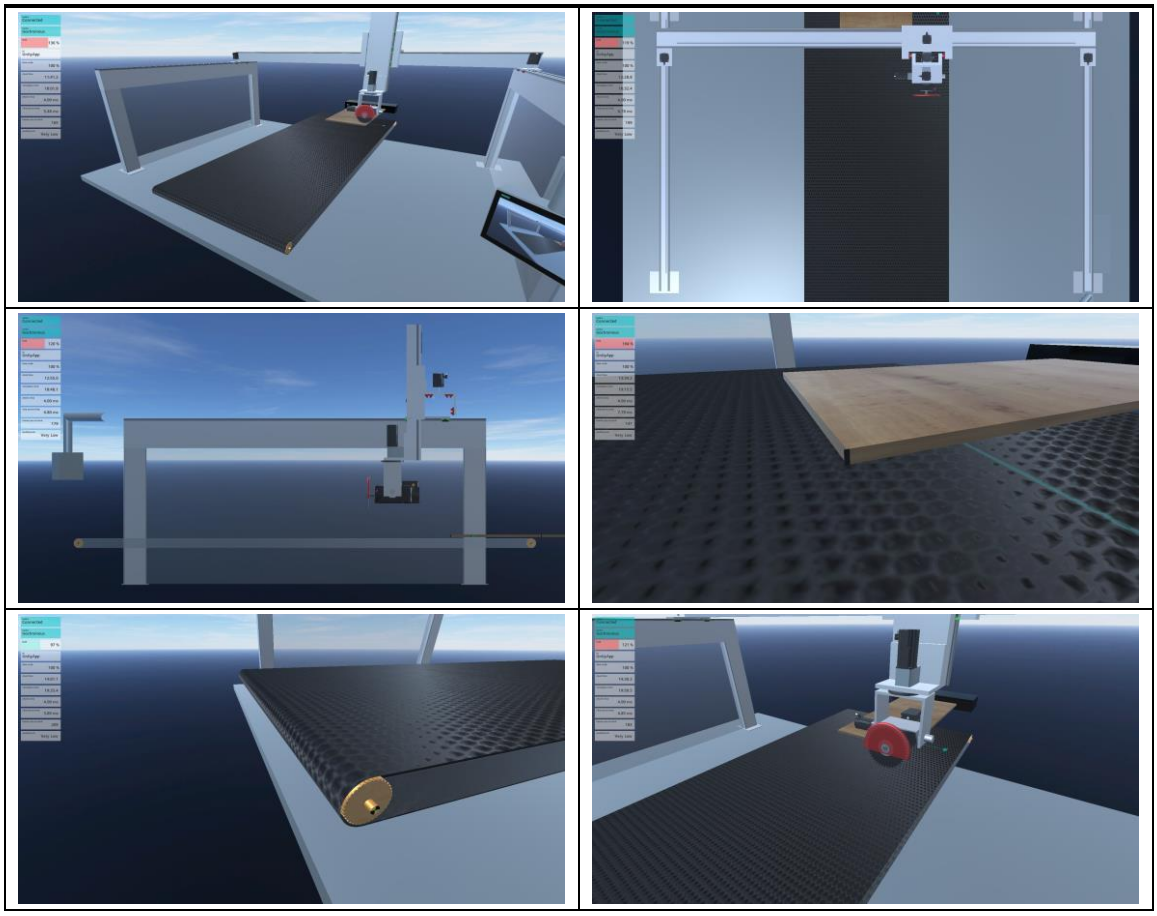
continuously by an object source (3). Depending on the configuration in SIMIT (Table 2-3: No. 6), print marks are generated (4). They are detected by a sensor (2) and read via PROFIdrive telegram (Figure 2-2).

