MachineMaker

User guide for creating and configuring robot cells and CNC machines in MachineMaker.

Start here

- Introduction to MachineMaker
- Creating a project
- Adding a mechanism

Interface

- Main window
- 3D navigation
- Toolbar
- Application Settings

Getting Started

- Prepare and import 3D objects
- Grouping elements into nodes
- Coloring
- Mechanism Simulation and Validation
- Assemblies
- Mechanisms Library
- Machine equipment configuration

Sections

Pages that differ between mechanism types show the variant for milling machines, robots or turn-milling machines on tabs. The tab selected on one page stays selected on other pages.

- Milling Machines — kinematic scheme, assembly options and examples of CNC milling machines.
- Robots — kinematic schemes of robots, positioners and end effectors, robot cell assemblies and examples.
- Turn-Milling Machines — kinematic scheme of turn-milling and Swiss type machines, Multi Tool Head and examples.

Additional tools

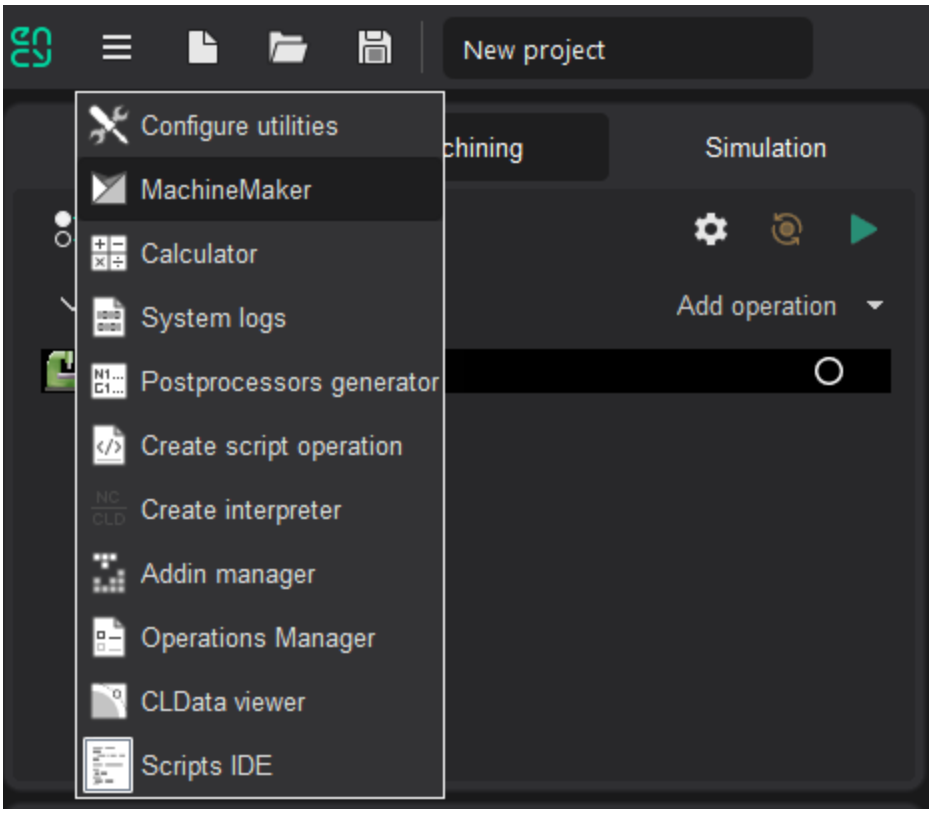
- Simplifier

Introduction to MachineMaker

MachineMaker is a standalone application which allows you to create robot cells and CNC machines for CAM system.

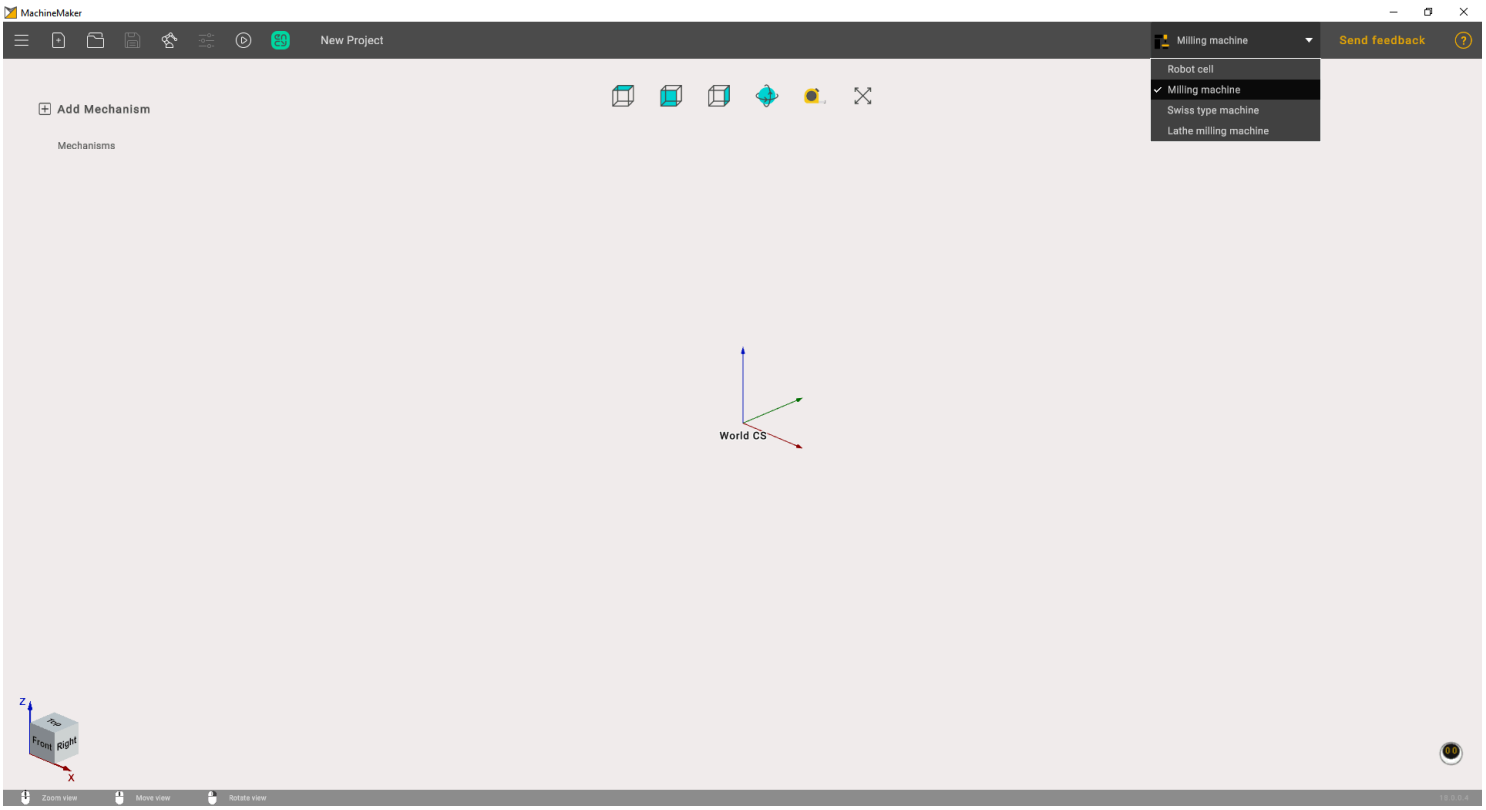
Latest version of MachineMaker carries robots from the following OEMs: ABB, Annin, AUBO, Borunte, Comau, Dobot, Doosan, Efort, Eidos, Epson, EVS, Fanuc, Han's, Hyundai, IIMT, Jaka, Kuka, Kawasaki, LNC, Mitsubishi, Motoman, Nachi, Newker, Regal, Siasun, Staubli, STEP, Tormach, uFactory, Universal, Simple.

You can launch MachineMaker directly from the CAM system utilities menu.

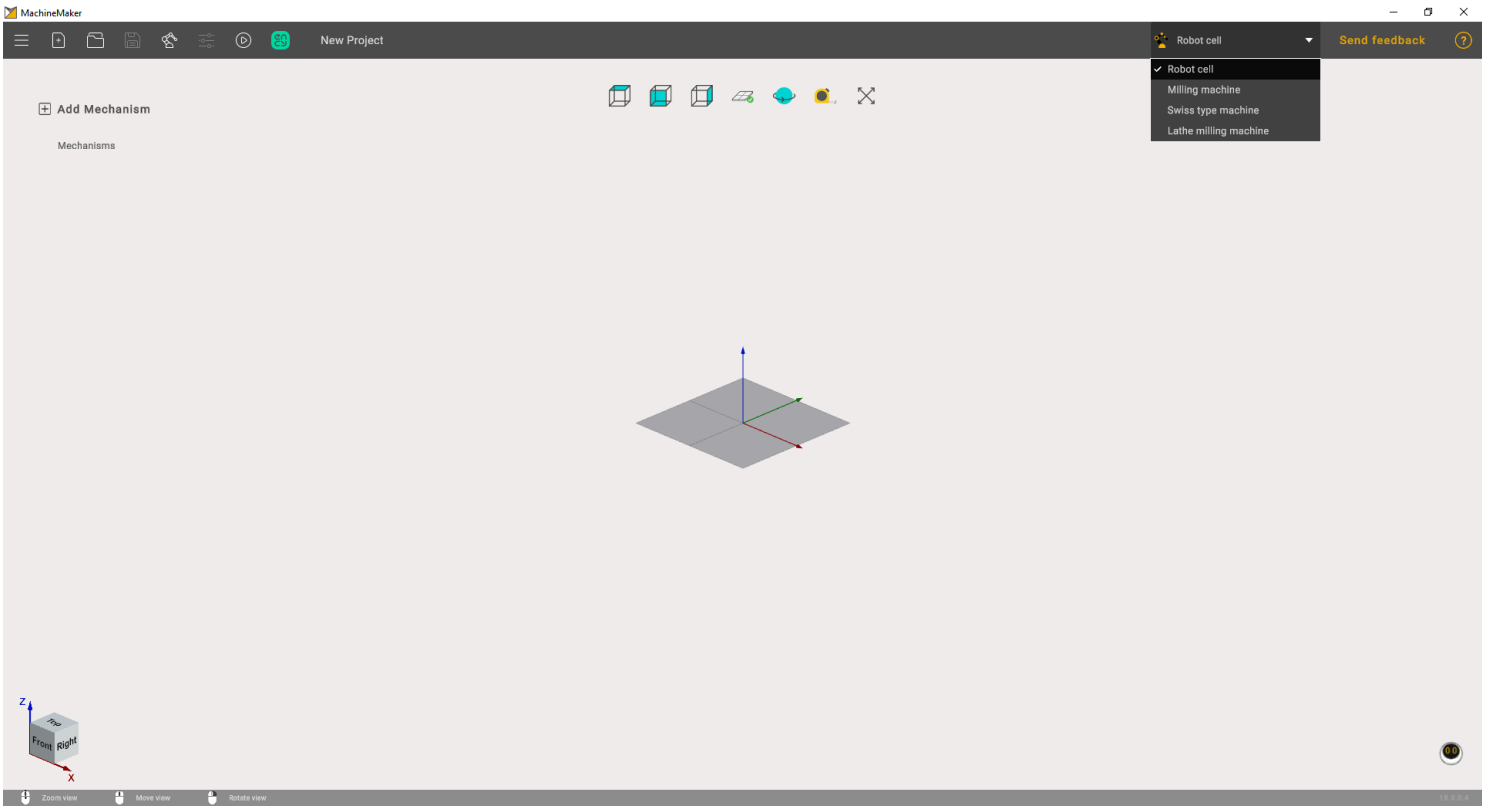


Next, it is necessary to select the correct application context using Application Mode Selector.

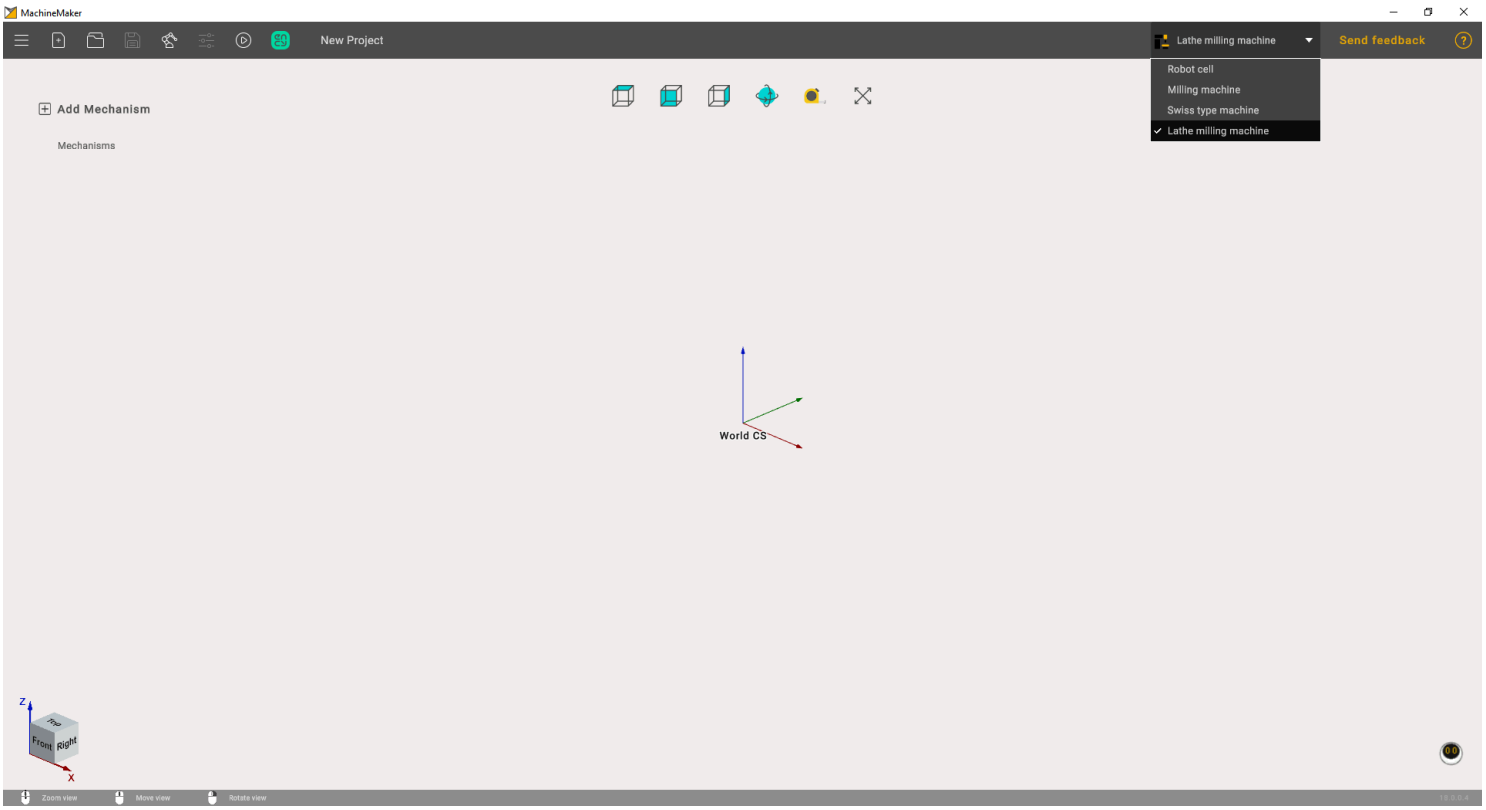
Milling Machines



Robots



Turn-Milling Machines



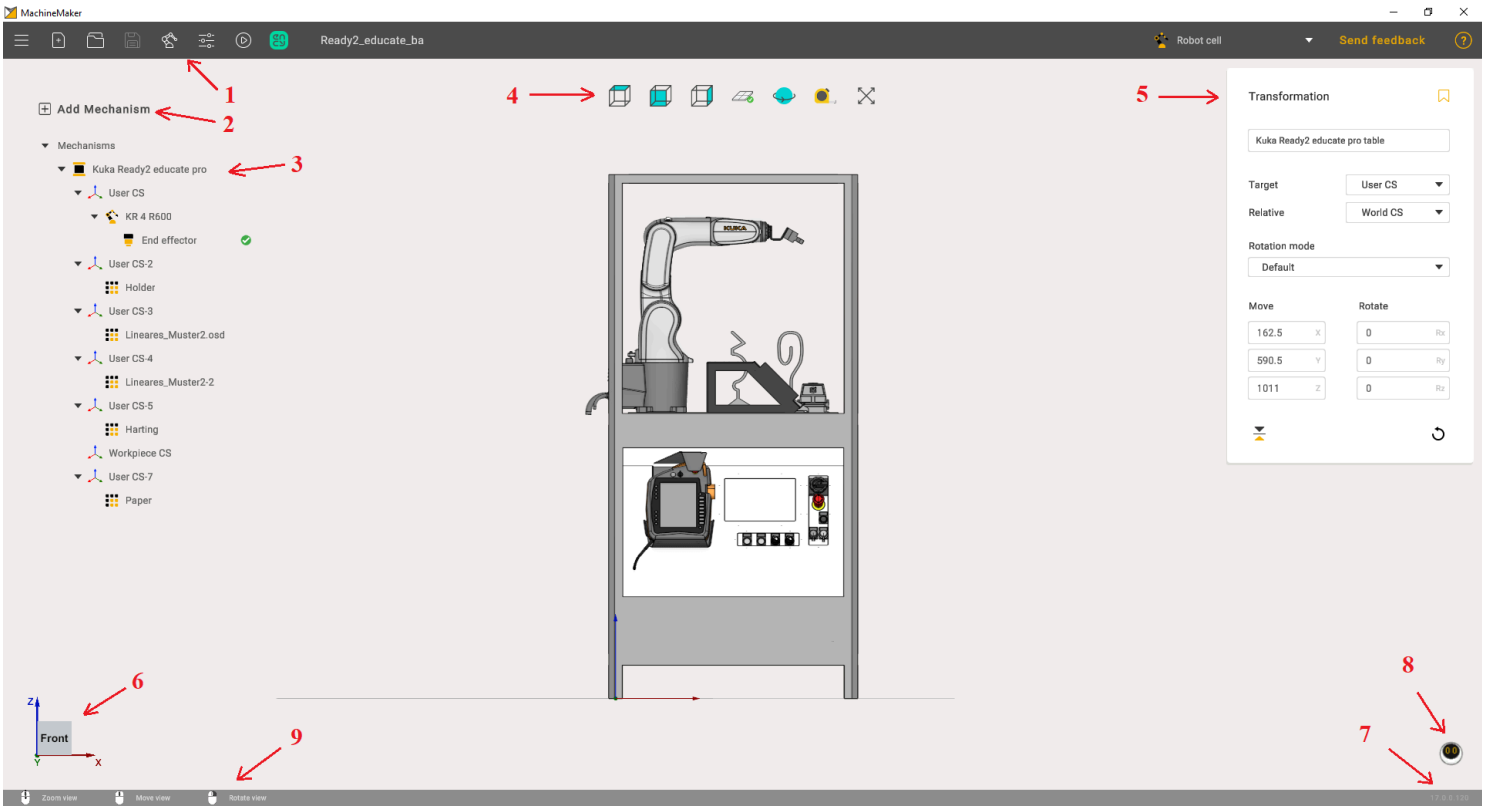
The common steps are described in Interface and Getting Started. Building the kinematic scheme, assembly settings and examples are described in the sections Milling Machines, Robots and Turn-Milling Machines.

Interface

The main window comprises the following sections:

1. Toolbar with the "Add Mechanism" button.
2. Assembly tree.
3. View controls.
4. Transformation panel.
5. Interactive View Coordinate System (CS).
6. Version information.
7. AI Assistant.
8. Interface help.

Main window



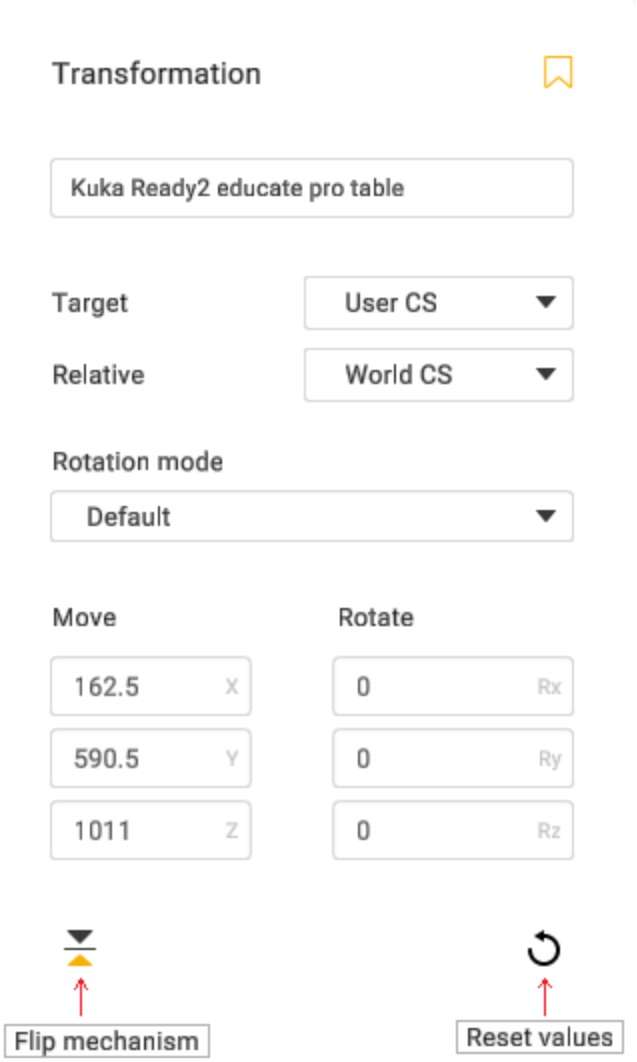
Main window contains following areas:

1. Toolbar
2. Add mechanism button
3. Assembly tree
4. View controls
5. Transformation panel
6. Interactive View CS
7. Version info
8. AI Assistant
9. Interface help

Select any mechanism to show the Transformation Panel. Use the transformation panel to change the object's position. In robot cells, this panel is also useful for table calibration.

The Transformation panel has 3 main functions:

1. Save to library. It is possible to change the selected mechanism name and save it to the local Mechanisms Library using the Save to library button.
2. Flip mechanism. Use  button to flip mechanism position.
3. Reset values. Use Reset button to zero all fields.



Double click on mechanism to enter Mechanism Edit mode.