Figure 3-1 Overview of the 3D model



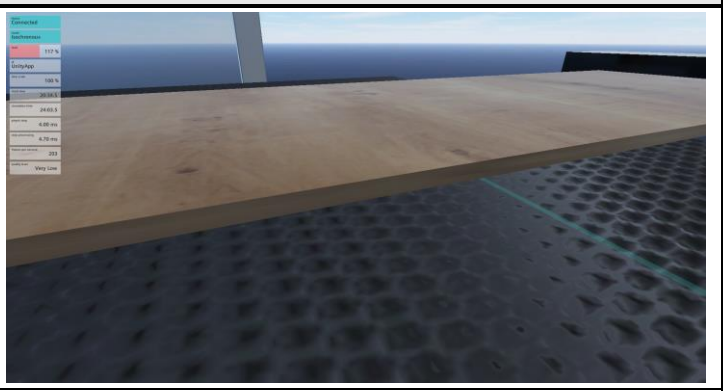
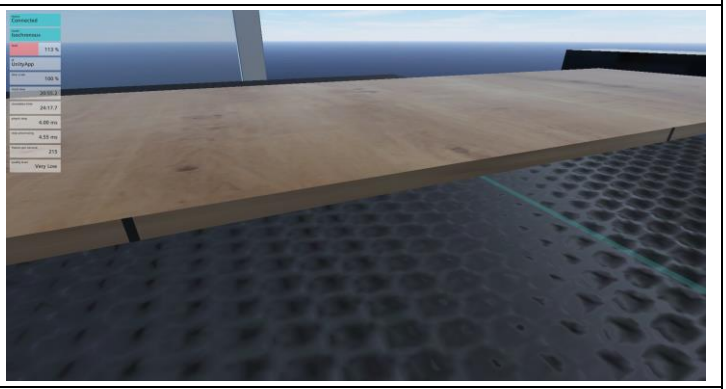
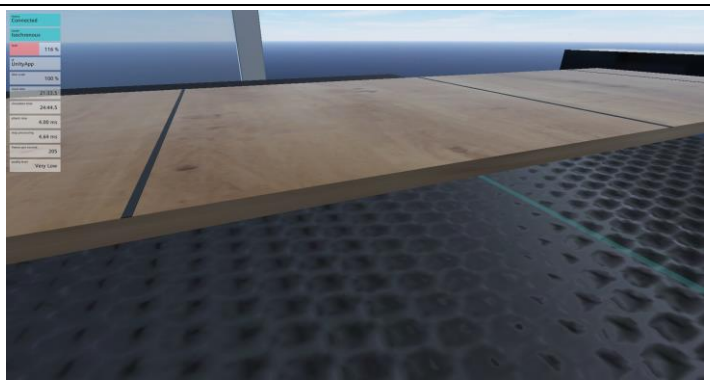
With the “Tab” key on the keyboard, between 6 different standard views can be switched.

Table 3-2 Standard views



With the “F2” key on the keyboard, the user can choose between 3 ways for the visualization of the print marks.

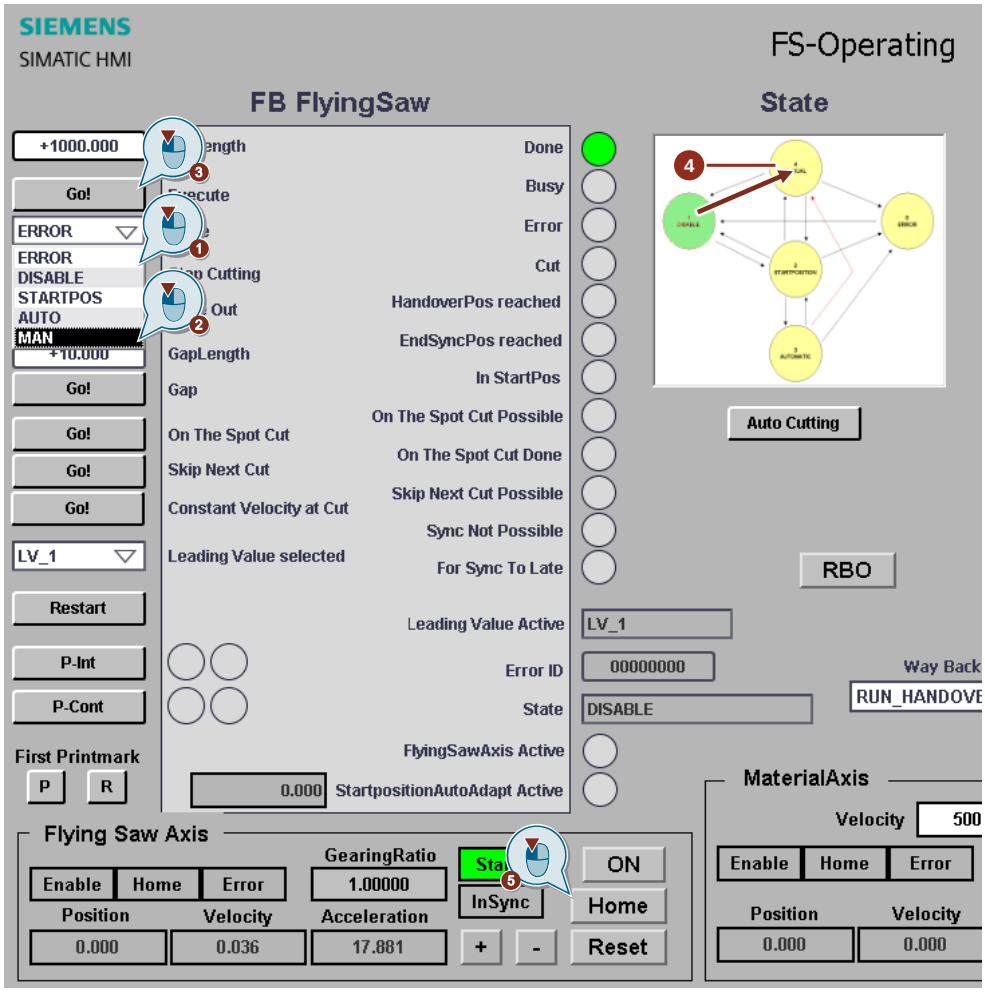
Table 3-3 Visualization of print marks

Type	Screenshot
Deactivated	
Side	
Top	

3.3 Mode manual

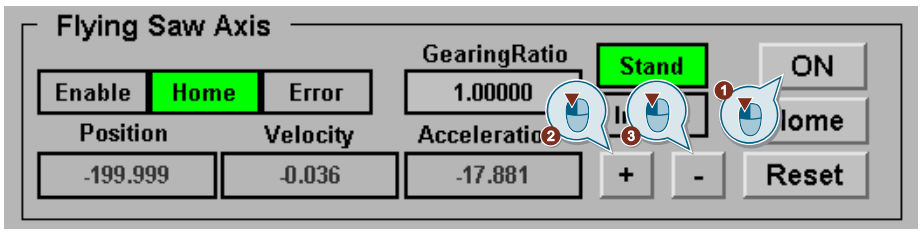
To switch into the manual mode, it is needed to select the dropdown for “Mode” (1) and select “MAN” (2). After executing the mode change with “Go!” (3), the state changes from “DISABLE” to “MANUAL” (4). When the simulation is started for the first time, the FlyingSawAxis needs to be homed (5).