3D navigation

It is recommended to use a 3-buttons mouse with a scroll wheel for a full experience in MachineMaker and 3D navigation.

Interactive rotate

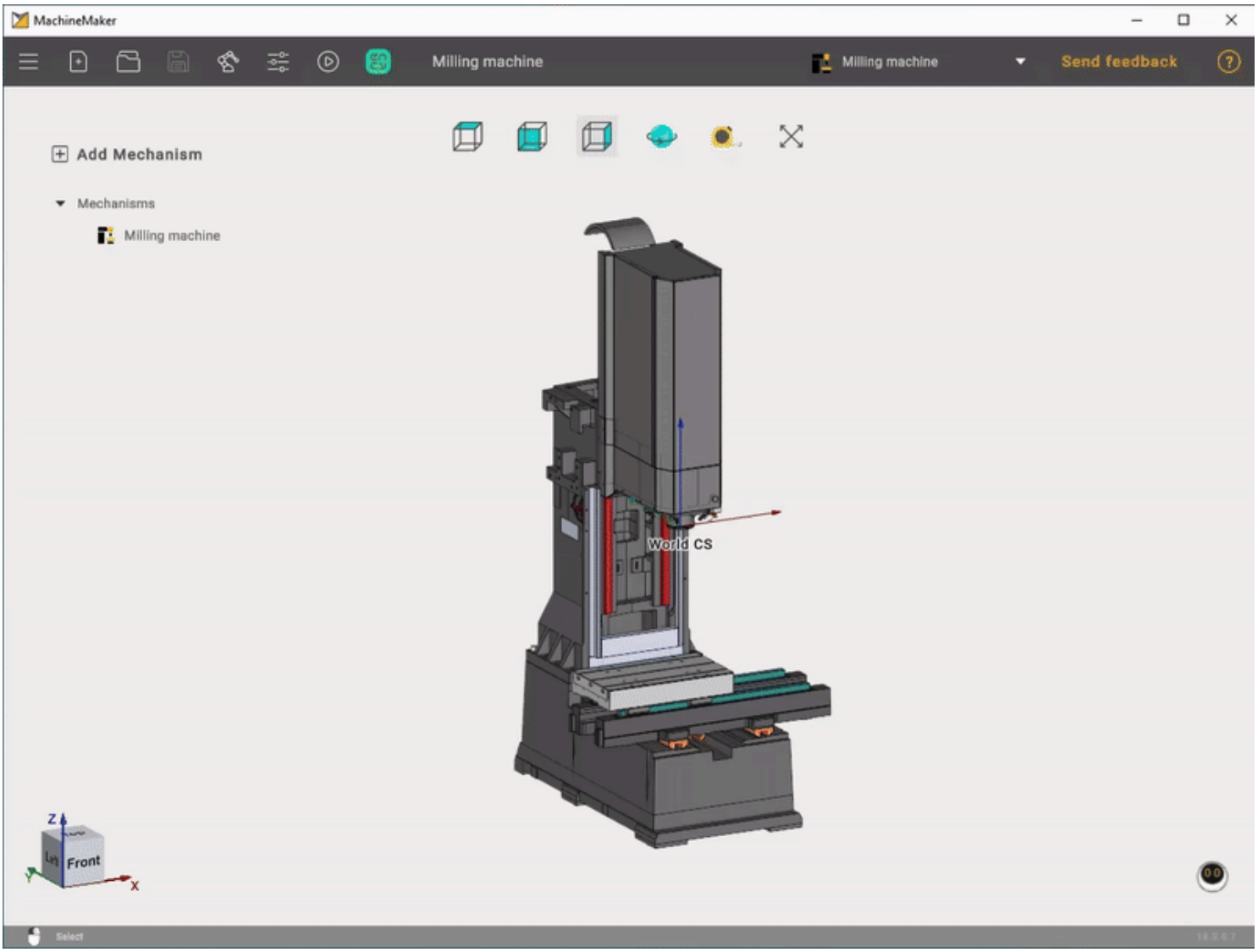
Press and hold the right mouse button and drag the cursor around for the view rotation in the main visualization screen. Drag the cursor up and down to rotate around the horizontal screen axis. Drag it left and right to rotate around the vertical screen axis.

Use  button to switch between free and Z-Fixed rotation modes.

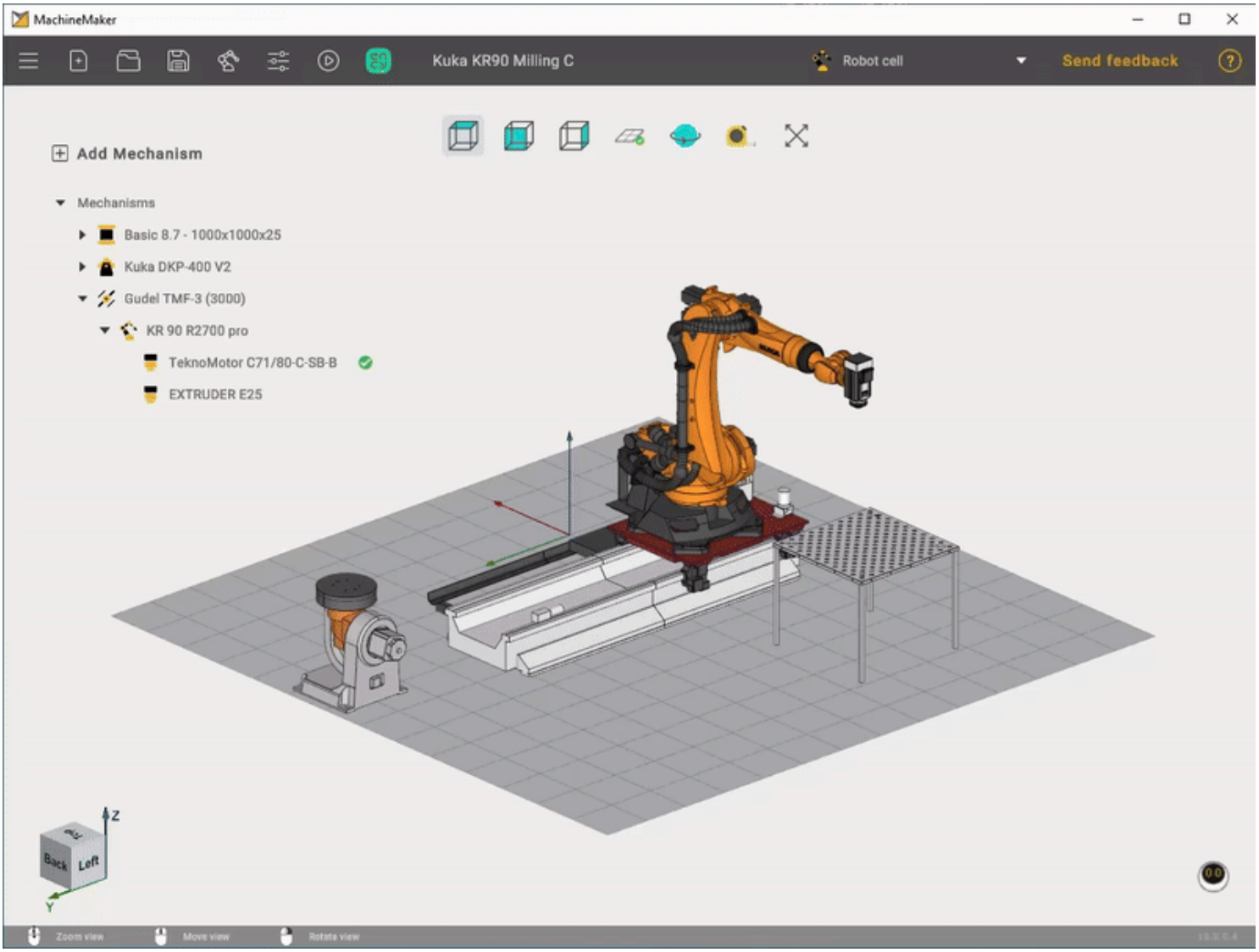
Use  the measure tool to measure the distance.

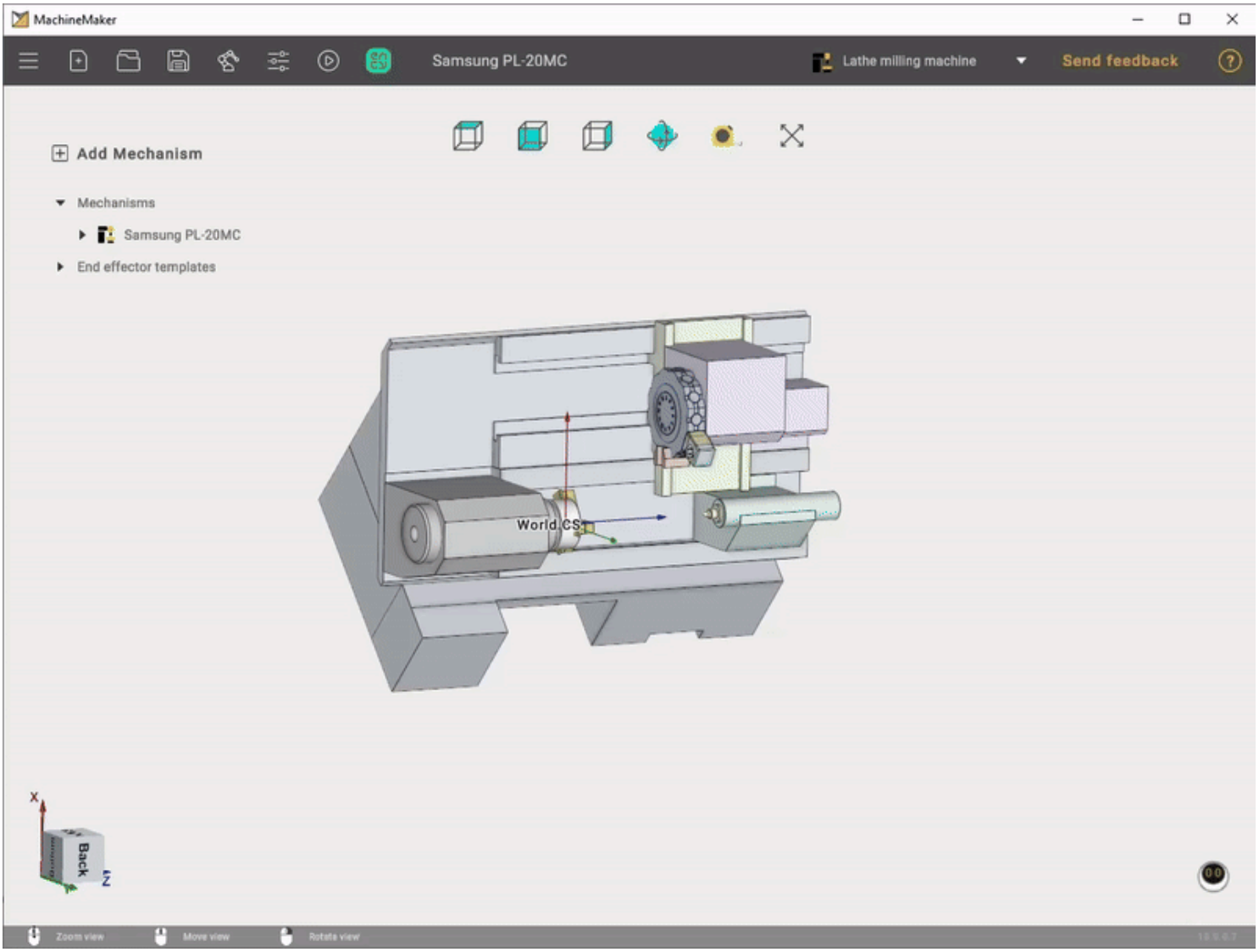
In robot cells, use  to turn off floor visibility.

Milling Machines



Robots

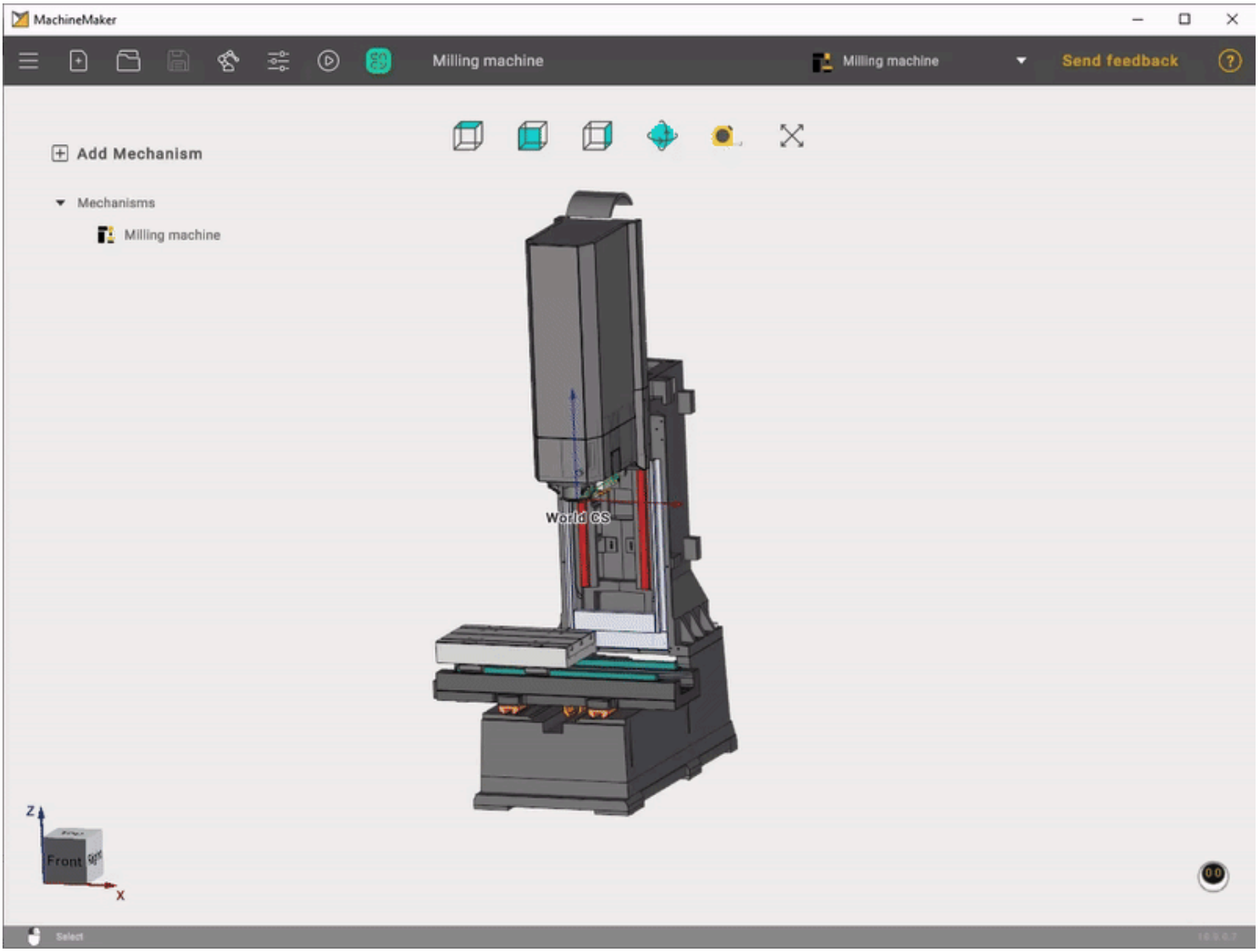

MachineMaker
Kuka KR90 Milling C
Robot cell
Send feedback
Add Mechanism
Mechanisms
Basic 8.7 - 1000x1000x25
Kuka DKP-400 V2
Gudel TMF-3 (3000)
KR 90 R2700 pro
TeknoMotor C71/80-C-SB-B
EXTRUDER E25
Back
Left
Z
Y
Zoom view
Move view
Rotate view

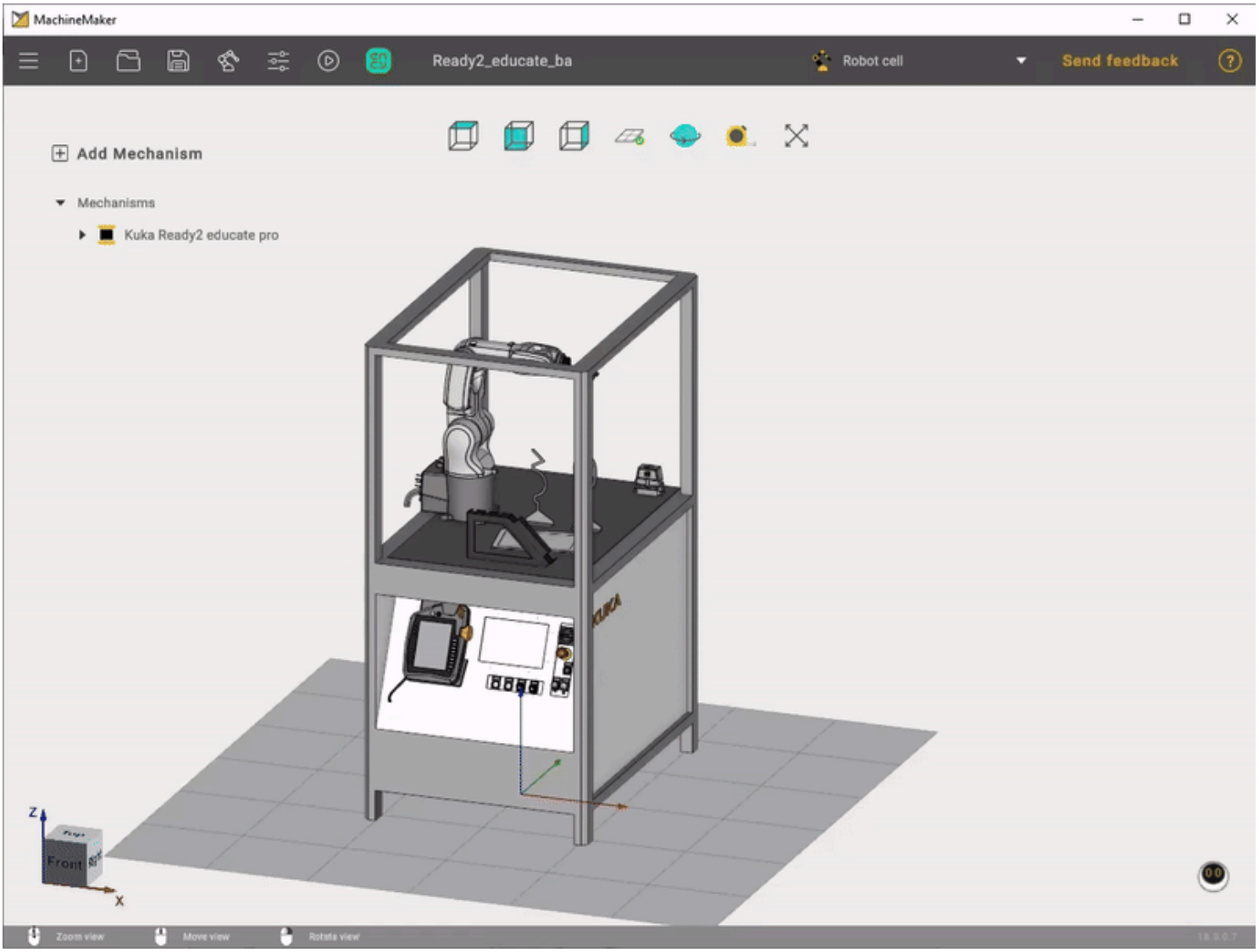


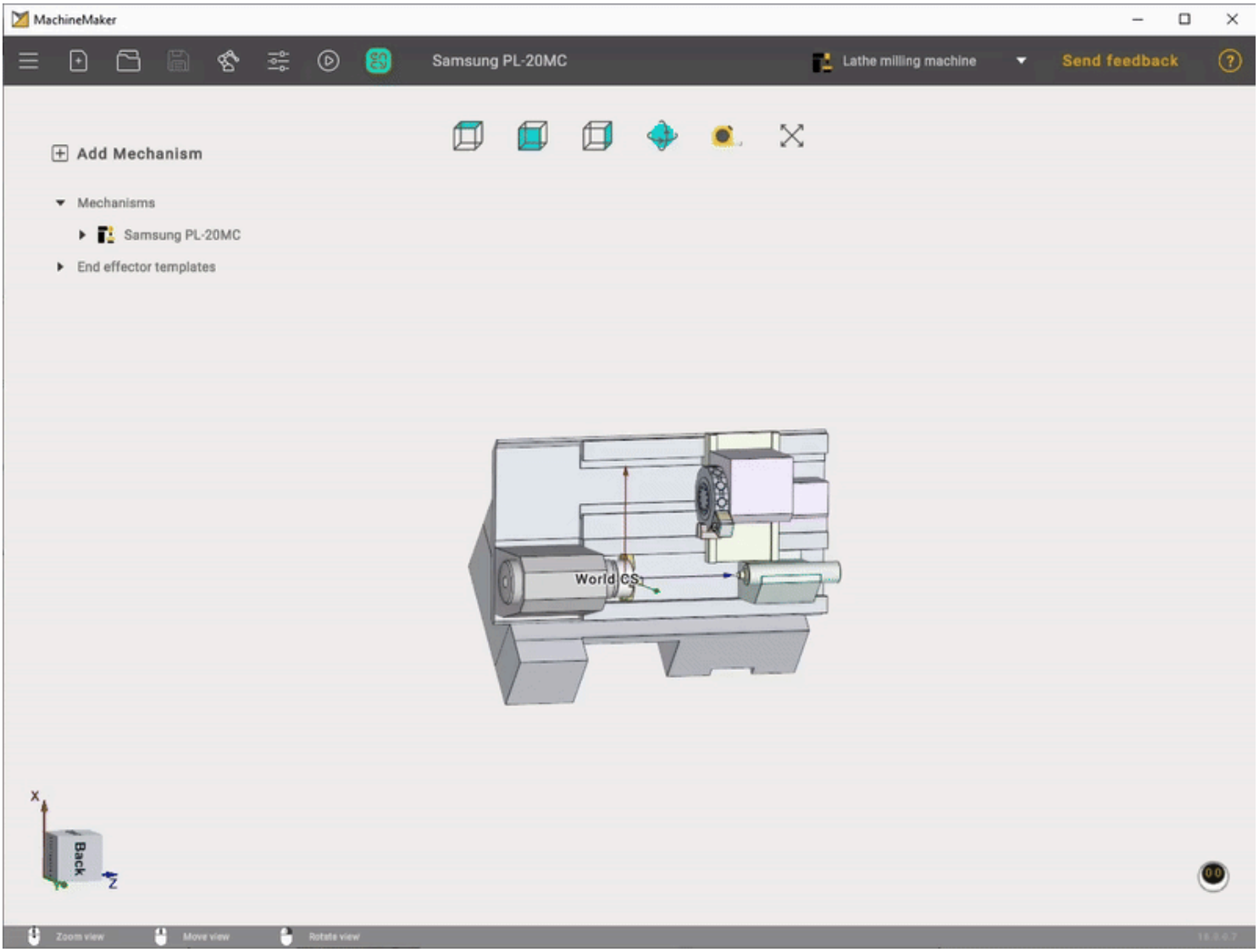
Changing the viewpoint can also be done by the Standard views buttons.