Figure 3-2 Changing to “MANUAL”



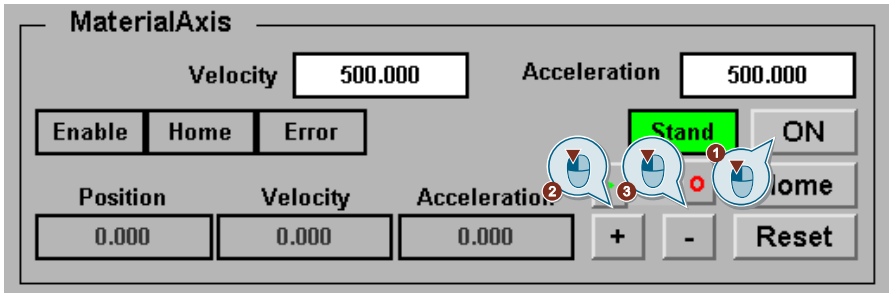
The FlyingSawAxis now can be enabled via “ON” (1) and jogged forward via “+” (2) and jogged backward via “-“ (3). With selecting “ON” a second time, the axis can be disabled.

Figure 3-3 Manual mode FlyingSawAxis



The LeadingValueAxis (MaterialAxis) can be jogged in a similar way. The axis can be enabled via “ON” (1). The jog command in positive direction can be set via “+” (2) and in negative direction via “-“ (3). Disabling the axis is done via selecting “ON” a second time.

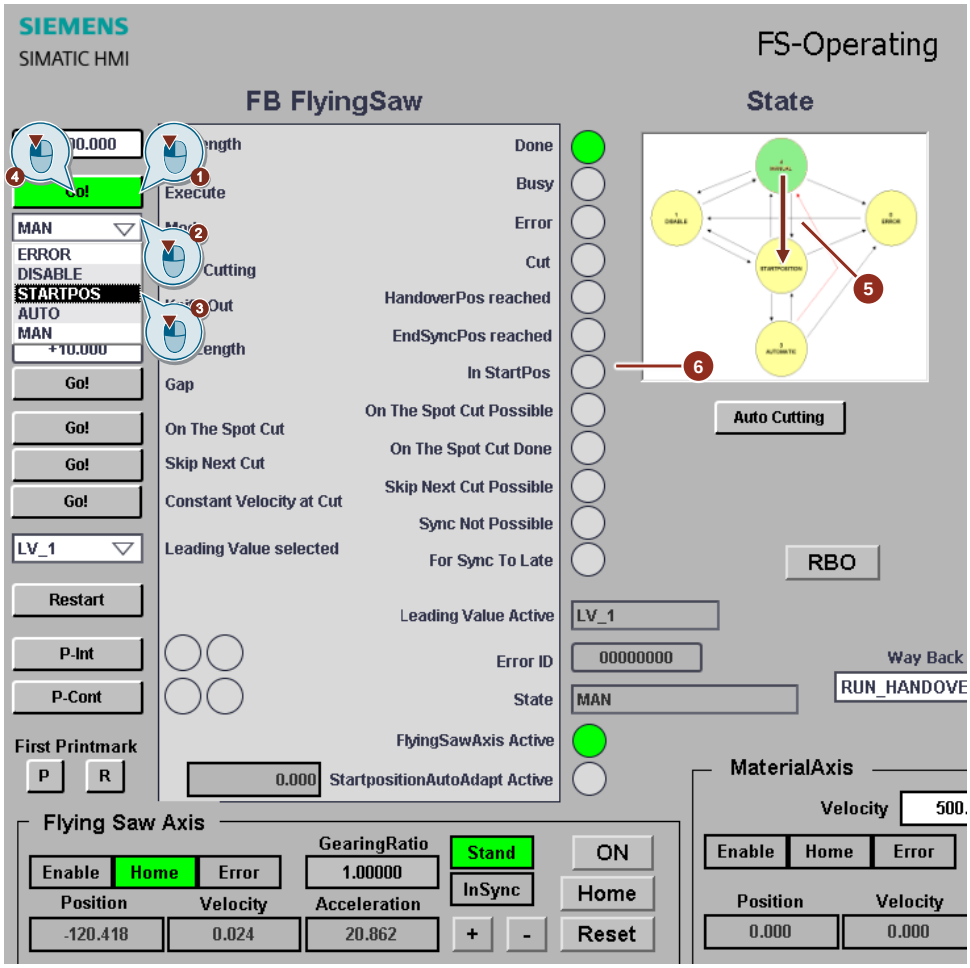
Figure 3-4 Manual mode LeadingValueAxis (MaterialAxis)



3.4 Mode start pos

For changing into mode “STARTPOS”, firstly the “Go!” signal needs to be deselected (1). After that, the mode “STARTPOS” can be selected (2, 3). With selecting “Go!” (4) the mode changes to “STARTPOS” (5). In the 3D model can be seen that the machine moves to the defined start position. When the start position is reached, the corresponding output is set (6).