You can also use interactive Global CS located in the lower left corner of the main window.


MachineMaker
Milling machine
Milling machine
Send feedback
Add Mechanism
Mechanisms
Milling machine
World CS
Z
Front
X
Select


MachineMaker
Ready2_educate_ba
Robot cell
Send feedback
Add Mechanism
Mechanisms
Kuka Ready2 educate pro
Front
Z
X
Zoom view
Move view
Rotate view



Clicking on the Middle Mouse Button (wheel) in the graphics window rotates the current view to the nearest standard plane.

Interactive pan

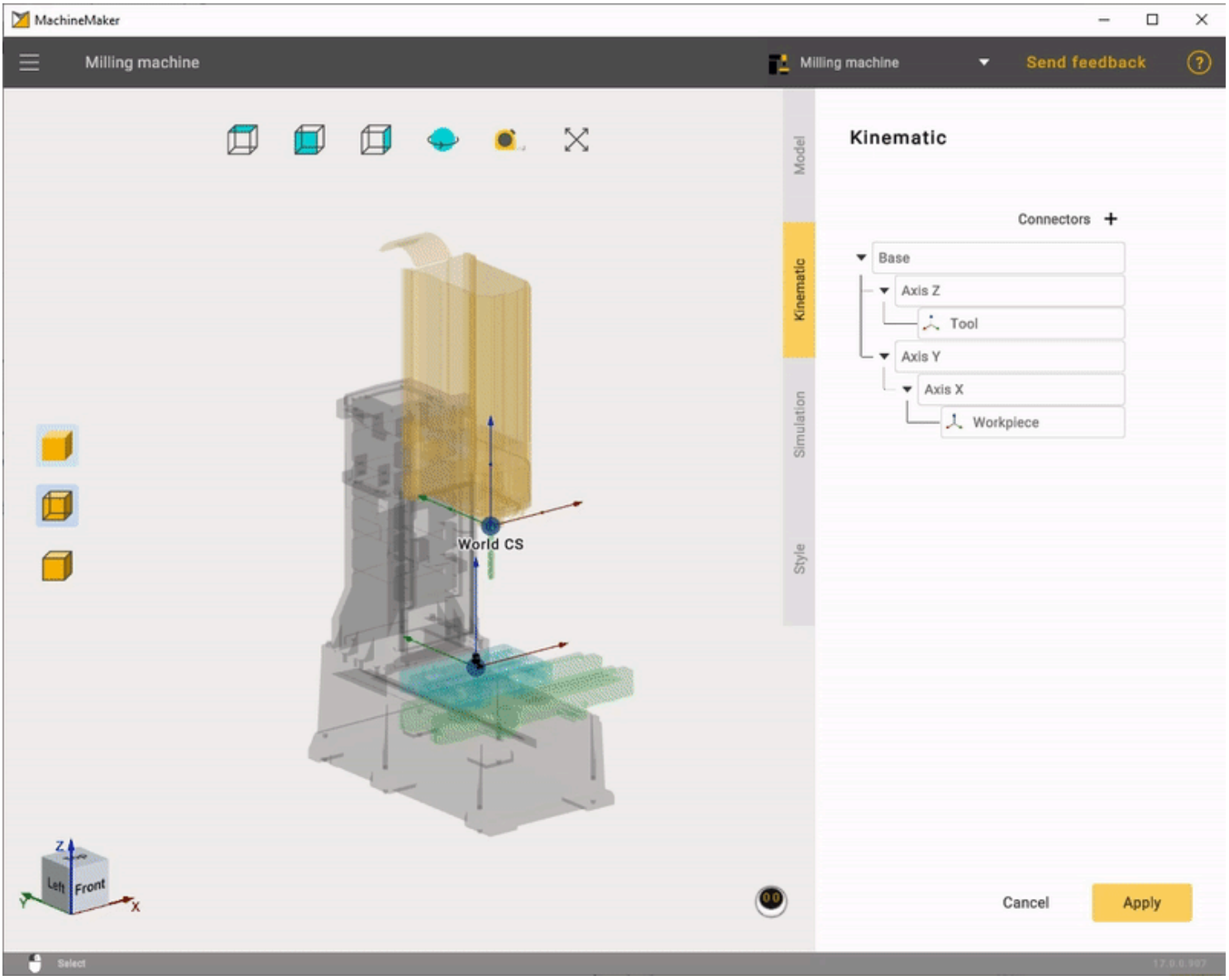
Press and hold the Middle Mouse Button (wheel) and drag the cursor in the main visualization screen to move the view vector.

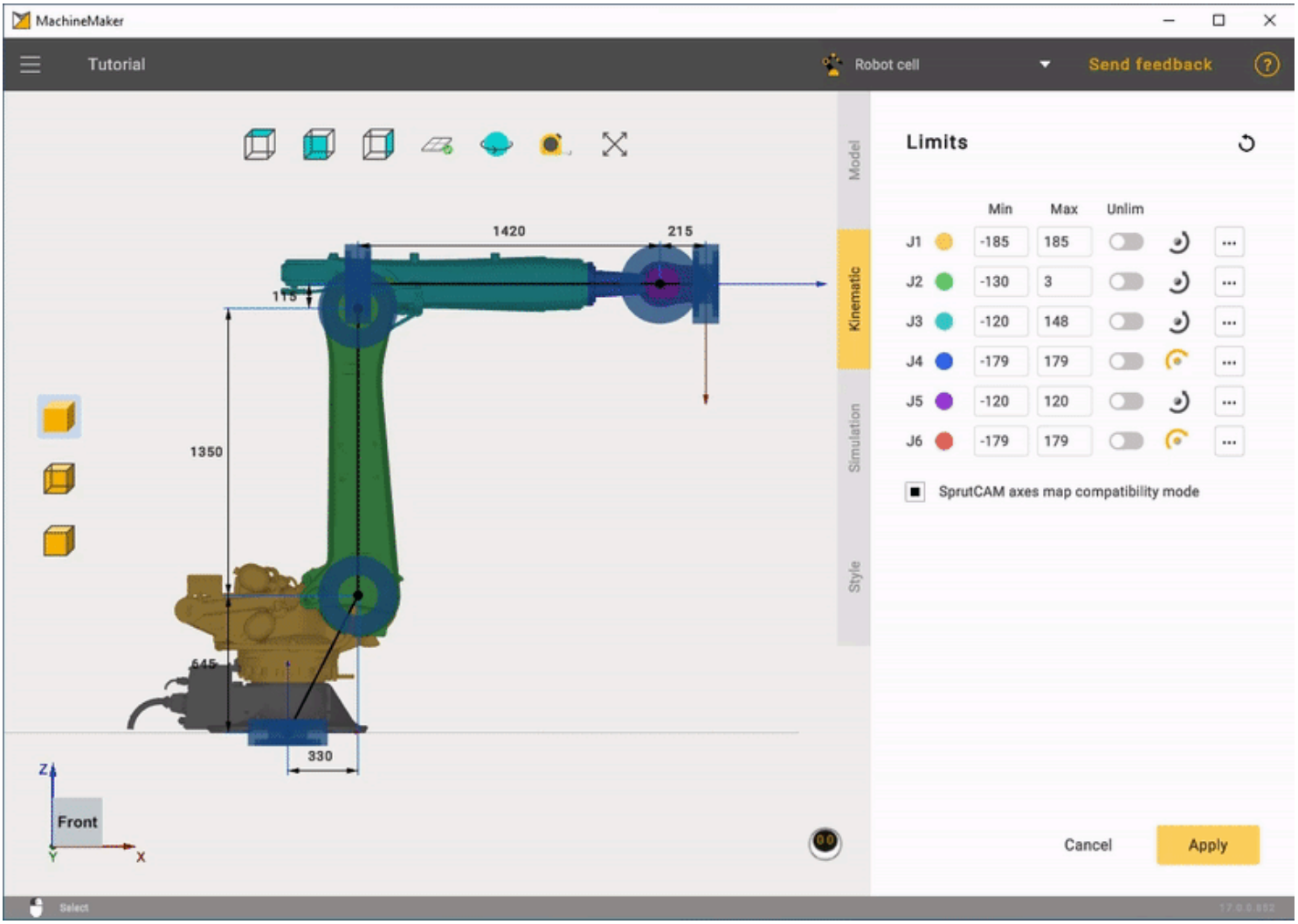
Interactive zoom in and out

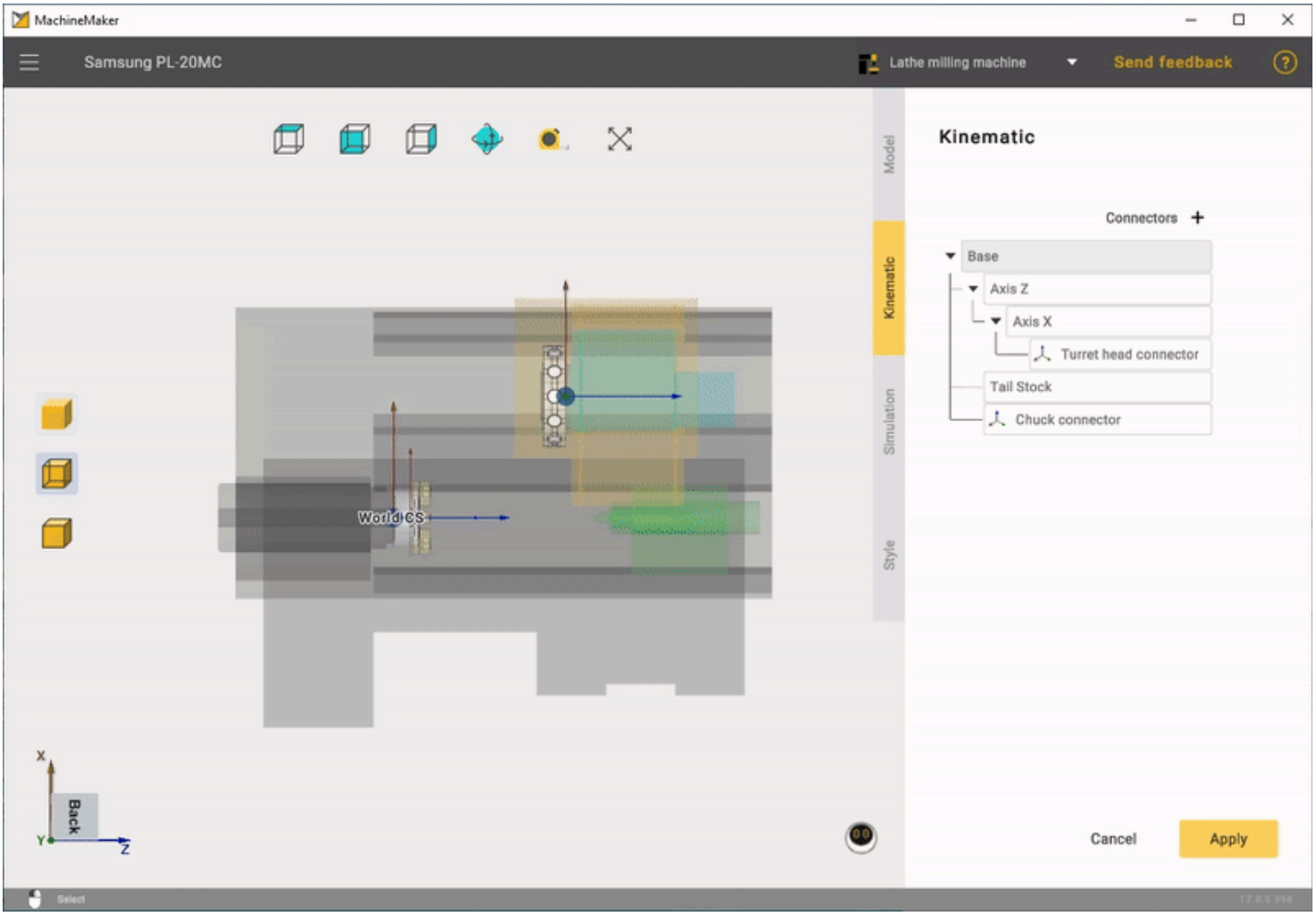
Use Mouse Wheel Scroll to zoom. The zoom area is where your mouse cursor is located.

Visualization mode

It is possible to change visualization mode in the Mechanism edit mode.


MachineMaker
Milling machine
Milling machine
Send feedback
Model
Kinematic
Simulation
Style
Kinematic
Connectors
Base
Axis Z
Tool
Axis Y
Axis X
Workpiece
World CS
Left
Front
Cancel
Apply
Select


MachineMaker
Tutorial
Robot cell
Send feedback
Model
Kinematic
Simulation
Style
Limits
Min
Max
Unlim
J1 -185 185
J2 -130 3
J3 -120 148
J4 -179 179
J5 -120 120
J6 -179 179
SprutCAM axes map compatibility mode
1420
215
115
1350
645
330
Z
Front
Y
X
Cancel
Apply
Select


MachineMaker
Samsung PL-20MC
Lathe milling machine
Send feedback
Model
Kinematic
Simulation
Style
Kinematic
Connectors
Base
Axis Z
Axis X
Turret head connector
Tail Stock
Chuck connector
World CS
Back
X
Y
Z
Cancel
Apply
Select

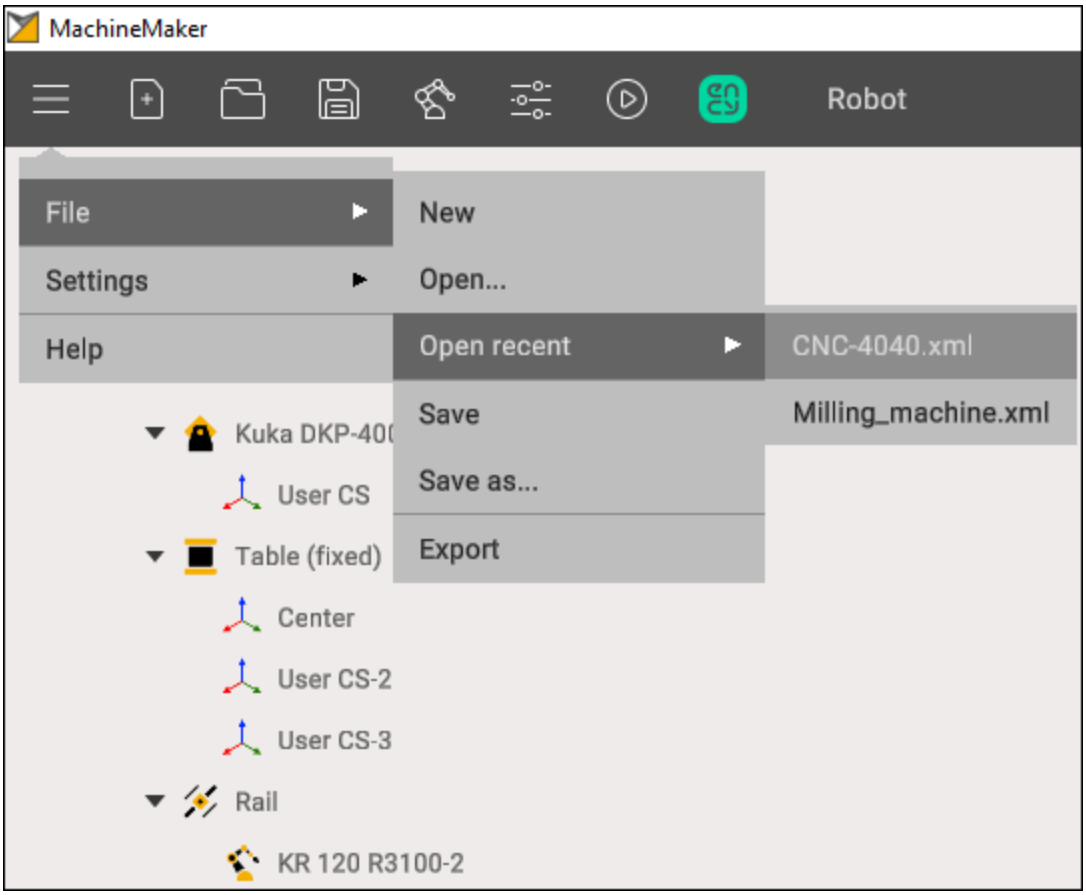
Toolbar

Application toolbar is located in the top panel of the main window.



Main menu (1)

Main Menu (1) contains the following items:



File opens a submenu for project operations:

- New - create a new project. It is also possible to use New (1) button in the toolbar.
- Open - open an existing project. It is also possible to use Open (3) button in toolbar.
- Open recent - show latest projects. Keep mouse over Open (3) button to show recent projects.
- Save - save current project. MachineMaker will ask for project destination folder when saving the file for the first time. It is also possible to use Save (4) button located in the toolbar.
- Save as - save current project to another folder

- Export - open CAM system with the current Machine. It is also possible to use CAM system button located in the toolbar

  It is necessary to add a mechanism (a robot or a machine) to the assembly to save the project

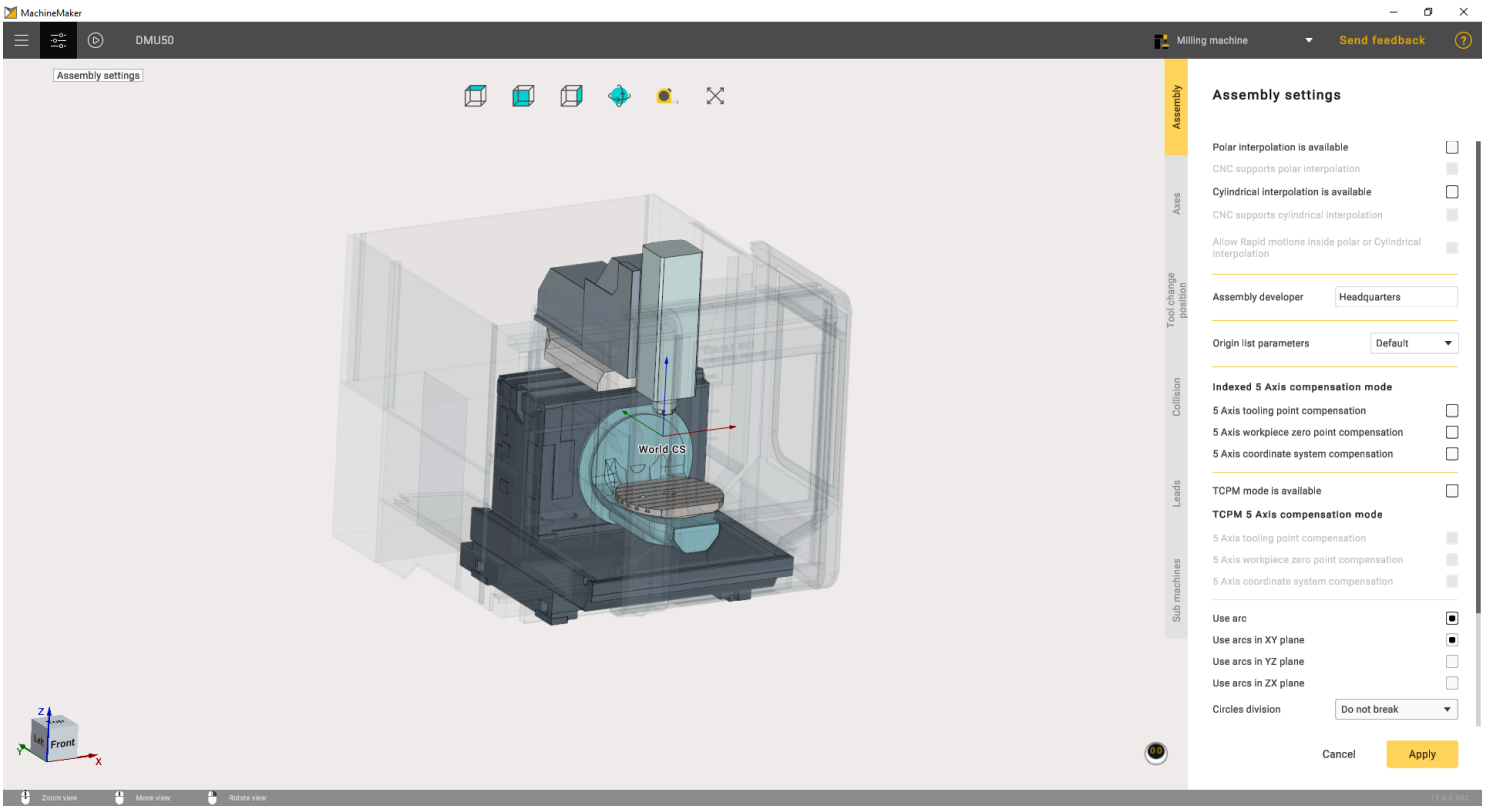
Mechanisms Library (5)

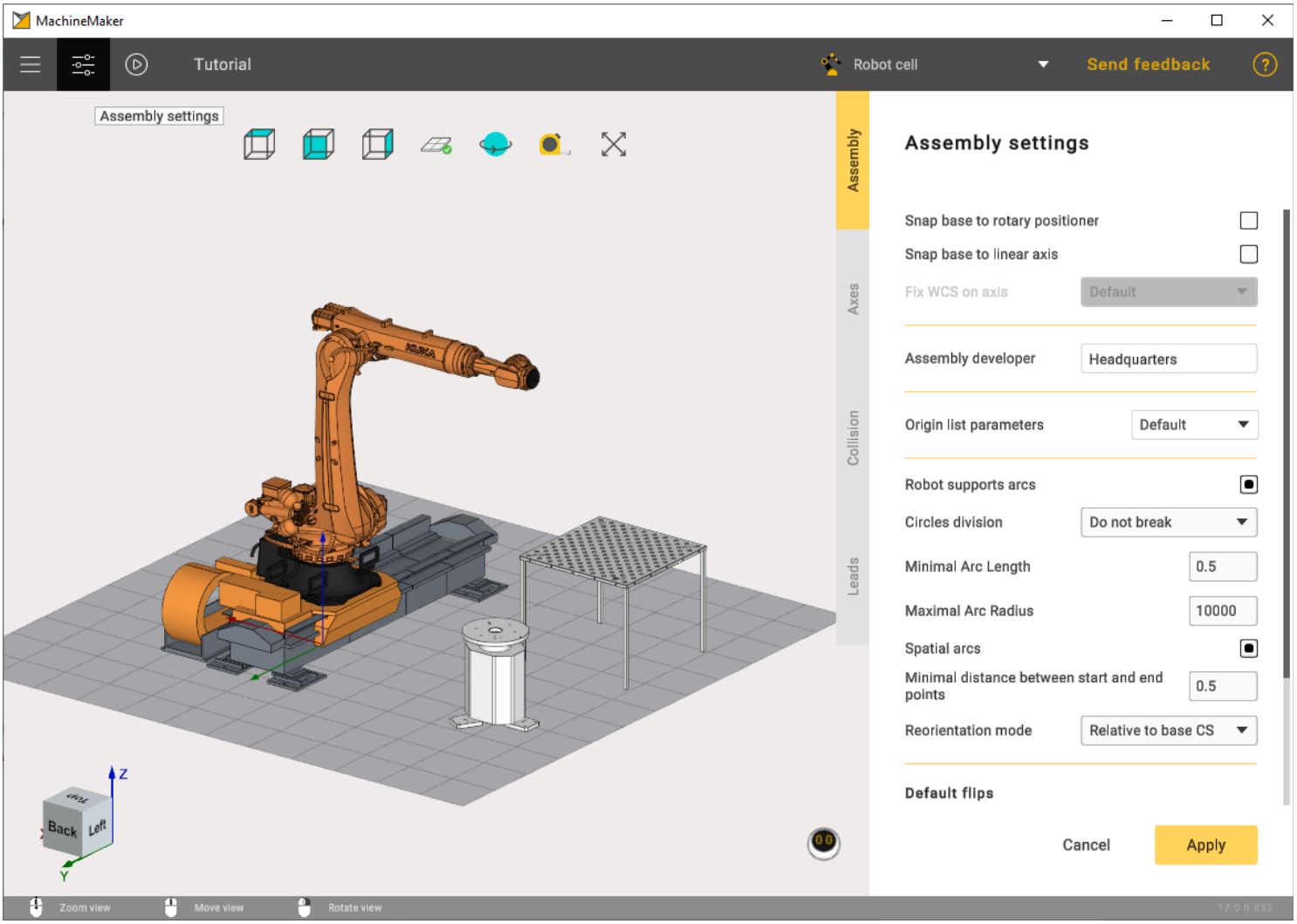
Opens a library of mechanisms. The library is divided into categories for robots, milling machines and lathe-milling machines. See Mechanisms Library.