Figure 3-5 Mode start pos



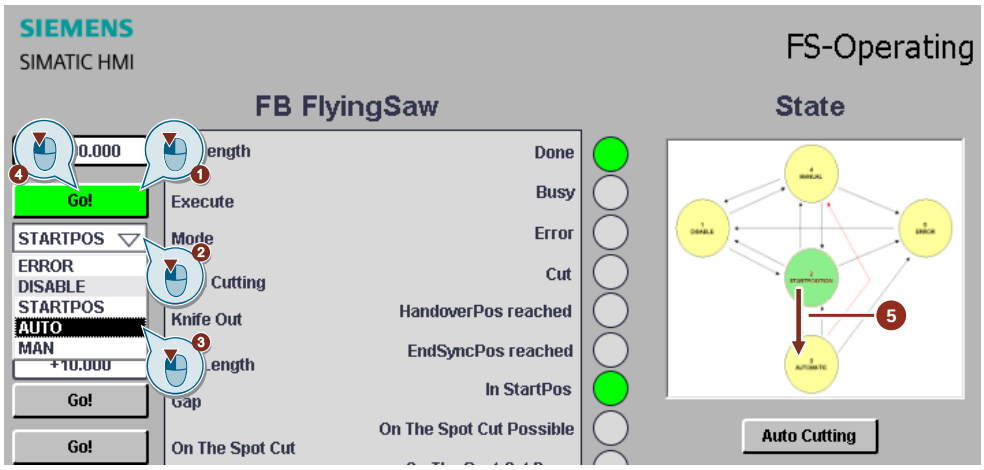
Before starting the automatic mode, the user needs to select the print mark generation mode. The user can select between “PM_MEASURED” and “PM_CALCULATED”.

Figure 3-6 Print mark generation mode

3.5 Mode automatic

For changing into mode “AUTO”, firstly the “Go!” signal needs to be deselected (1). After that, the mode “AUTO” can be selected (2, 3). With selecting “Go!” (4) the mode changes to “AUTO” (5).

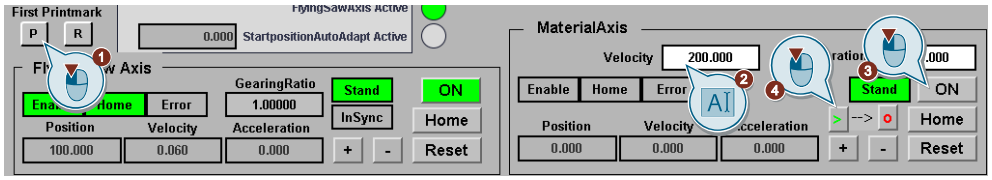
Figure 3-7 Mode auto



3.5.1 Print mark measured

This mode is active, when “PM_MEASURED” as print mark generation mode was selected (Mode start pos). To activate the permanent print mark detection, select “P” (1). Now the MaterialAxis can be started. For that, the axis needs to be turned on (2). Before starting the axis with “>” (4), the velocity needs to be set to 200mm/s (3).