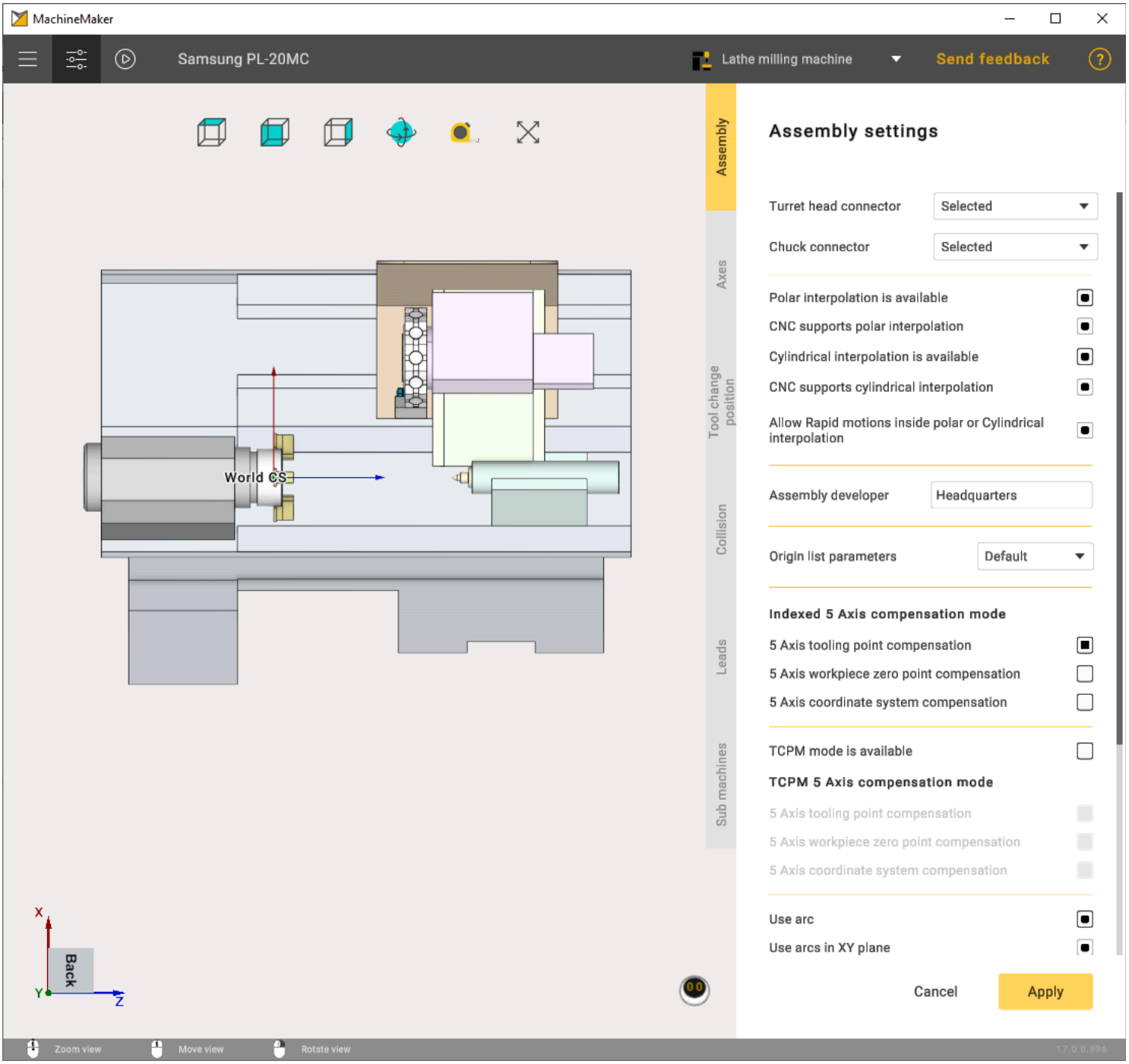
Assembly settings (6)

Use Assembly settings (6) button to open assembly settings panel.

Milling Machines

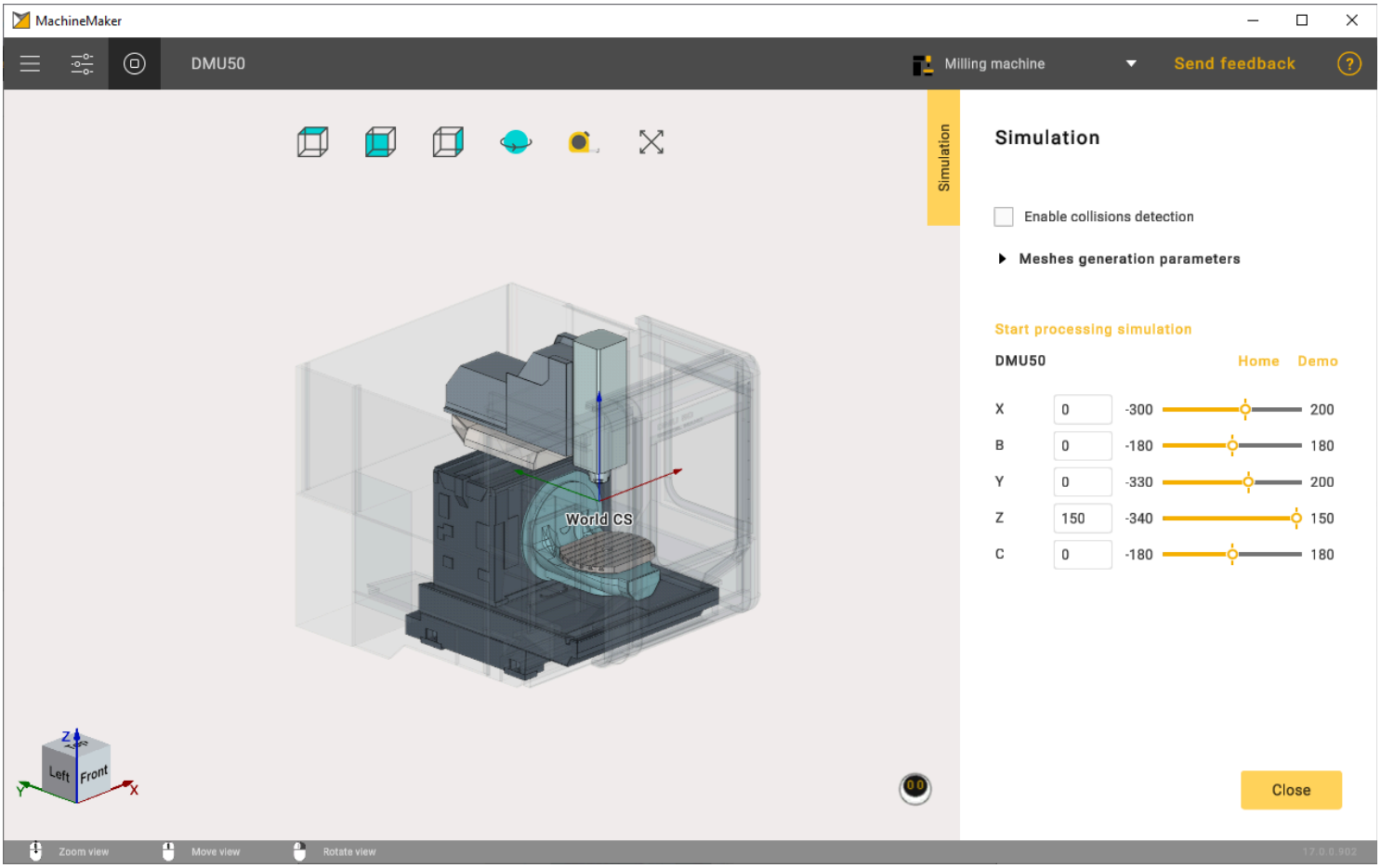



MachineMaker
Tutorial
Robot cell
Send feedback
Assembly settings
Assembly
Axes
Collision
Leads
Assembly settings
Snap base to rotary positioner
Snap base to linear axis
Fix WCS on axis
Default
Assembly developer
Headquarters
Origin list parameters
Default
Robot supports arcs
Circles division
Do not break
Minimal Arc Length
0.5
Maximal Arc Radius
10000
Spatial arcs
Minimal distance between start and end points
0.5
Reorientation mode
Relative to base CS
Default flips
Cancel
Apply
Back
Left
Z
Y
Zoom view
Move view
Rotate view

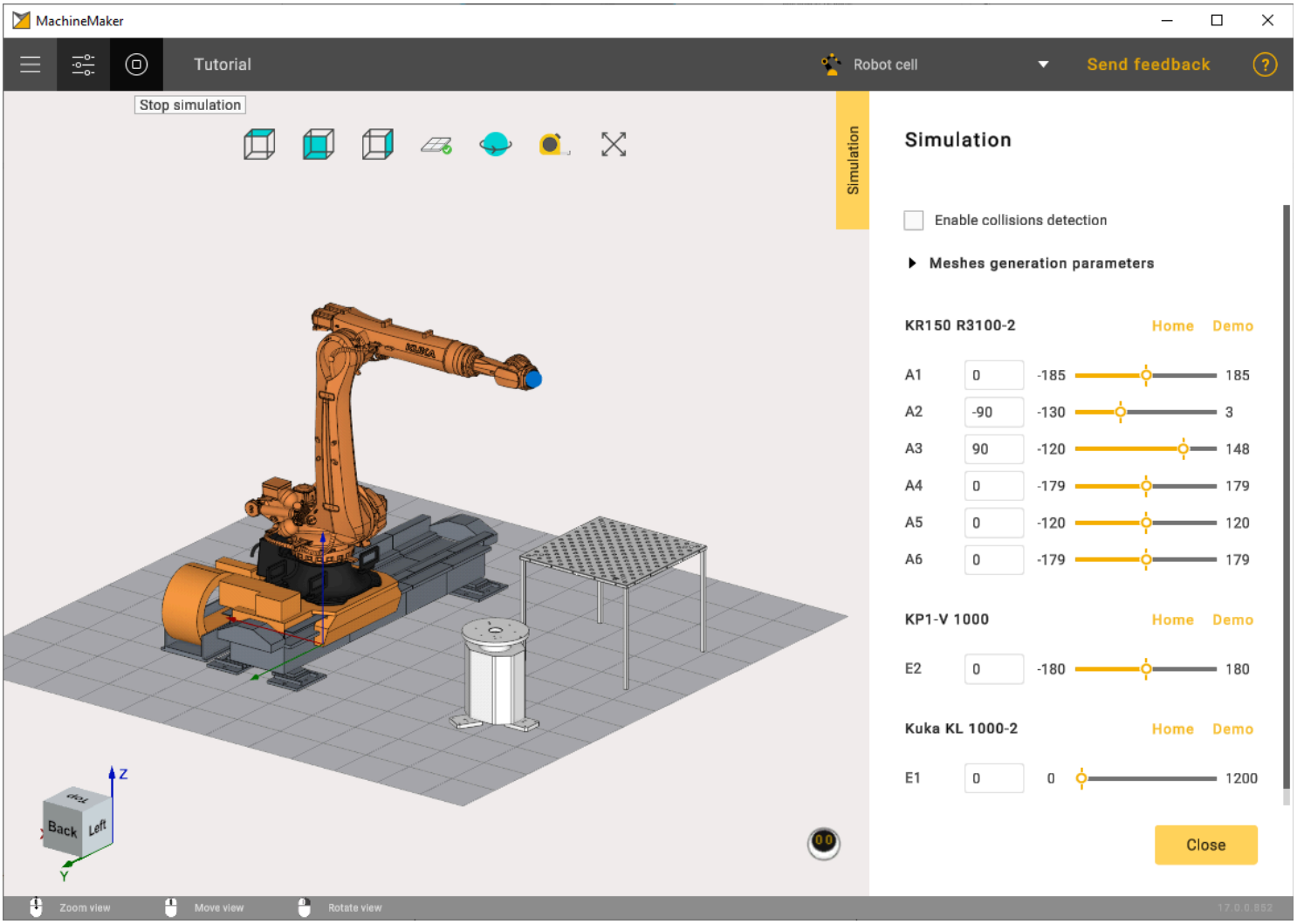


Simulation (7)

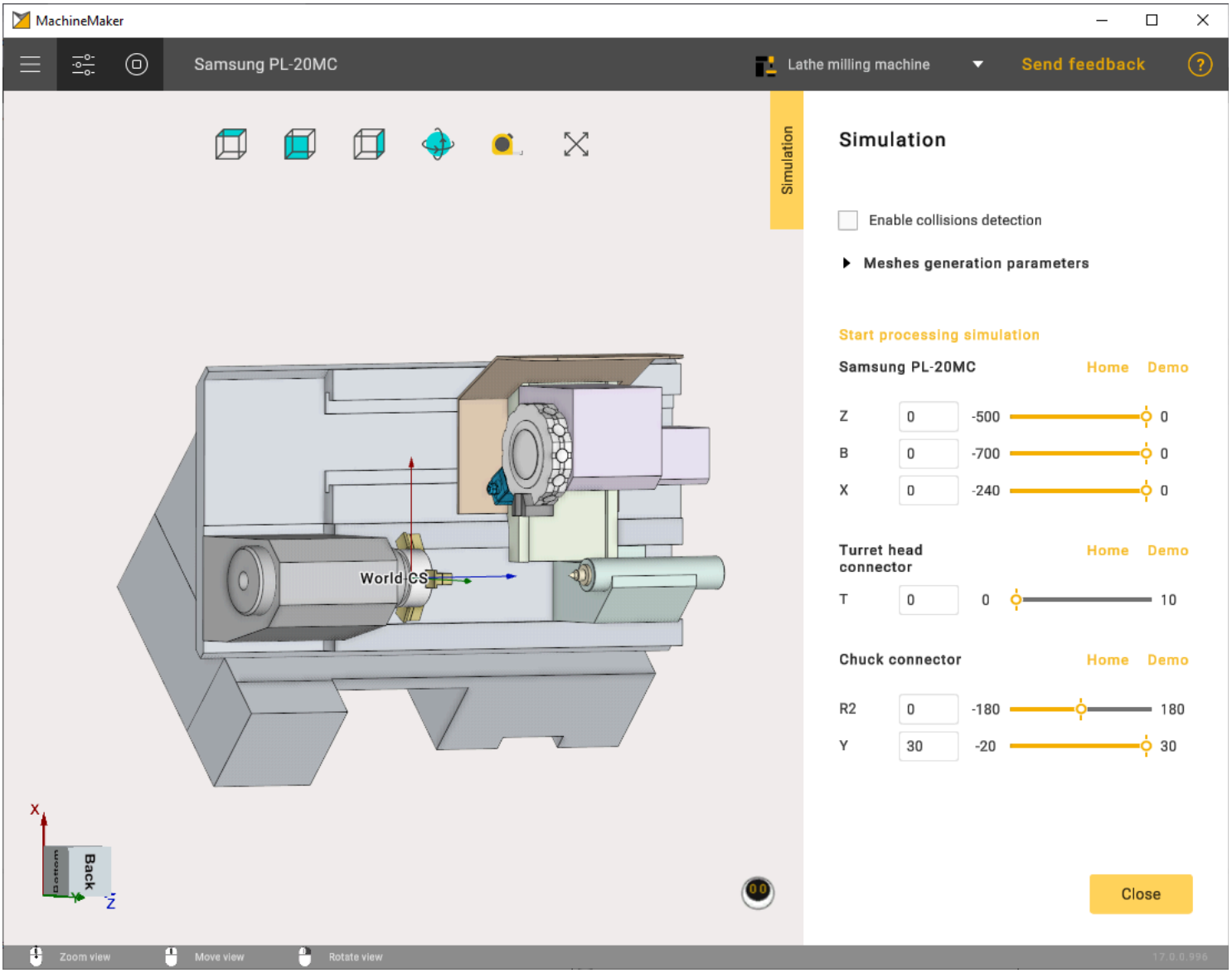
Use Simulation (7) button to validate all mechanisms kinematics.


MachineMaker
DMU50
Milling machine
Send feedback
Simulation
Simulation
Enable collisions detection
Meshes generation parameters
Start processing simulation
DMU50
Home
Demo
X 0 -300 200
B 0 -180 180
Y 0 -330 200
Z 150 -340 150
C 0 -180 180
World CS
Left
Front
Close
Zoom view
Move view
Rotate view

Robots


MachineMaker
Tutorial
Robot cell
Send feedback
Stop simulation
Simulation
Simulation
Enable collisions detection
Meshes generation parameters
KR150 R3100-2
Home
Demo
A1 0 -185 185
A2 -90 -130 3
A3 90 -120 148
A4 0 -179 179
A5 0 -120 120
A6 0 -179 179
KP1-V 1000
Home
Demo
E2 0 -180 180
Kuka KL 1000-2
Home
Demo
E1 0 0 1200
Close
Z
Back
Left
Y
Zoom view
Move view
Rotate view

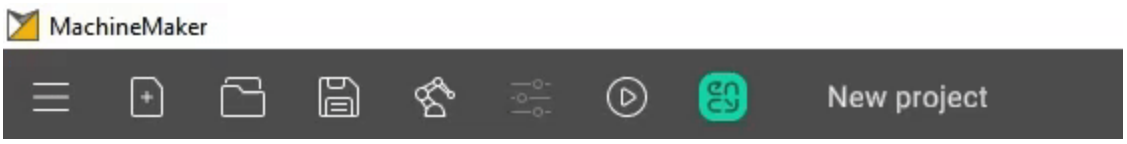
Turn-Milling Machines



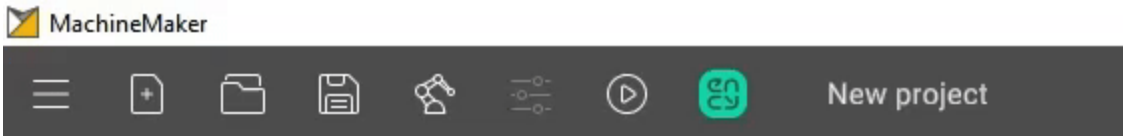
Project name (9)

Use double click on project name to change it. Entered project name will be used by CAM system. It is also possible to change project name in settings panel.

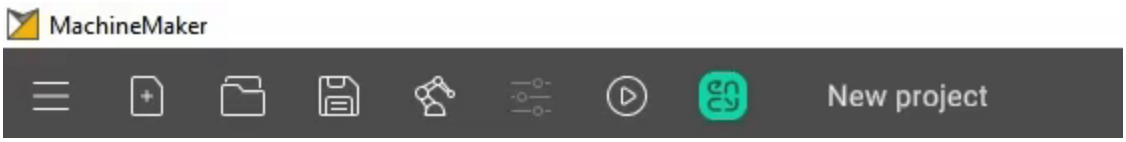
Milling Machines



Robots



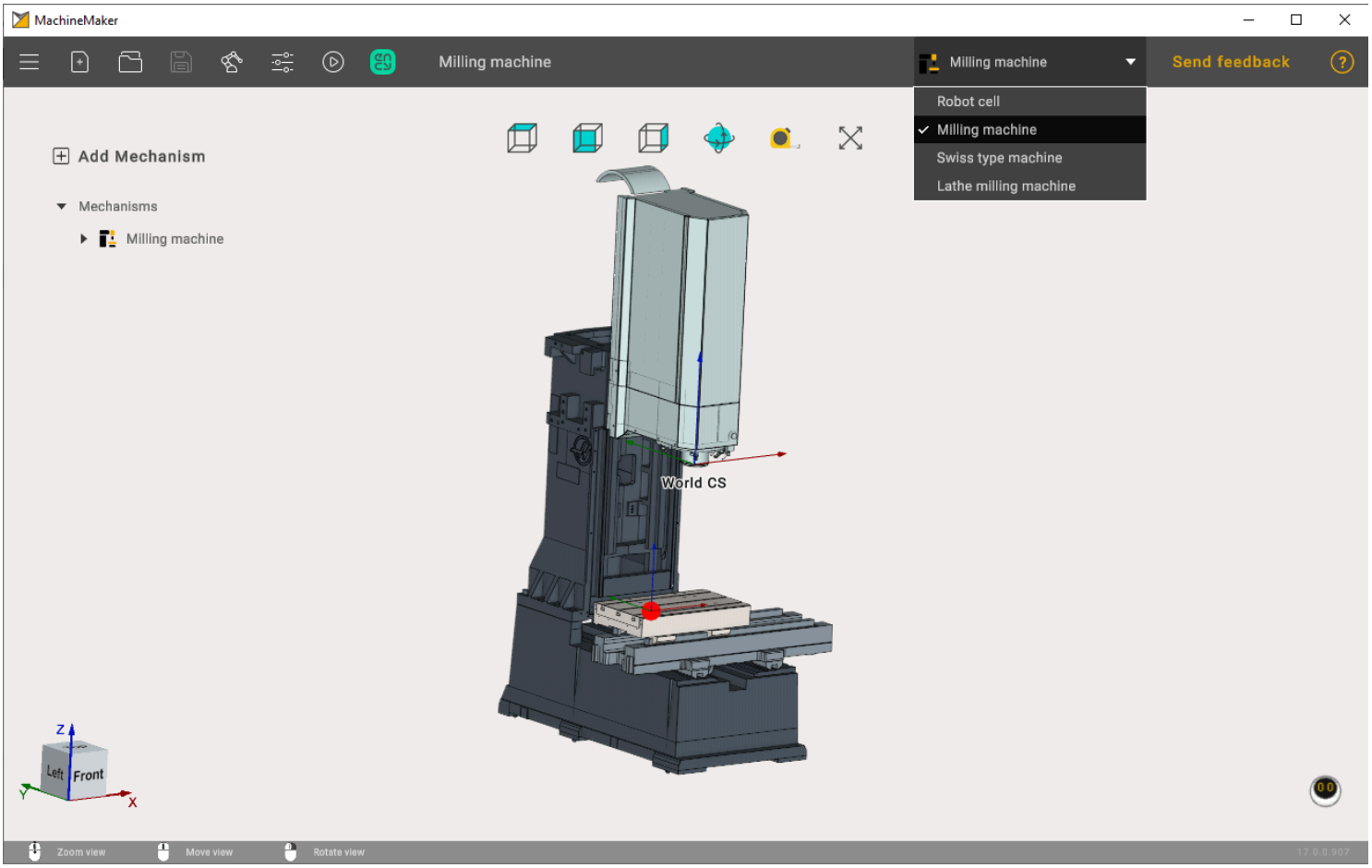
Turn-Milling Machines



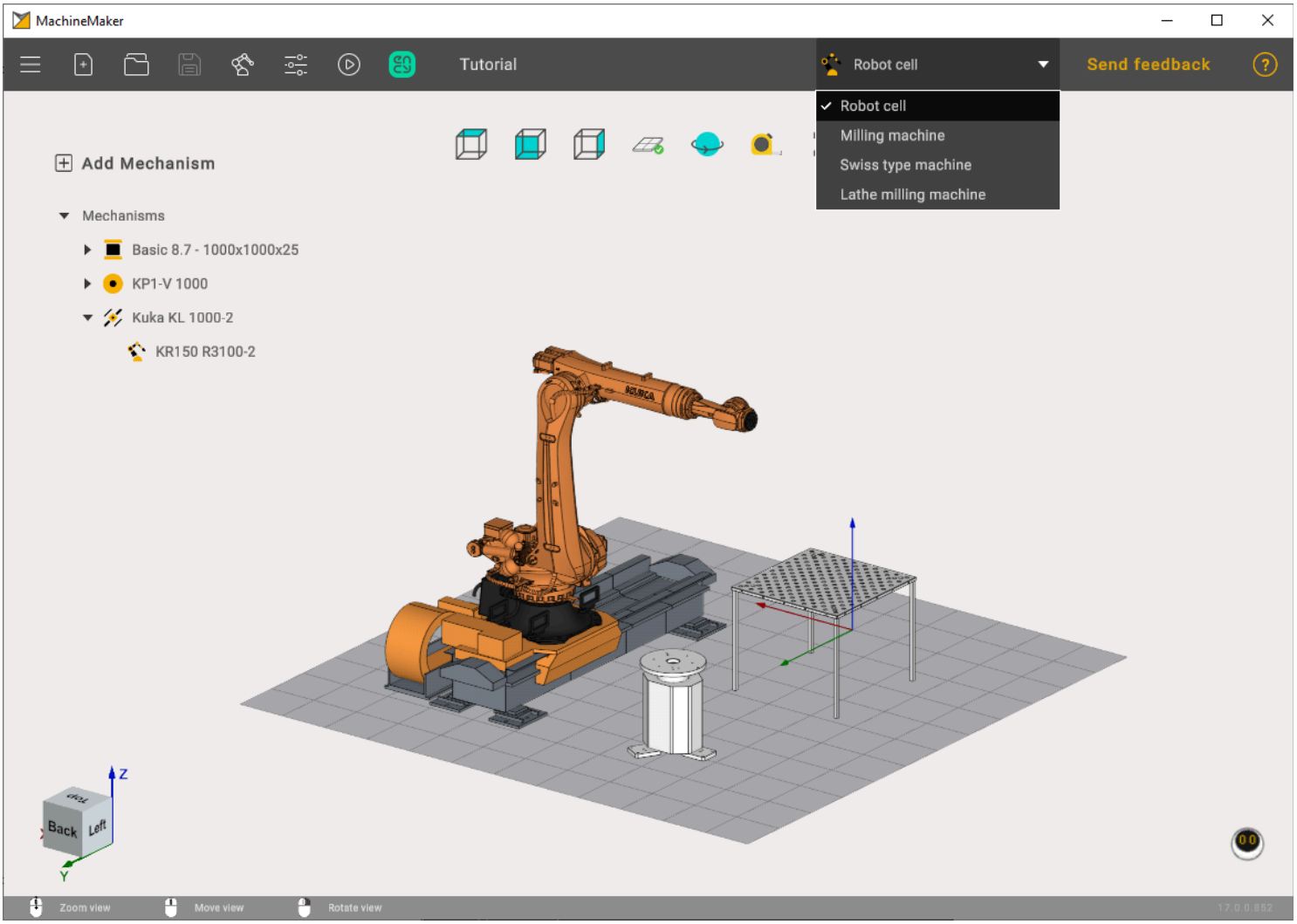
Context switcher (10)

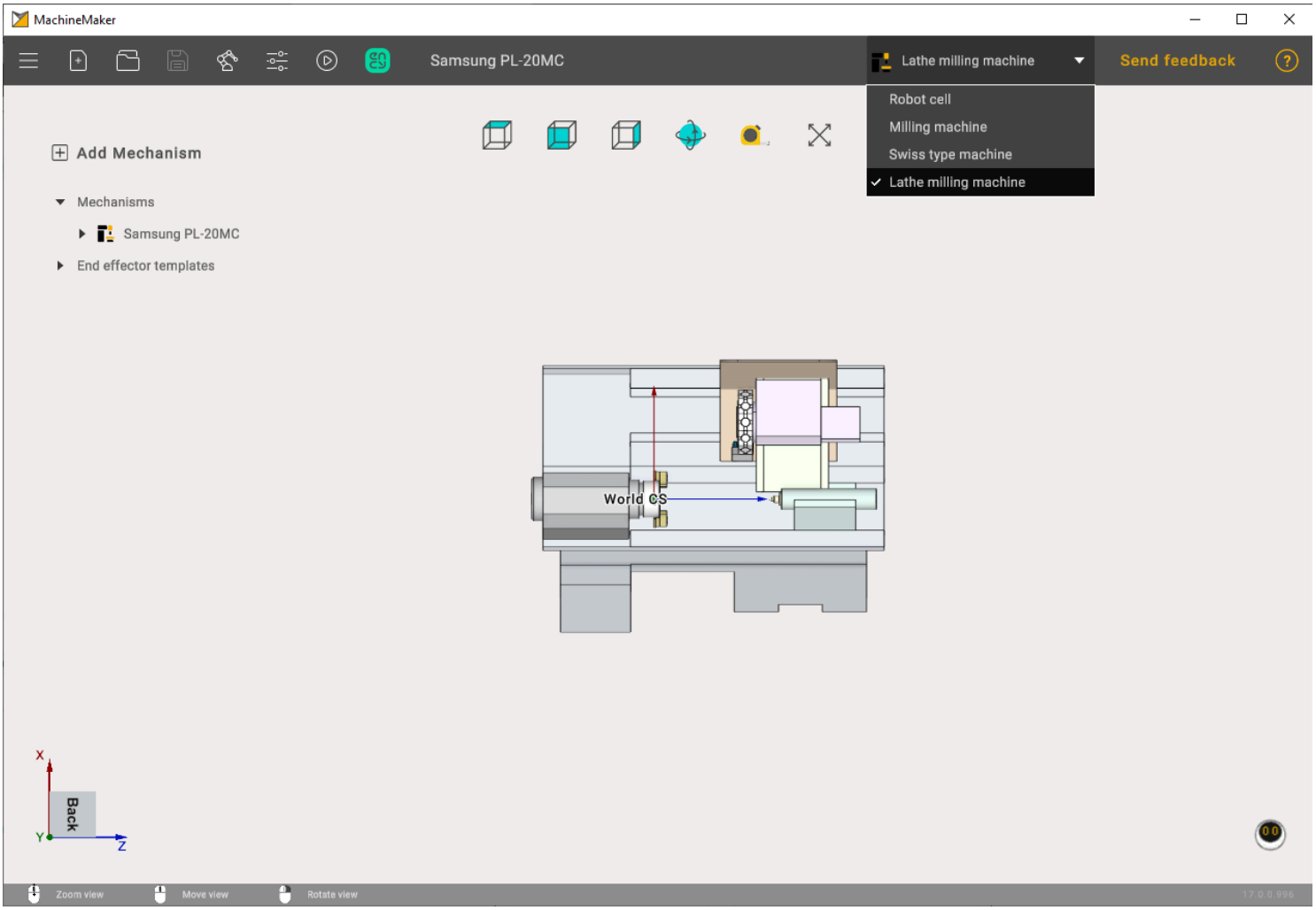
Select the context depending on your tasks.

Milling Machines



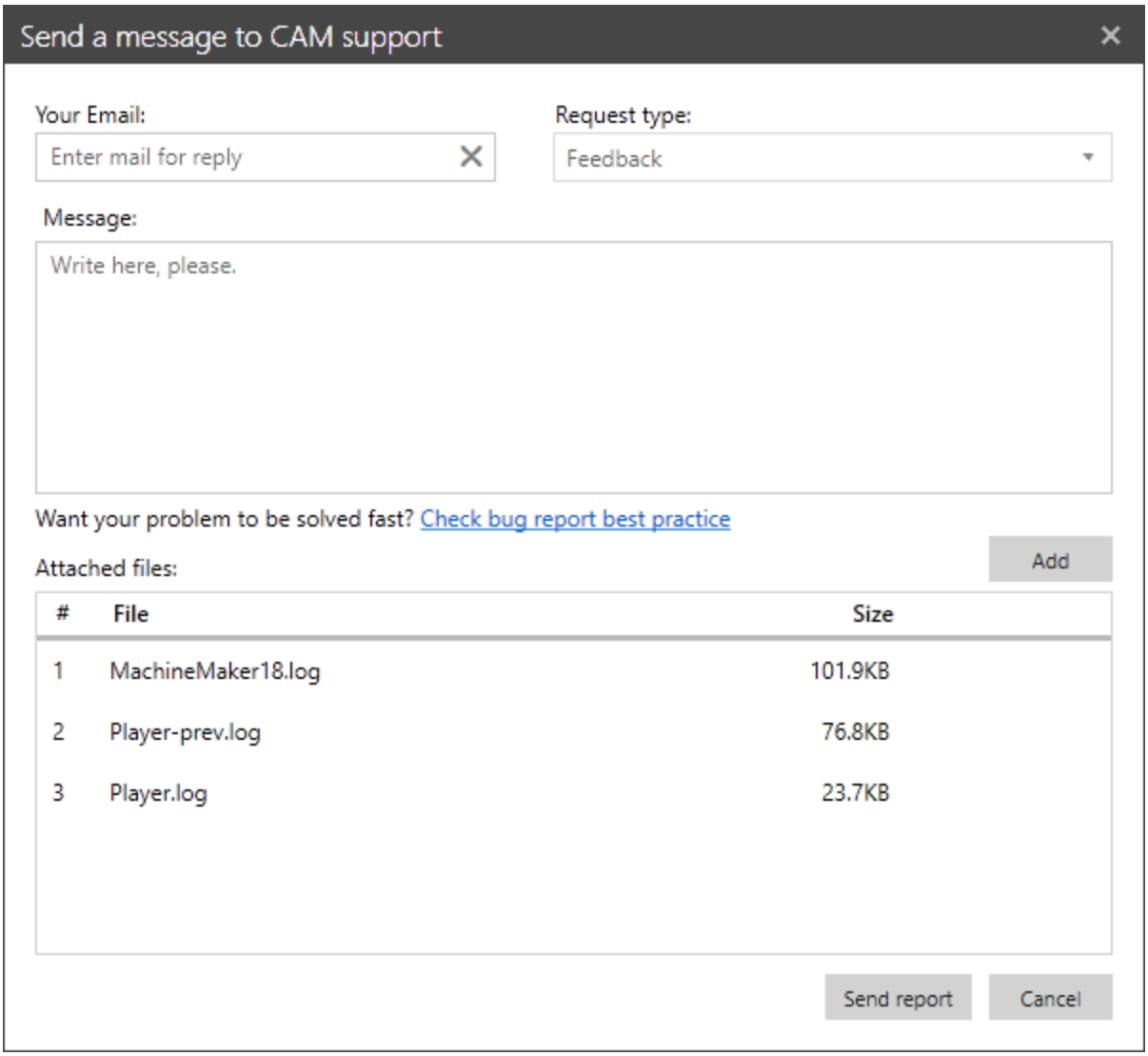
Robots


MachineMaker
Tutorial
Robot cell
Send feedback
Robot cell
Milling machine
Swiss type machine
Lathe milling machine
Add Mechanism
Mechanisms
Basic 8.7 - 1000x1000x25
KP1-V 1000
Kuka KL 1000-2
KR150 R3100-2
Back
Left
Z
Y
Zoom view
Move view
Rotate view



Feedback and help

Use Feedback (11) button to provide your feedback or ask for assistance.

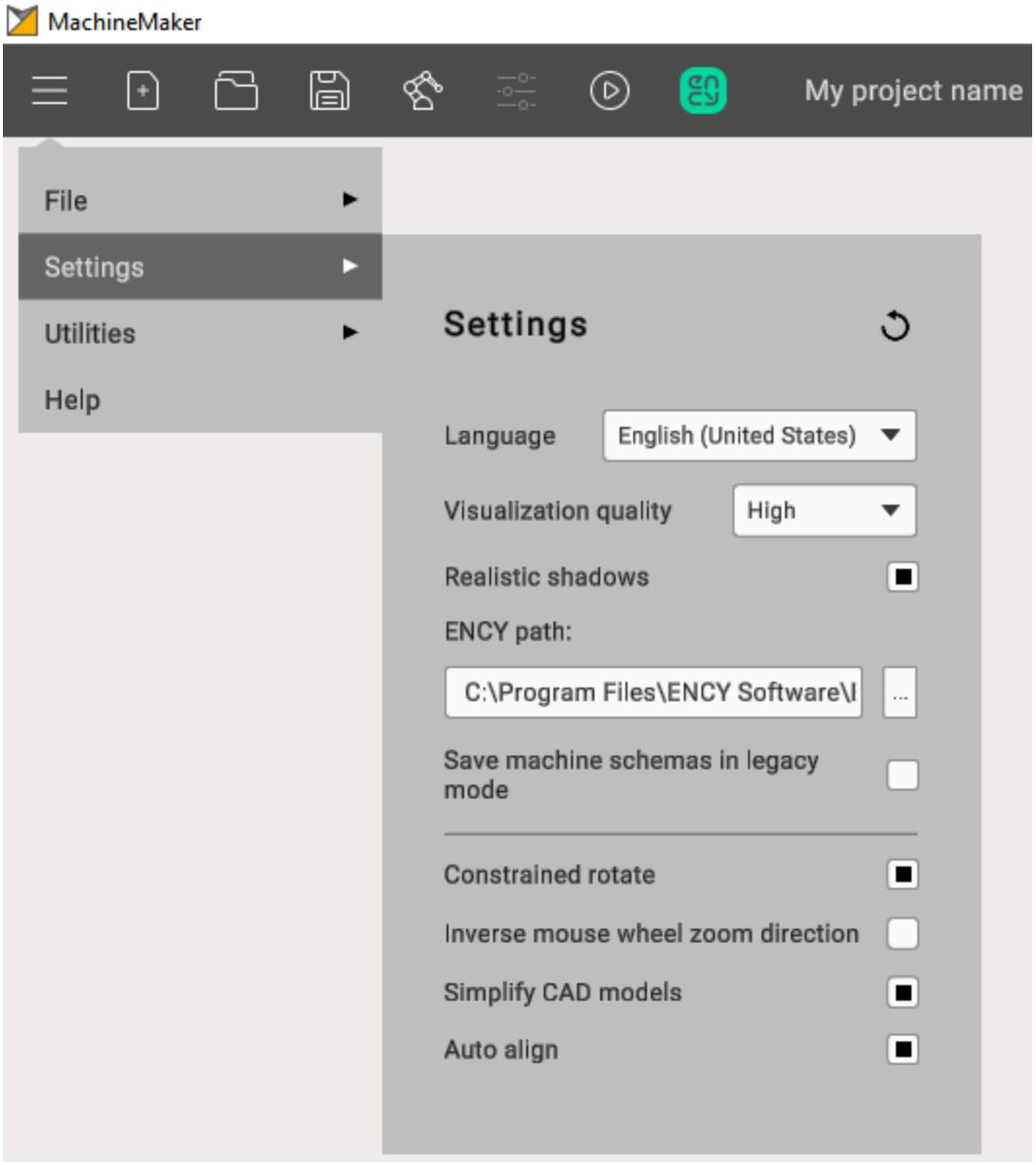


MachineMaker will automatically attach log files and current project to your request, It is possible to remove any attachment and attach any new file to your request.

Use Help (12) button to open this help and tutorial.

Application Settings

Settings panel can be opened from Main menu.



General

- Language. MachineMaker uses CAM system language by default but it is possible to change it here.
- Visualization quality. Reduce quality if you have any problems with video memory or MachineMaker does not work smoothly enough. We recommend keeping High quality.
- ENCY path. MachineMaker detects installed CAM system automatically. But it is also possible to specify ENCY path here.
- Constrained rotate mode allows fixing Z axis during rotation. It is also possible to change this parameter from "Toolbar".
- Inverse mouse wheel zoom direction. Change this parameter to inverse zoom behavior on mouse scroll.
- Simplify CAD models allows you to reduce 3D model size. See "Prepare 3D models" page for details.

- Auto Align. MachineMaker will automatically go through the imported 3D models and try to find optimal position for each new mechanism in assembly.

Getting Started

In this chapter, you will learn how to create a project, add a new mechanism, prepare and import 3D objects, group elements into nodes, change the color of a mechanism, model and validate mechanisms, assemble mechanisms and configure machine equipment.

Constructing kinematic schemes for different mechanisms, configuring assembly parameters and exporting assemblies to CAM system are described in the sections Milling Machines, Robots and Turn-Milling Machines.