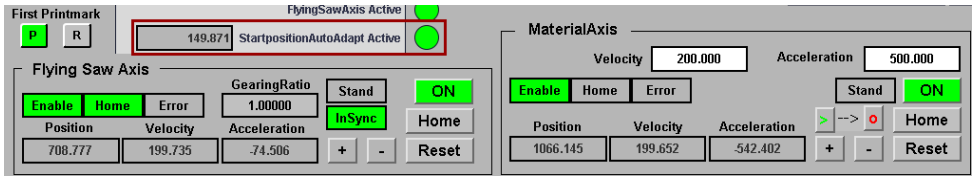
Figure 3-8 Print mark measured (1)



In this mode the flying saw is waiting for a detected print mark. When a print mark was triggered, the flying saw synchronizes to the print mark. When the synchronization is done, the command is set by the application, that the cut can be executed. After that, the execution of the component “Control additional axes” is triggered (Charts of the SIMIT project).

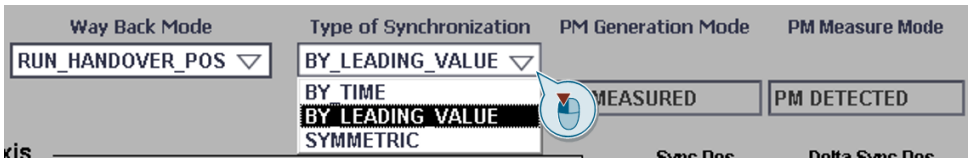
The automatic start position adaption is activated automatically. If the velocity of the MaterialAxis is gradually increased, then the calculated start position rises accordingly. With decelerating the MaterialAxis, the calculated start position approaches the defined start position.

Figure 3-9 Start position adaption



Per default, “BY_LEADING_VALUE” is set as type of synchronization. The application allows to change the type on the fly.