Video tutorials for robot cells

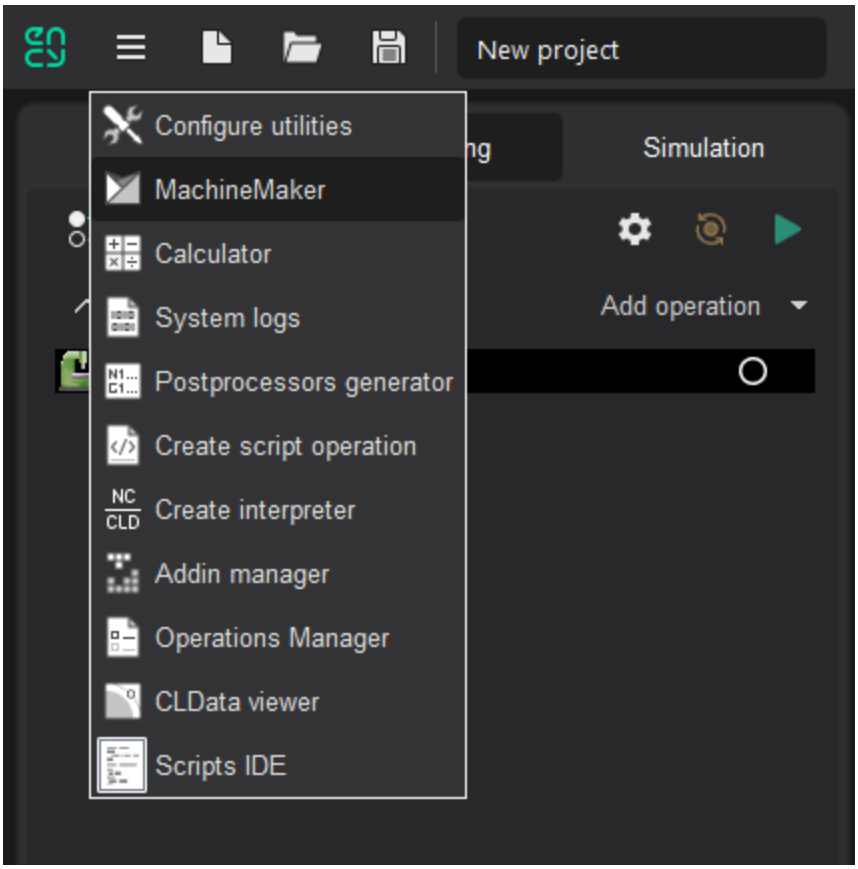
You can also check out additional instructional videos at the links:

1. MachineMaker for Robots
2. Construction of a More Complex Robot Cell
3. Construction of a Simple Robot Cell, using Mechanisms Library
4. Saving and Transferring MachineMaker Robot Cell to CAM system

Creating a project

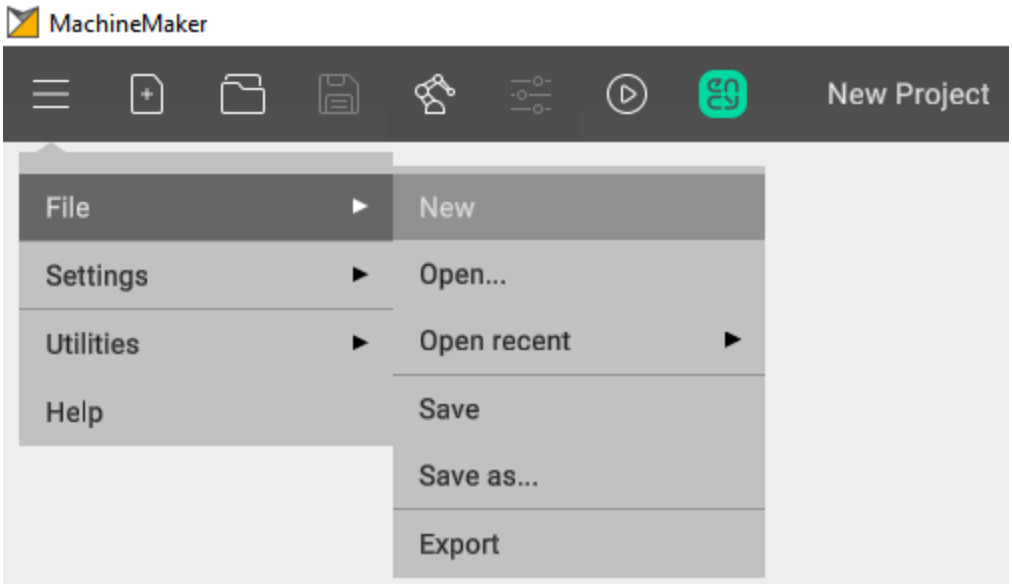
Starting MachineMaker

MachineMaker can be started directly from the CAM system utilities menu



Creating a project

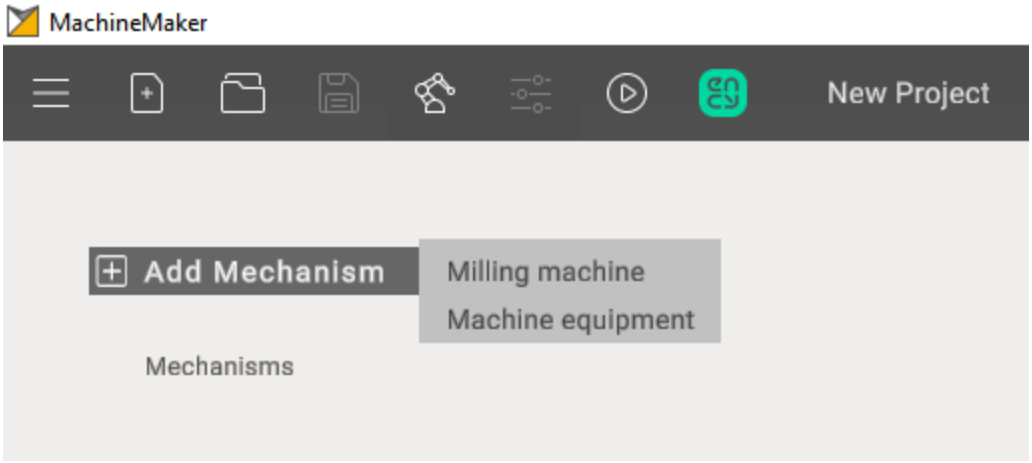
MachineMaker automatically creates a new project at startup. It is possible to create a new project any time using Menu - File - New



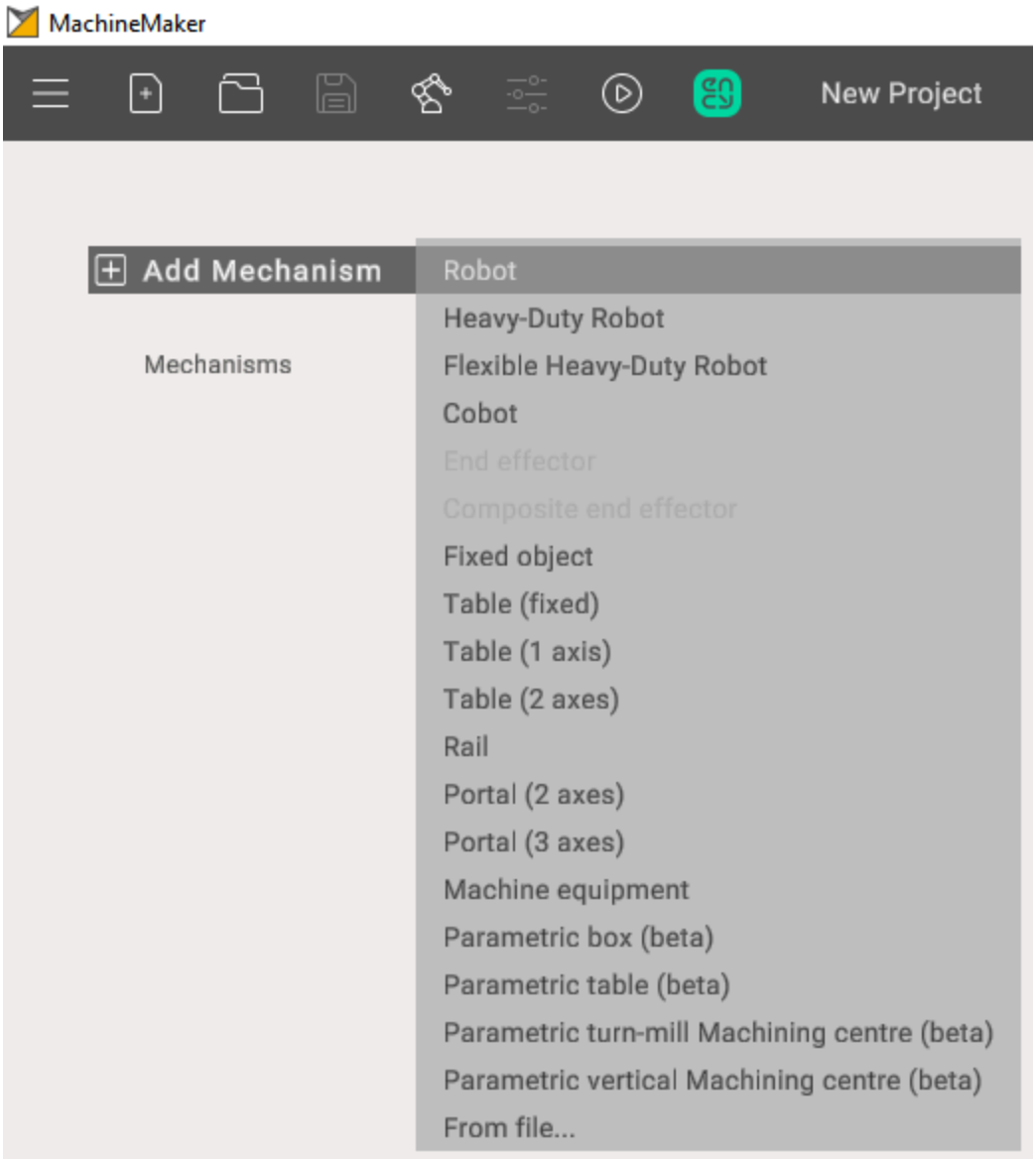
Adding a mechanism

First of all it is necessary to add the desired mechanism to your project using Add Mechanism button

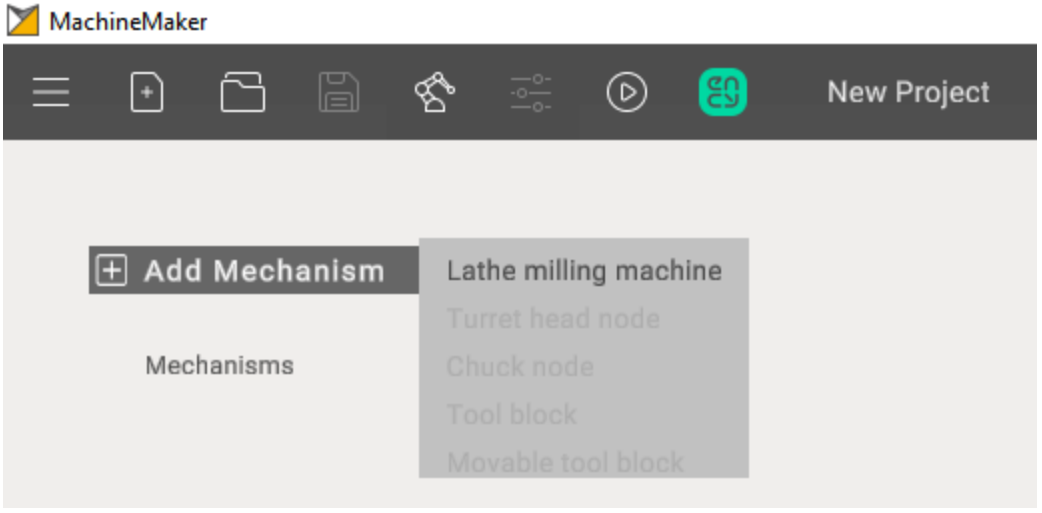
Milling Machines



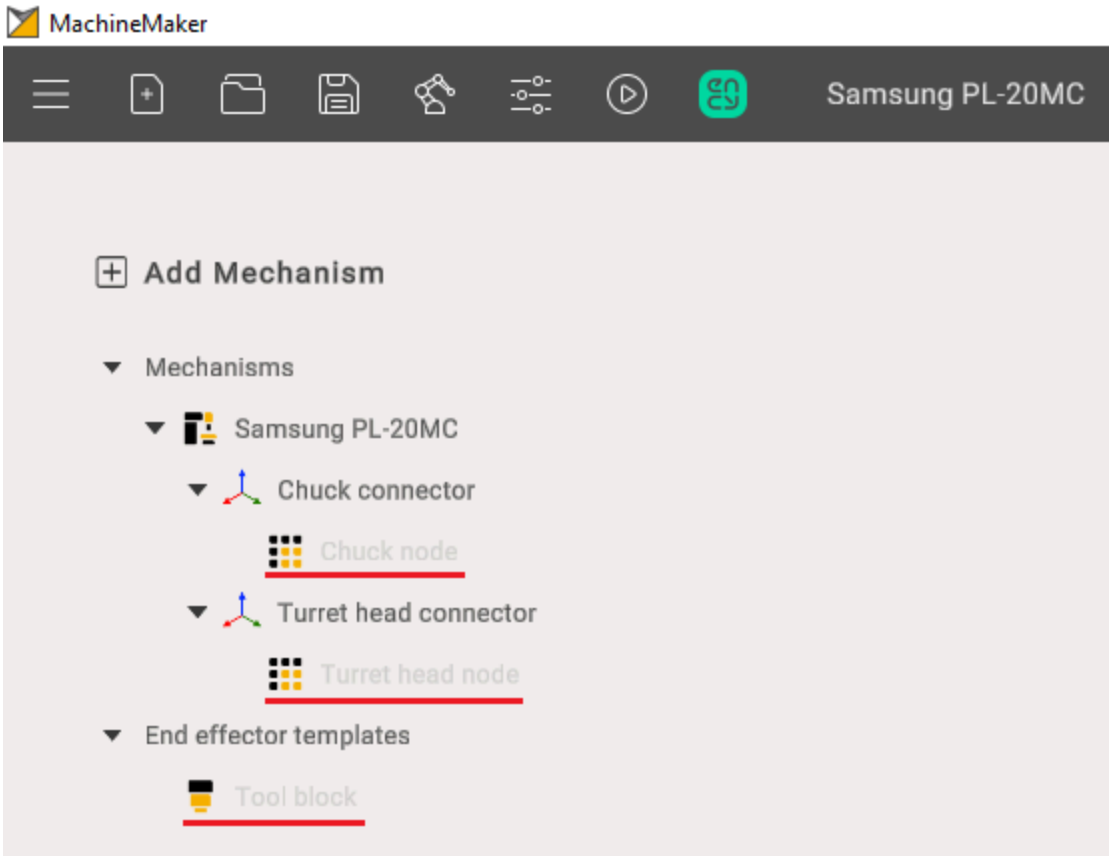
Robots



Turn-Milling Machines



When adding additional mechanisms, you can double-click on the desired option in the mechanism tree to open a selection of files or use "Add mechanism"



Supported mechanism types

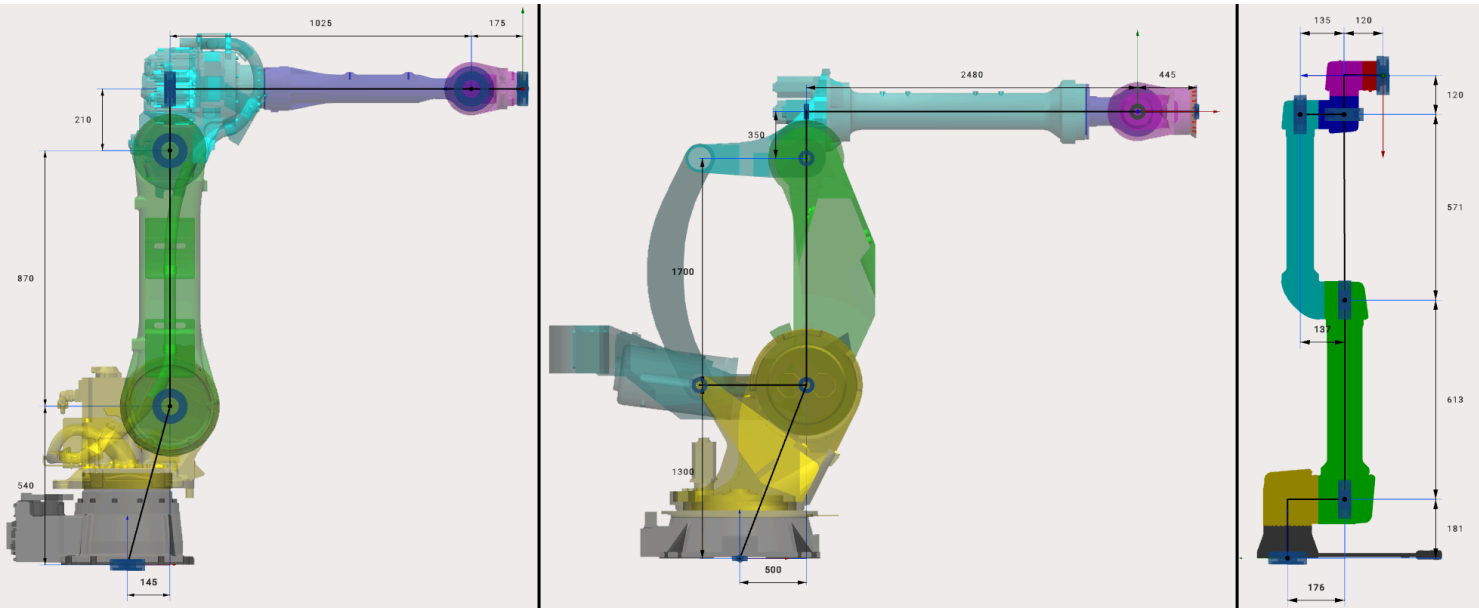
The list of mechanism types depends on the application context. For a milling machine, add its 3D model; the machine template is selected when grouping elements into nodes.

Robot cells

- Robot - common industrial 6-axes robotic arm.
- Heavy-Duty Robot - high payload robot with additional joints.
- Cobot - collaborative 6-axes robotic arm.
- End effector - device at the extremity of the robotic arm, designed to interact with the environment. Spindles, Laser Heads, Wire Cutters and etc. Robot can contain any number of end effectors. End effector can be added only after the robot is selected.
- Composite End effector - complex devices, contain movable parts. For example gripper with fingers.
- Fixed object - any fixed object (controller, enclosure, etc).
- Table (fixed) - static table
- Table (1 axis) - rotary table (positioner) with 1 axis
- Table (2 axes) - rotary table (positioner) with 2 axes
- Rail - rail or any another linear axis. Usually allows you to move the robot along the X axis.
- Portal (2 axes) - mechanism with 2 linear axes. Usually allows you to move the robot along X-Y axes.

- Portal (3 axes) - portal, mechanism with 3 linear axes. Usually allows you to move the robot along X-Y-Z axes.
- Machine equipment - Universal equipment with the possibility of configuration.
- Parametric box - Cube, with the possibility of changing its length, width, height.
- Parametric table - Table, with the possibility of changing its length, width, height, thickness and height of legs.
- Parametric turn-mill Machining centre - Parametric machine (Turn).
- Parametric vertical Machining centre - Parametric machine (Mill).
- From file - allows you to add a mechanism exported to .mmm file. Check Mechanisms Library for more information about .mmm files

Robots, Heavy-Duty Robots and Cobots have different kinematic schemes:



Turn-milling machines

- Turret Head Node - a component enabling tool rotation and positioning during operation, often facilitating tool fixation, tool change, and positional data processing.
- Chuck Node - a component for securing workpieces or tools during machining, typically incorporating clamping mechanisms such as collet chucks or hydraulic clamps, with control and adjustment features.
- Tool Block - a component for mounting and supporting cutting tools during material processing, designed for various tool types like drills, mills, and inserts, usually equipped with quick-change and adjustment mechanisms.
- Movable Tool Block - a device capable of spatial movement to precisely position tools or workpieces during machining operations, often movable along different axes and controlled by mechanical, hydraulic, or electrical systems.

Prepare and import 3D objects

Supported 3D model formats

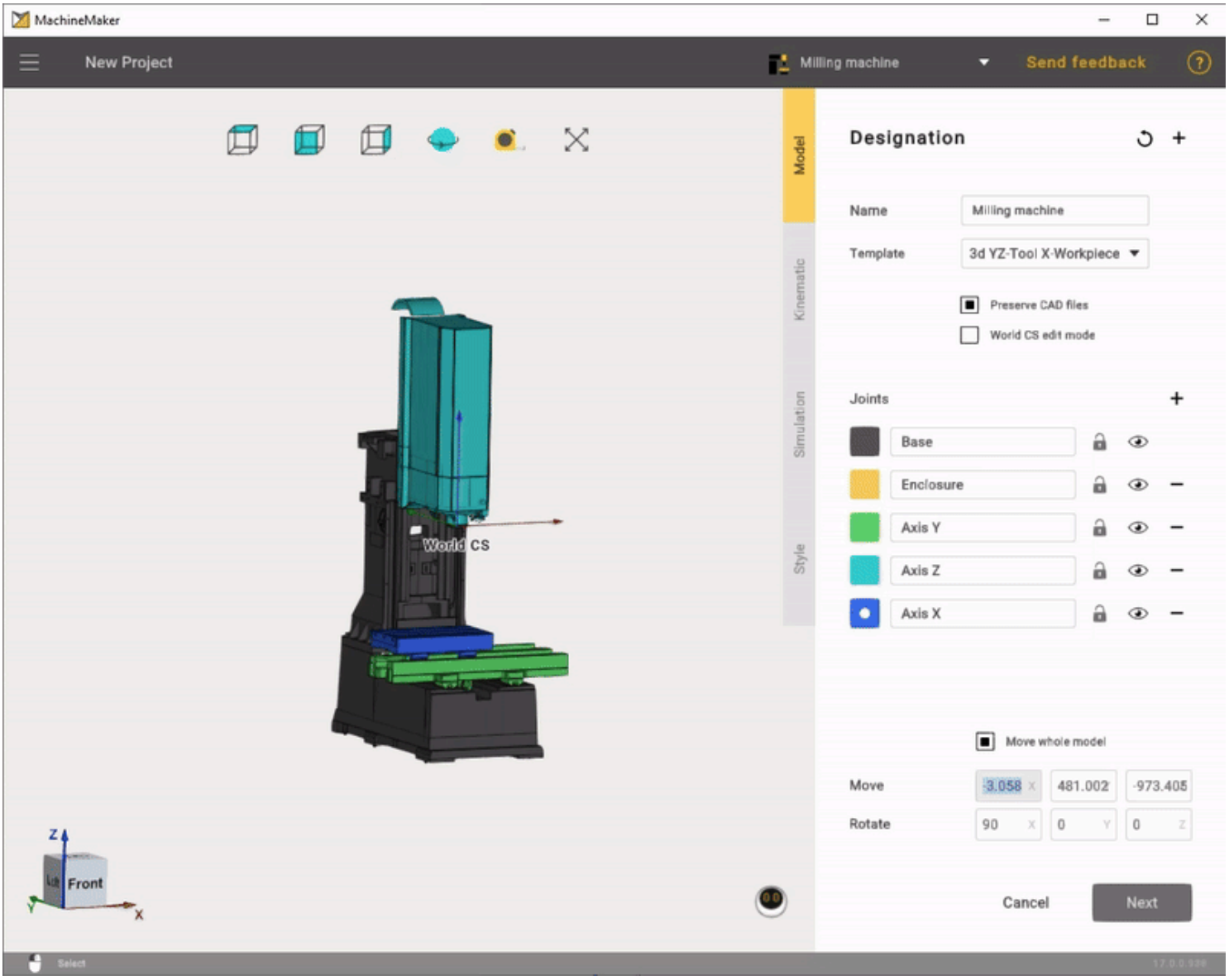
- 3dm: Rhinoceros 3D
- sldprt, sldasm: SolidWorks
- par, psm, pwr, asm: Solid Edge
- stp, step
- x_t, x_b : Parasolid
- igs, iges
- jt
- OSD
- STL

It is also possible to select several files at once. This may be useful if you had split your mechanism and saved each node in a separate file.

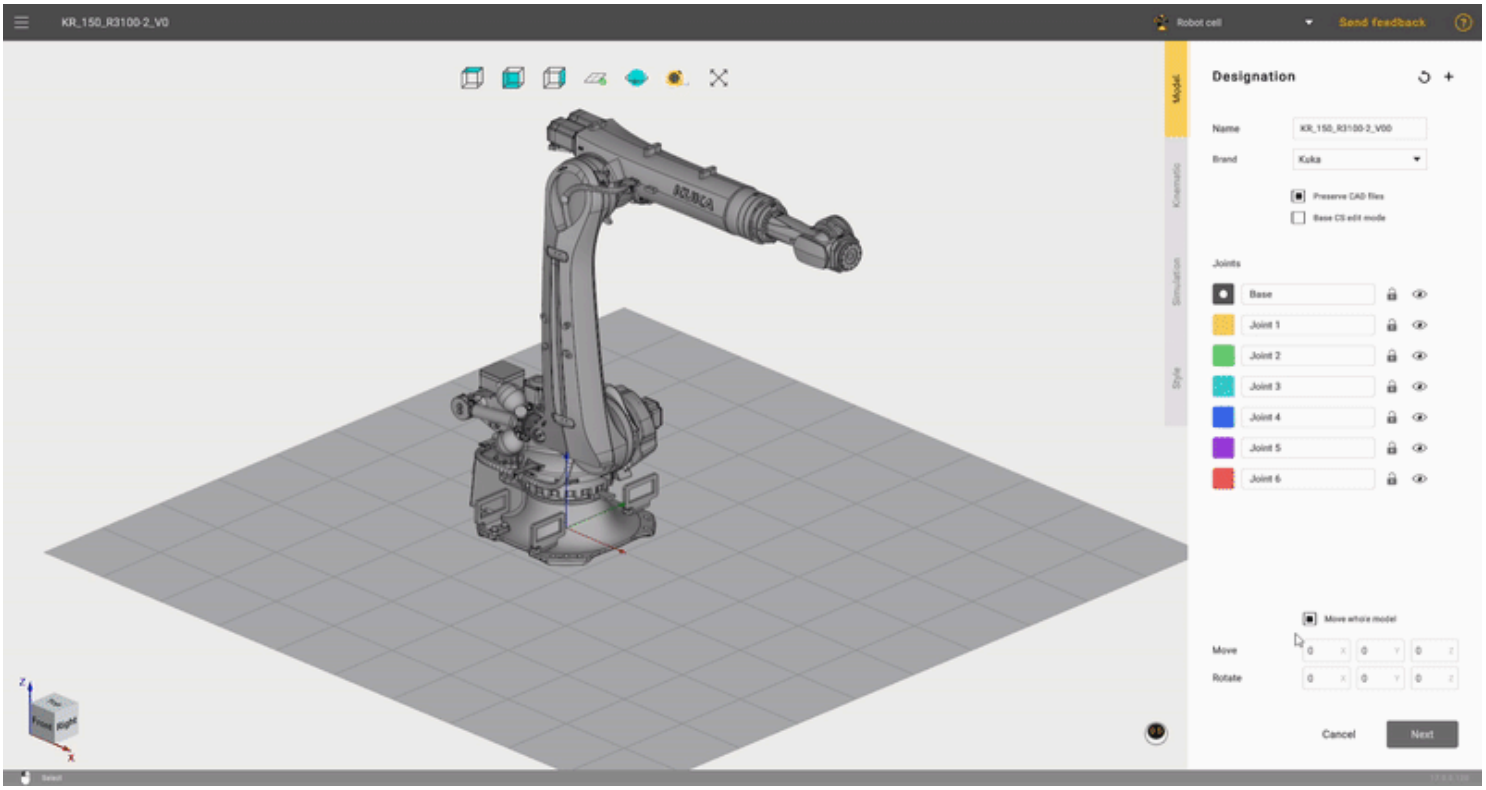
Preparing models

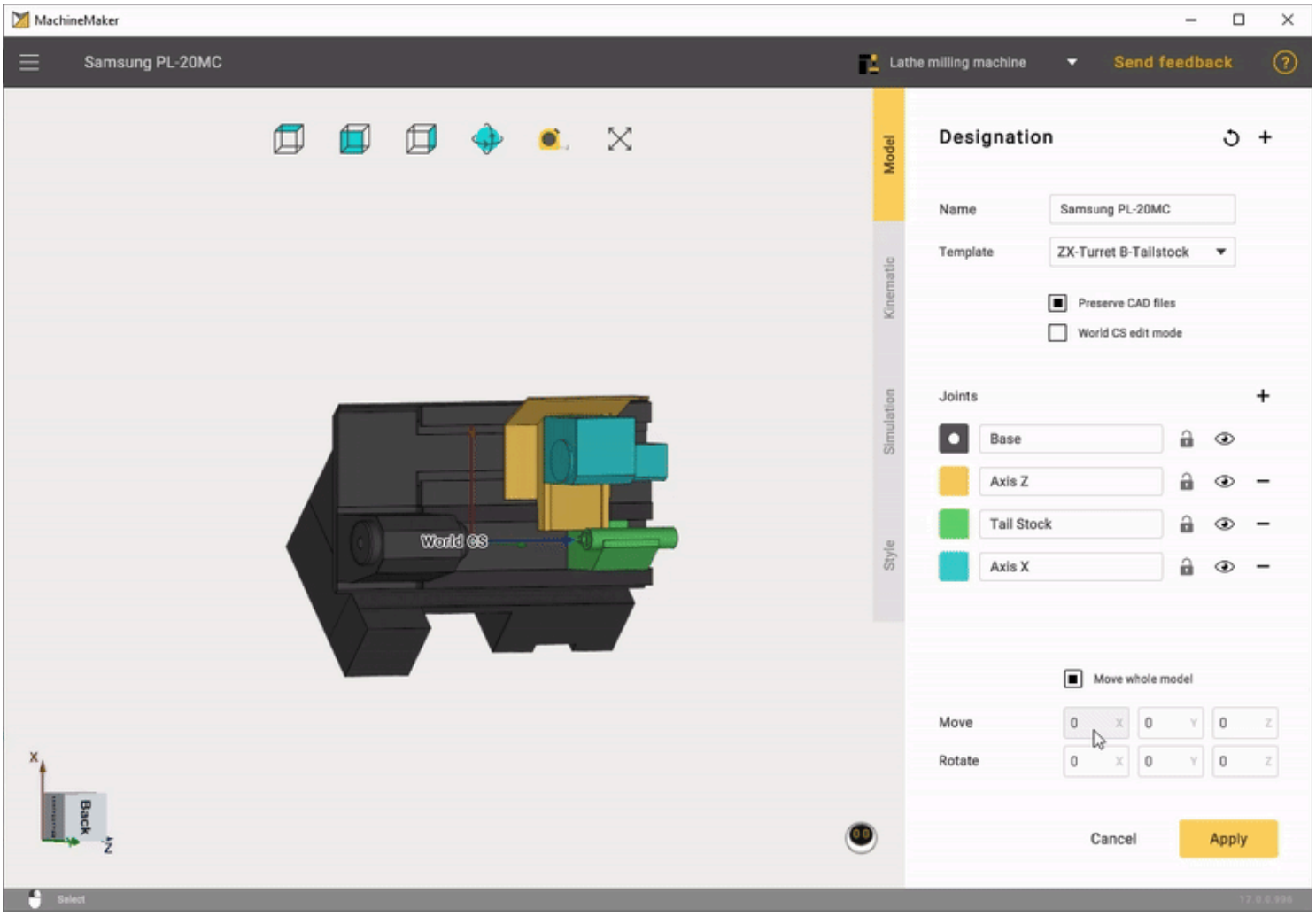
Many robot manufacturers (such as KUKA, Abb, Fanuc etc.) provide 3D models of their robots which can be used in MachineMaker without any adaptation.

MachineMaker allows you to make some basic operations with imported 3D models like moving and rotating. Use transformation panel in the lower right corner to transform your 3D models.


MachineMaker
New Project
Milling machine
Send feedback
Model
Kinematic
Simulation
Style
Designation
Name
Milling machine
Template
3d YZ-Tool X-Workpiece
Preserve CAD files
World CS edit mode
Joints
Base
Enclosure
Axis Y
Axis Z
Axis X
World CS
Move whole model
Move
3.058
481.002
-973.405
Rotate
90
0
0
Front
Cancel
Next
Select

Robots


KR_150_R3100-2_V0
Robot cell
Send feedback
Designation
Name
KR_150_R3100-2_V00
Brand
Kuka
Preserve CAD files
Base CS edit mode
Joints
Base
Joint 1
Joint 2
Joint 3
Joint 4
Joint 5
Joint 6
Move whole model
Move
Rotate
Cancel
Next

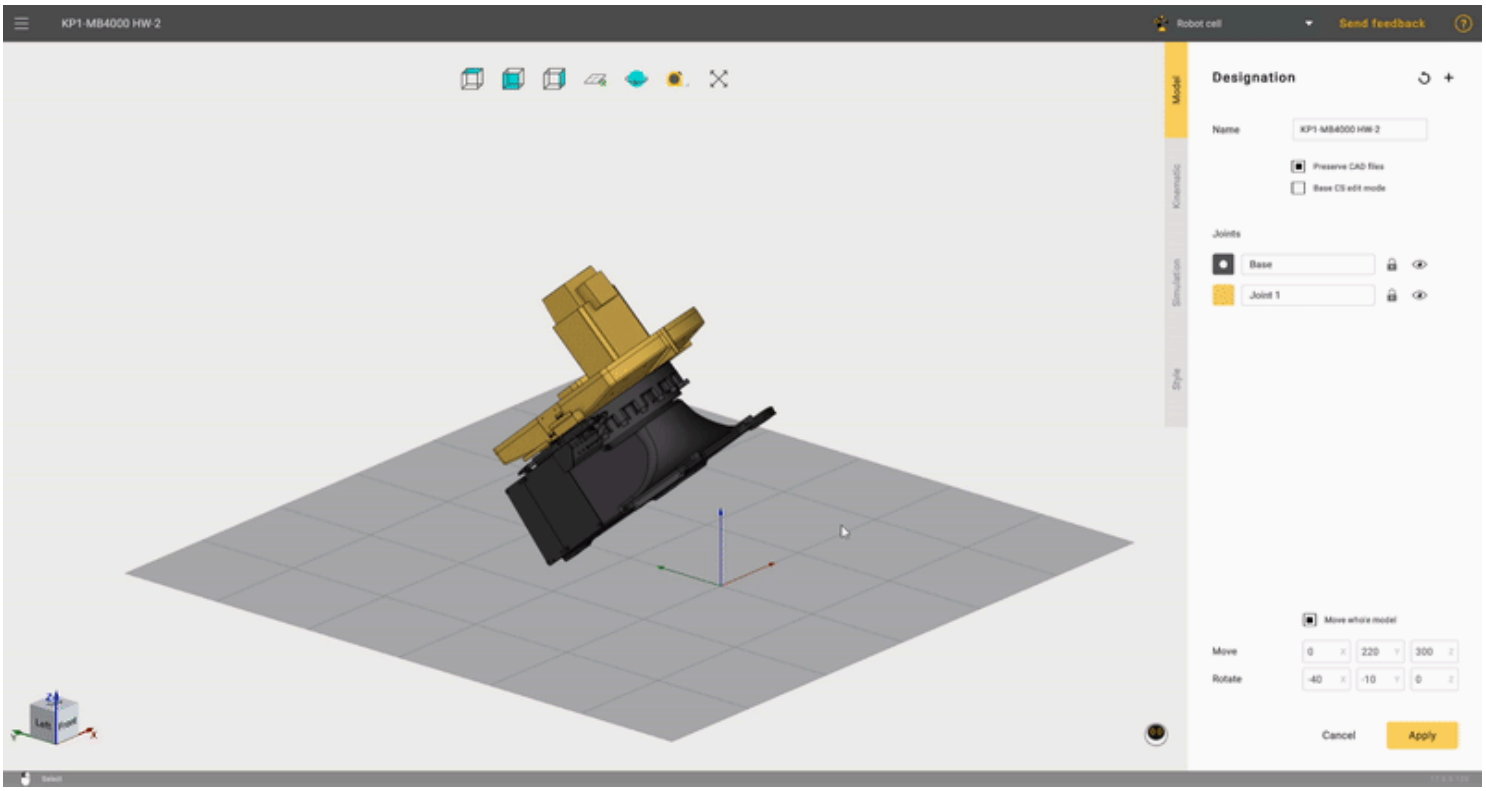


It is possible to move and rotate only the entire 3D model. Please use an external CAD system to make more complex operations with the 3D model.

We recommend saving mechanism 3D model at HOME (zero) positions.

Base CS transformation

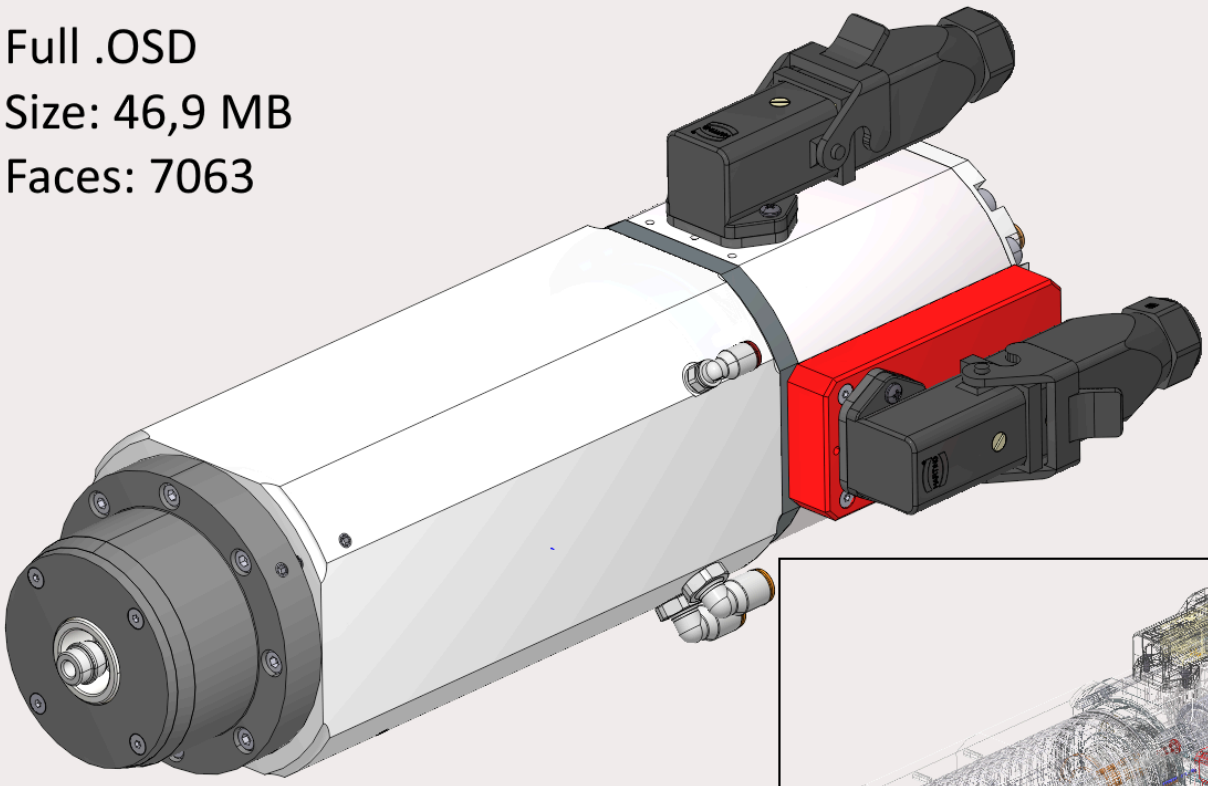
It is possible to specify the mechanism's Base Coordinate System using the mouse. Turn on Base CS editing mode then hold down the Left Ctrl key and drag you Base CS into the correct position.

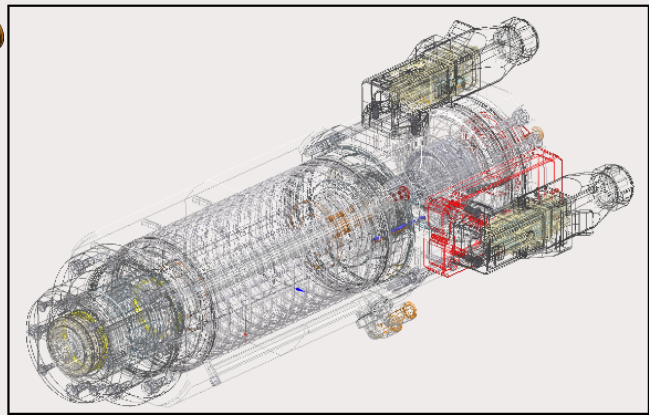


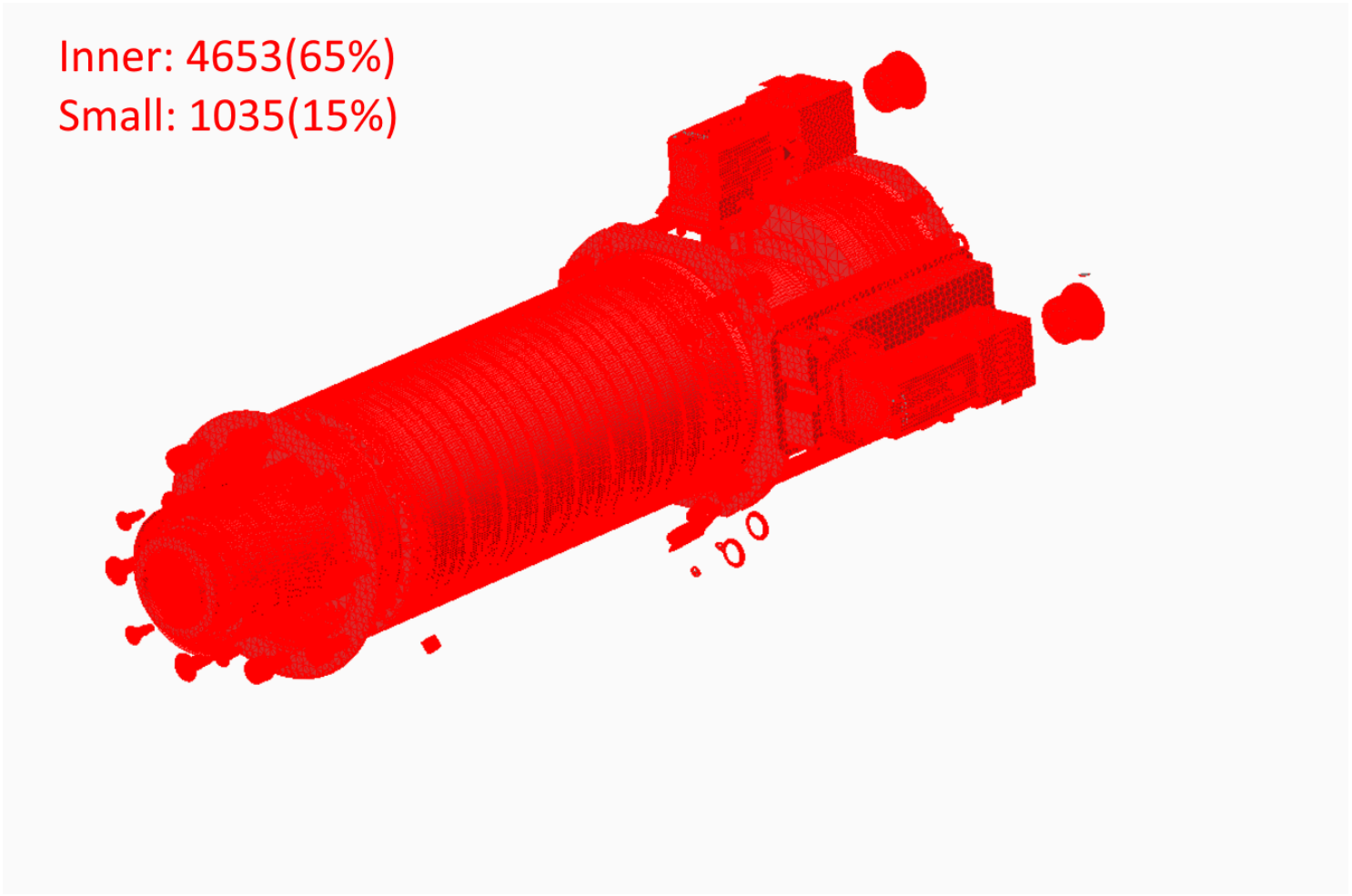
3D models simplifier

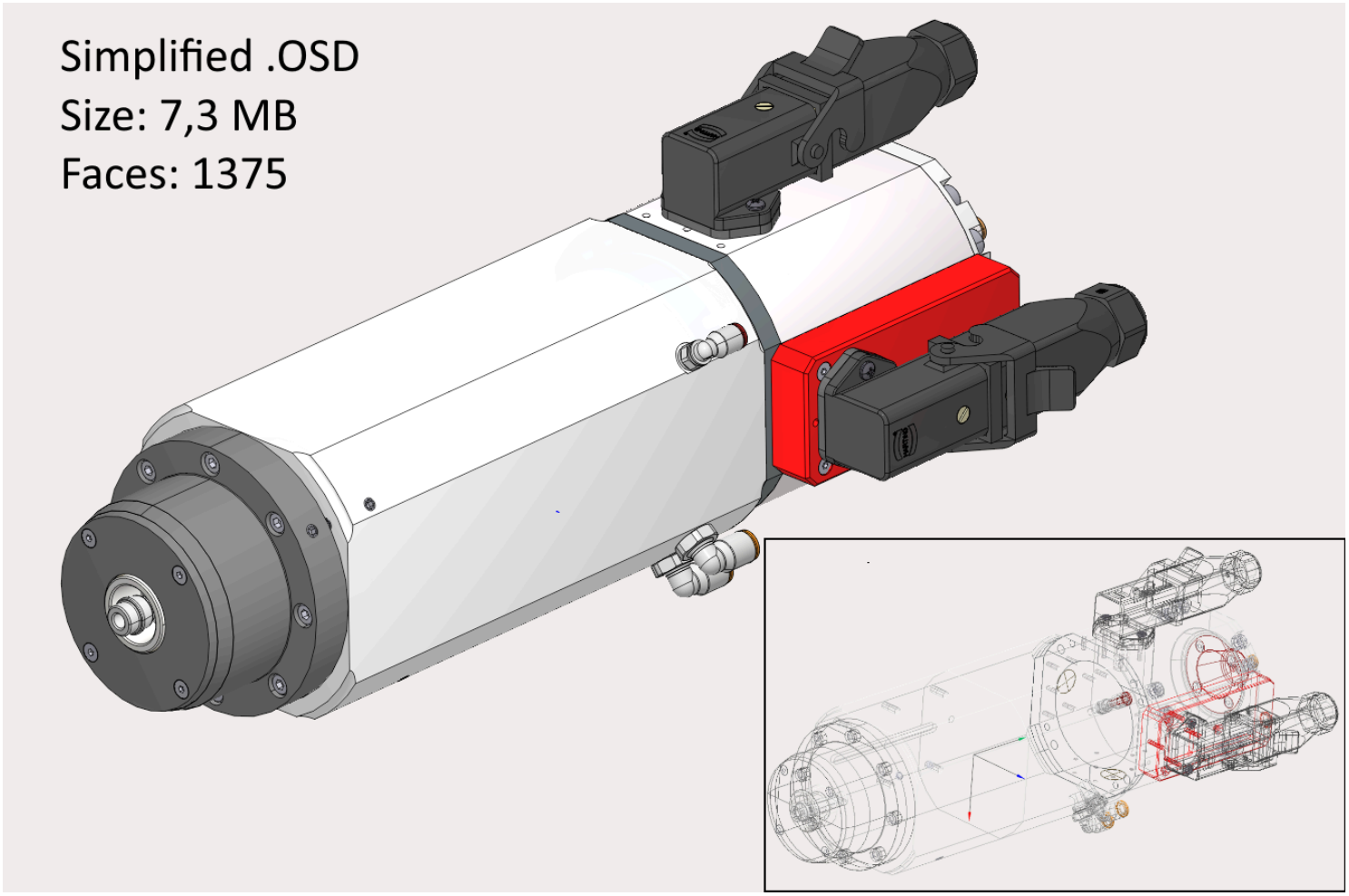
MachineMaker automatically simplifies imported files. All unnecessary inner faces and small objects will be deleted.