Figure 3-10 Type of synchronization

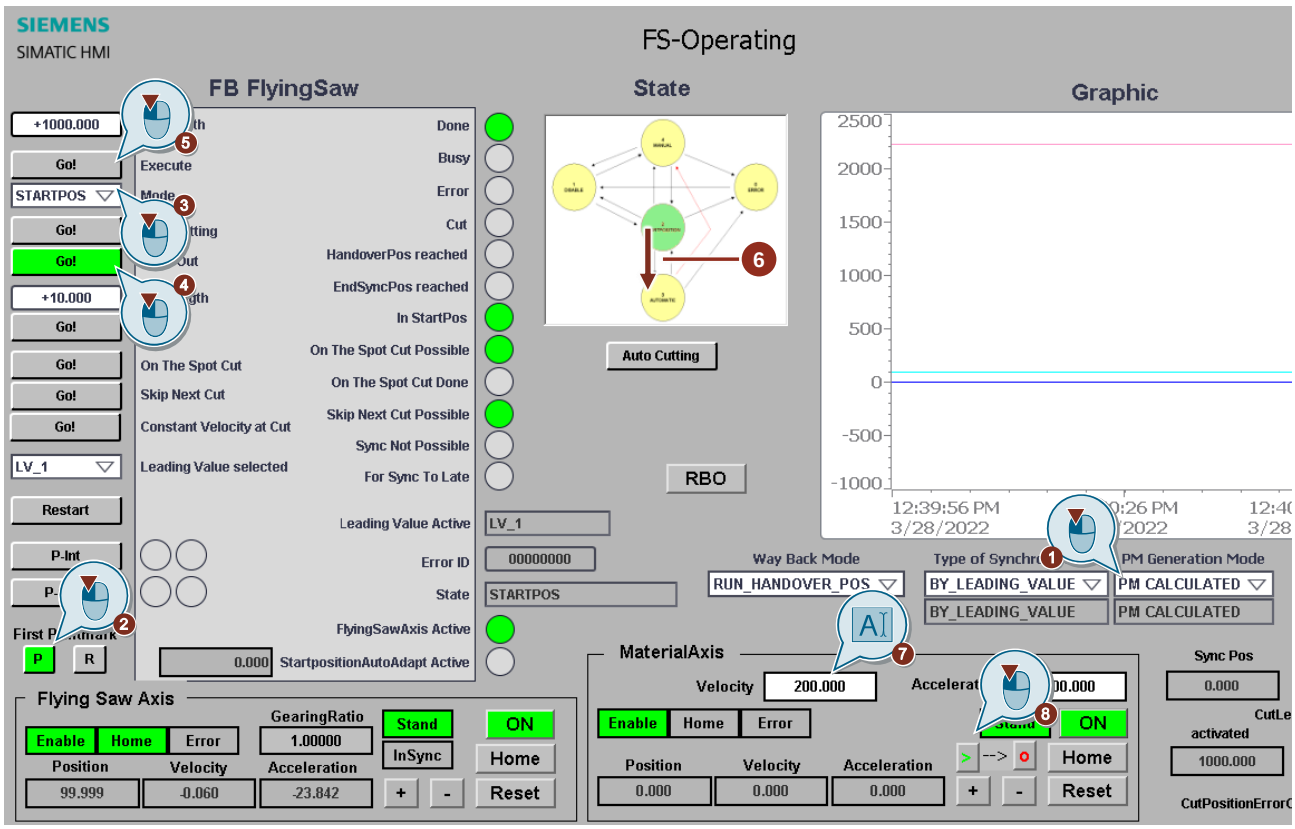


To stop the automatic mode, the red “o” needs to be clicked and the mode “STARTPOS” needs to be selected.

3.5.2 Print mark calculated

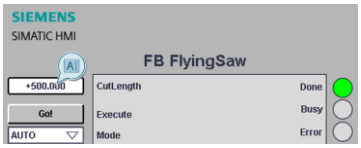
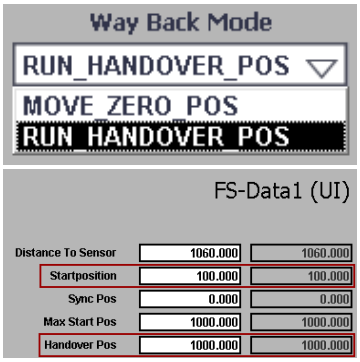
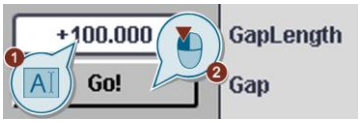
For changing the print mark generation mode to “PM_CALCULATED”, the corresponding option in the drop down menu needs to be selected (1). Next step is to deactivate the permanent print mark detection (2). This is not strictly required, because the print mark detection is not active in the now selected print mark generation mode. After that, mode can be changed to “AUTO” 3, 4, 5, 6). The flying saw can be started with a set point velocity of 200mm/s (7, 8).

Figure 3-11 Print mark calculated (1)



The following functions of the application can be tested very easily.

Table 3-4 Functions that can be tested

Function	Description	Screenshot
Changing “CutLength” on the fly	The user can change the cut length with changing the corresponding parameter on the HMI.	
Changing “Way Back Mode” on the fly	The user can choose between two way back modes, after the cut was executed. RUN_HANDOVER_POS: FlyingSawAxis stays synchronized until the “Handover Pos” is reached. MOVE_ZERO_POS: FlyingSawAxis desynchronizes after the cut and moves back to “Startposition”	
Executing “On The Spot Cut”	By setting this signal, a cut is executed immediately.	
Activation of “Creating a Gap”	After the cut, the saw moves between the material and the wooden blank. After that, the FlyingSawAxis accelerates and creates a gap, with a definable length, between the material and the wooden blank.	

4 Appendix

4.1 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:

siemens.com/SupportRequest

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

4.2 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

4.3 Application support

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4.4 Links and literature

Table 4-1

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/109744840
\3\	SIMATIC SIMIT Simulation Platform https://support.industry.siemens.com/cs/ww/de/view/109746429
\4\	SIMIT-Unity coupling https://support.industry.siemens.com/cs/ww/de/view/109769816

4.5 Change documentation

Table 4-2

Version	Date	Modifications
V1.0	04/2022	First version