Full .OSD
Size: 46,9 MB
Faces: 7063

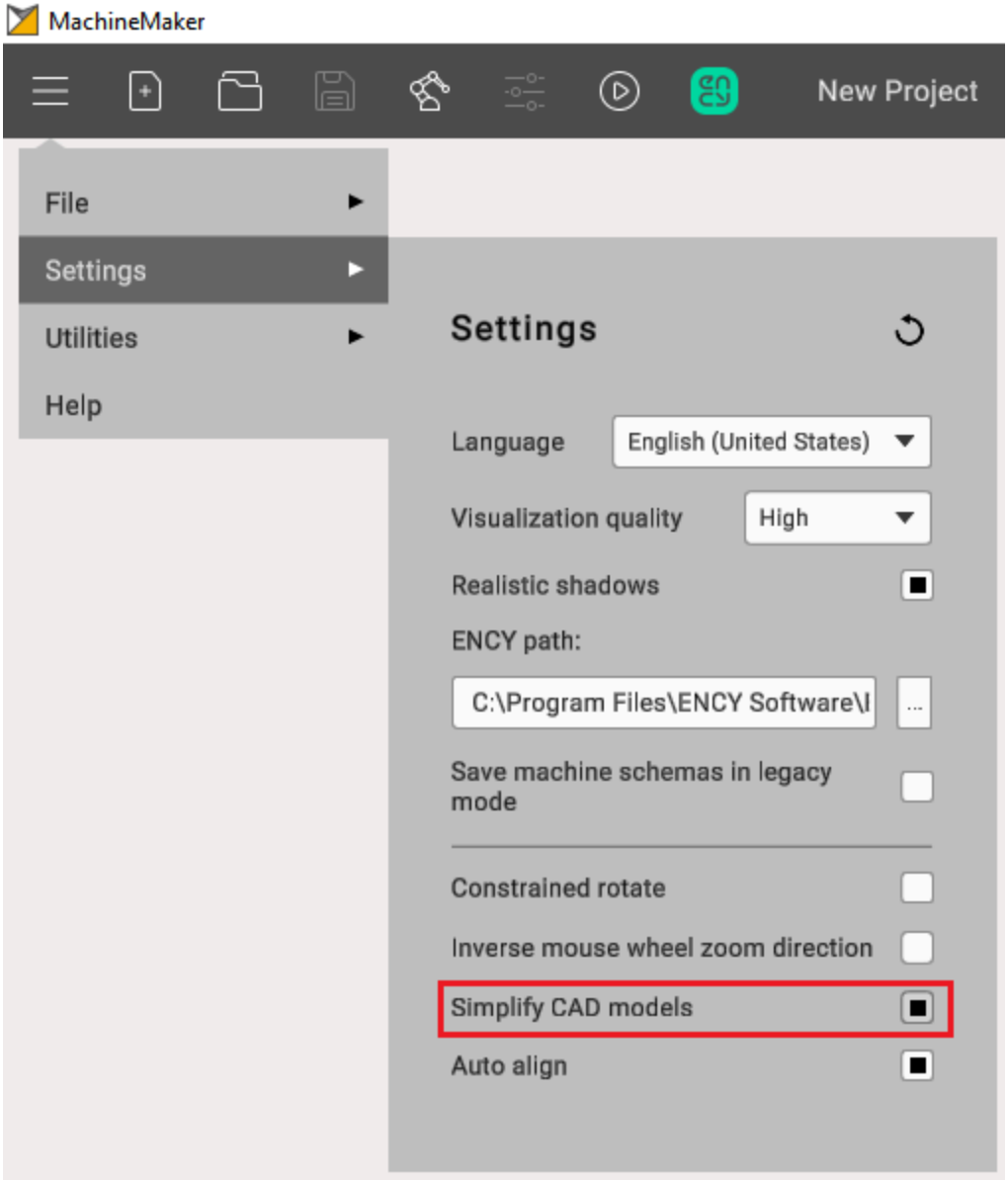





Inner: 4653(65%)
Small: 1035(15%)



You can disable the simplifier in the application settings. Or use the integrated simplifier manually.


MachineMaker
New Project
File
Settings
Utilities
Help
Settings
Language
English (United States)
Visualization quality
High
Realistic shadows
ENCY path:
C:\Program Files\ENCY Software\I
...
Save machine schemas in legacy mode
Constrained rotate
Inverse mouse wheel zoom direction
Simplify CAD models
Auto align

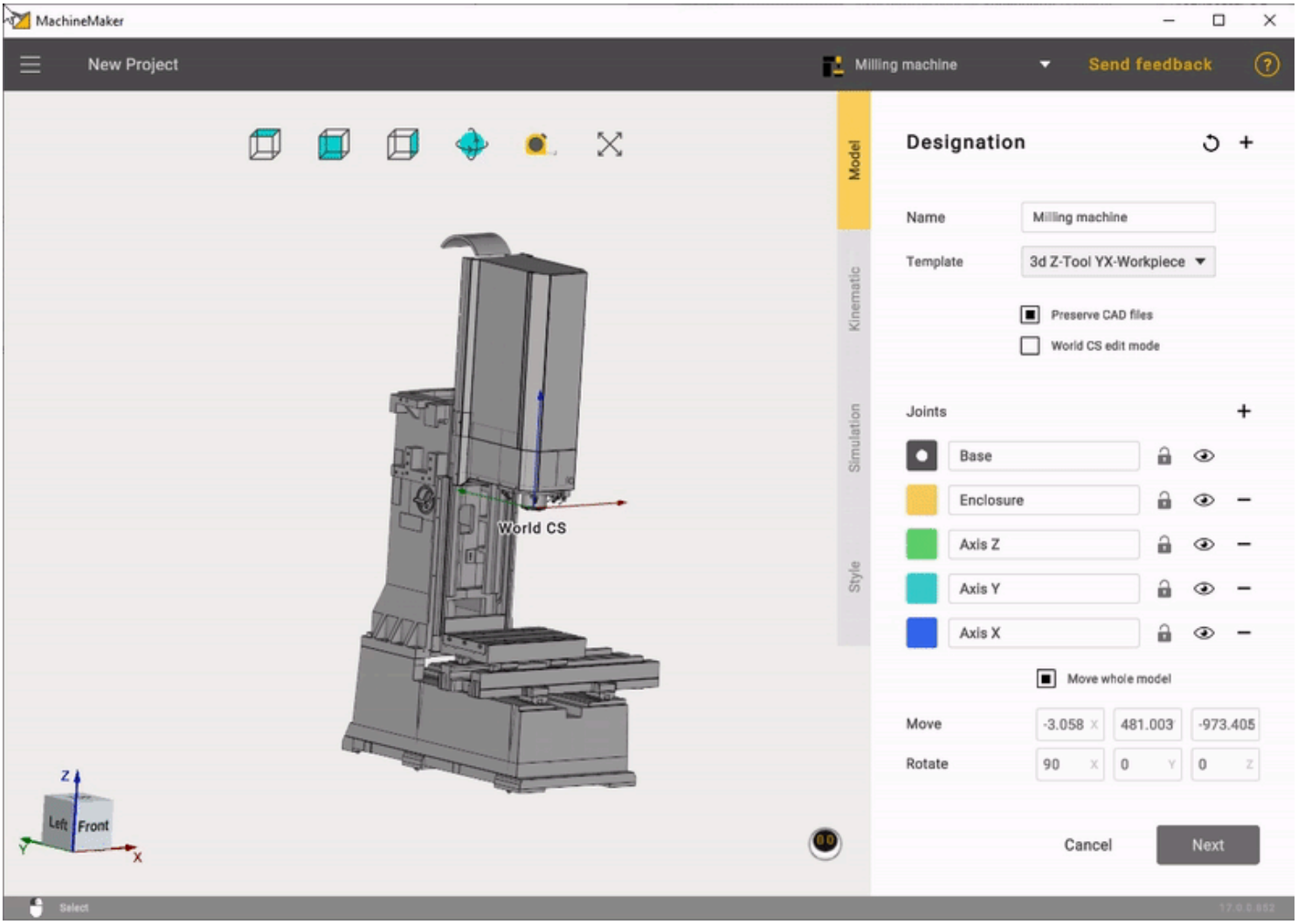
Grouping elements into nodes

Grouping elements

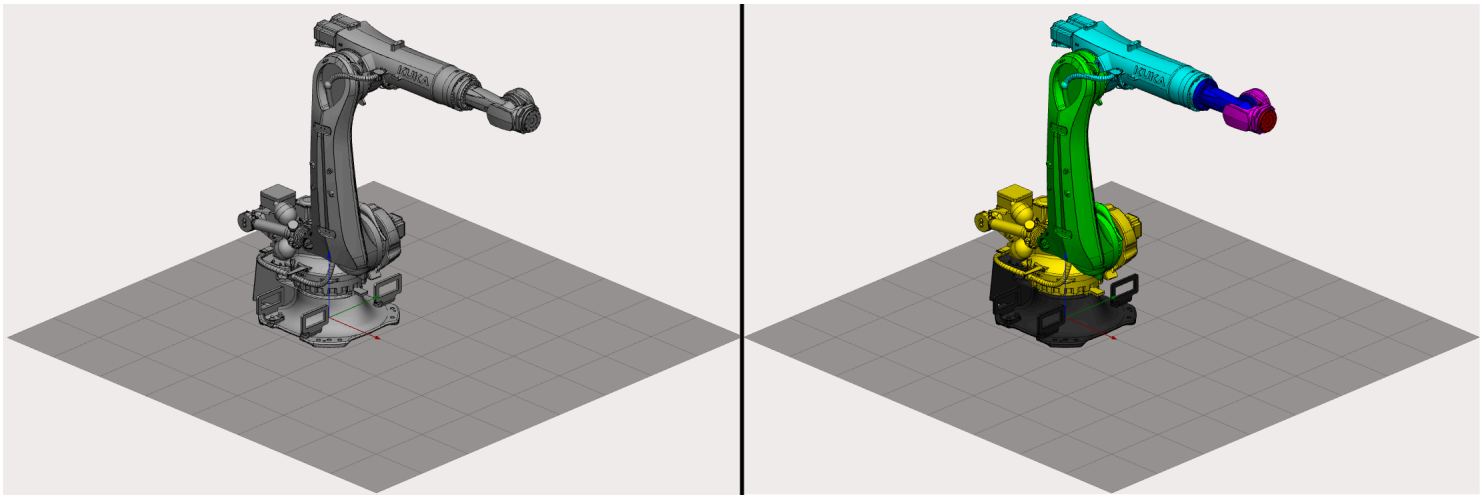
Equipment elements need to be grouped into nodes. Mark 3D model elements with specific colors to group them.

For machines, you can choose a template that suits your machine.

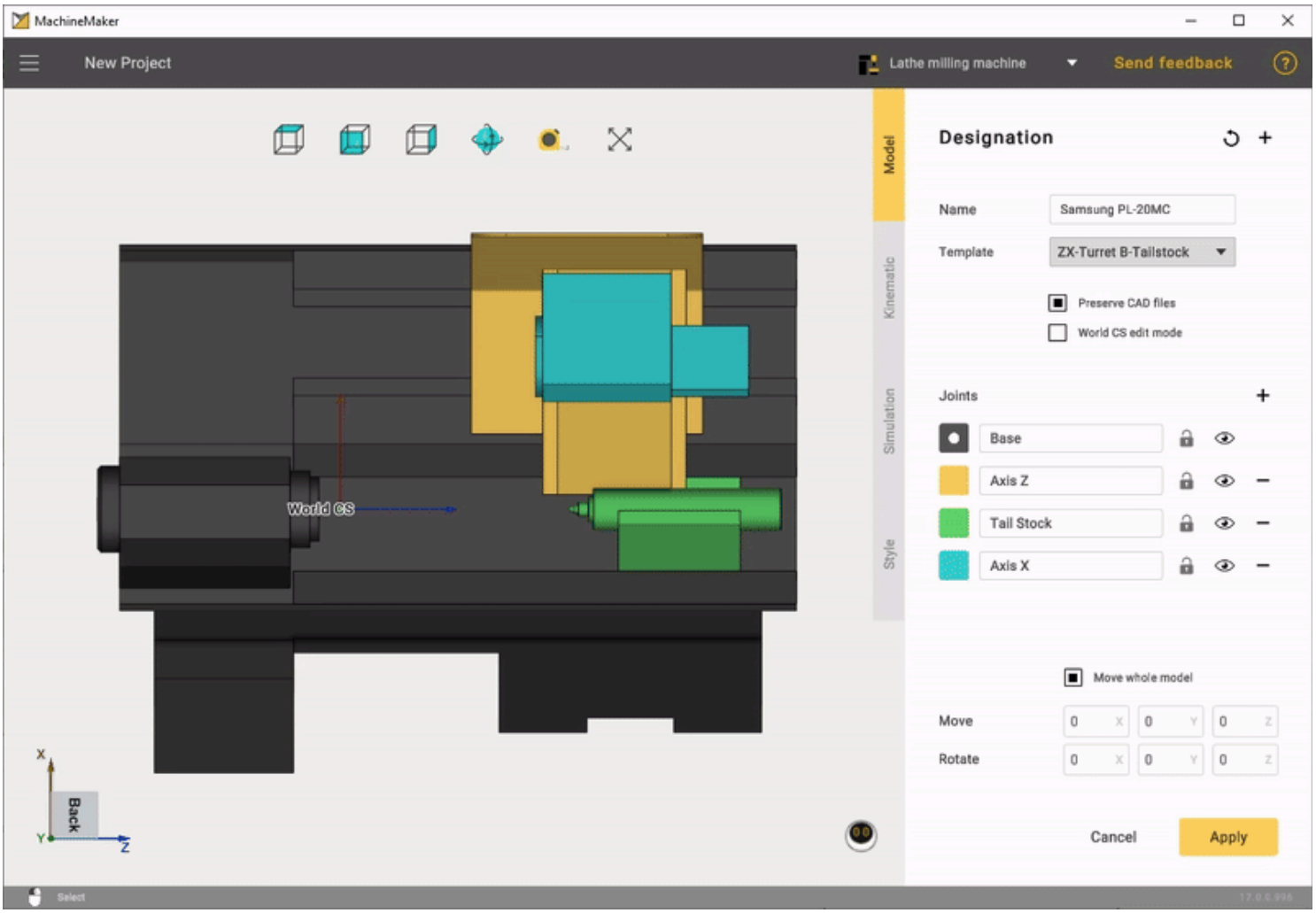
Milling Machines



Robots



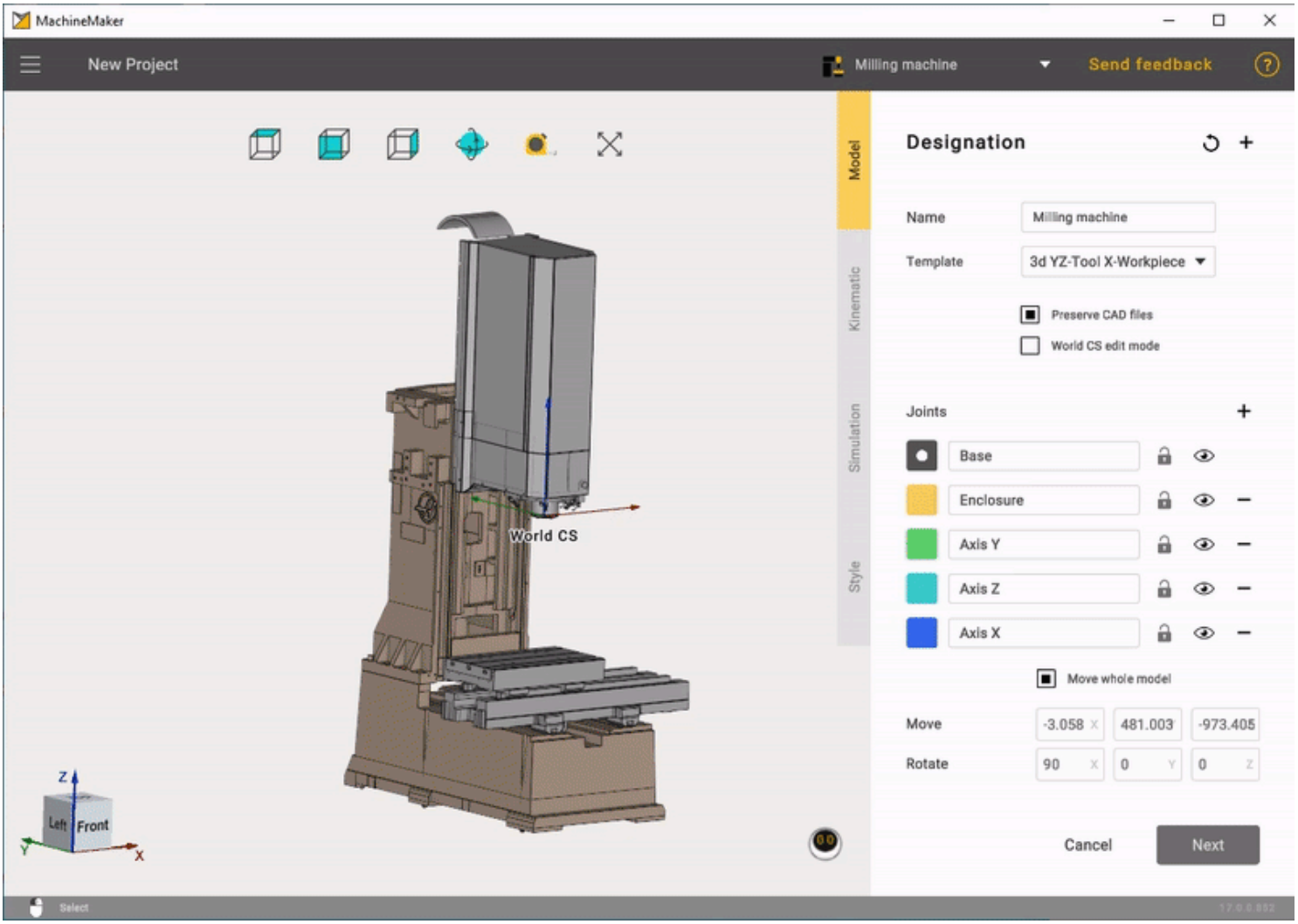
Turn-Milling Machines



Select a node color from the right panel and mark desired elements on the 3D model. Each element marked with the same color will be added to the same group.

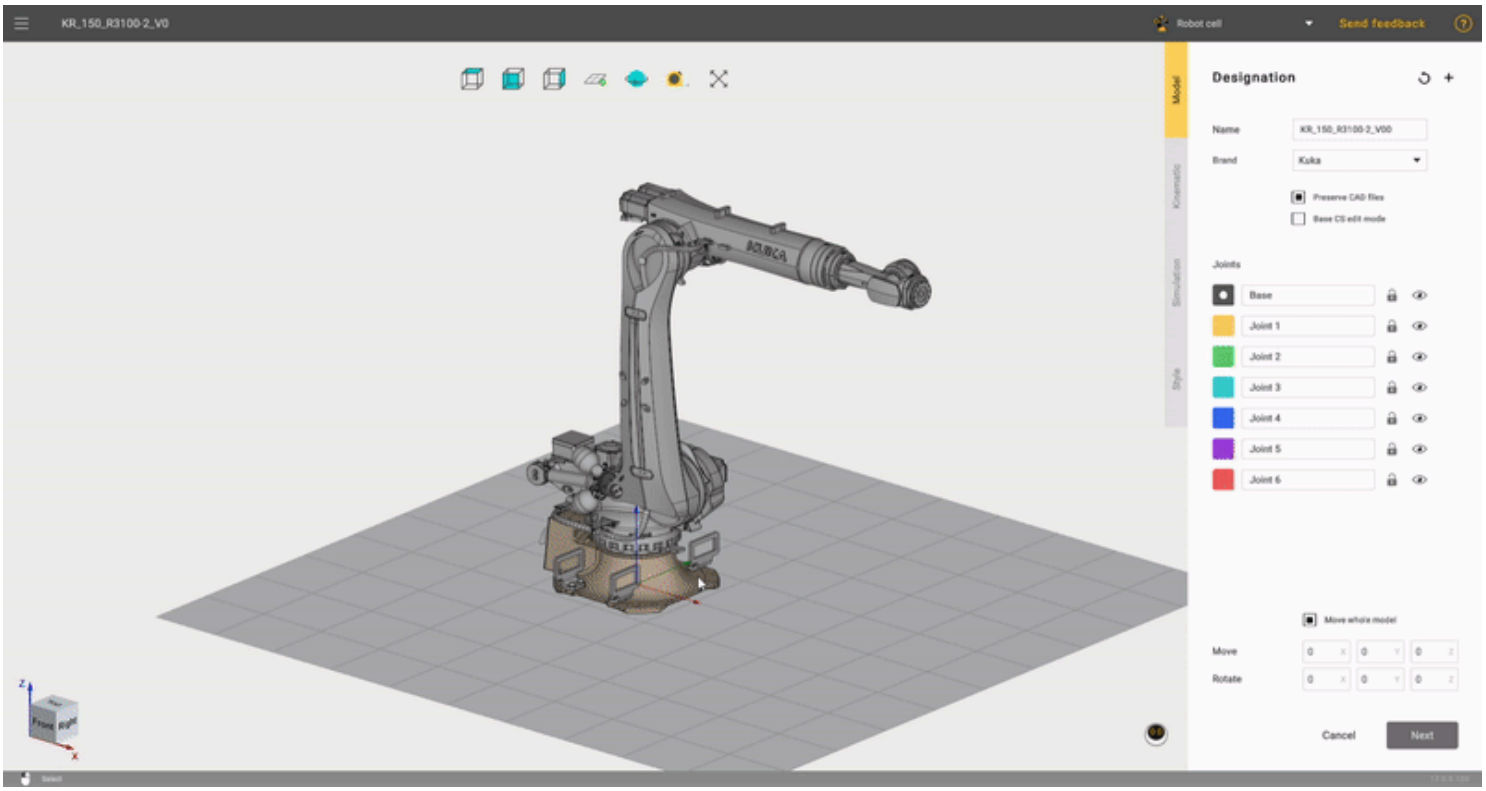
Use Tab, ↑, ↓ keys to switch current color.

Milling Machines

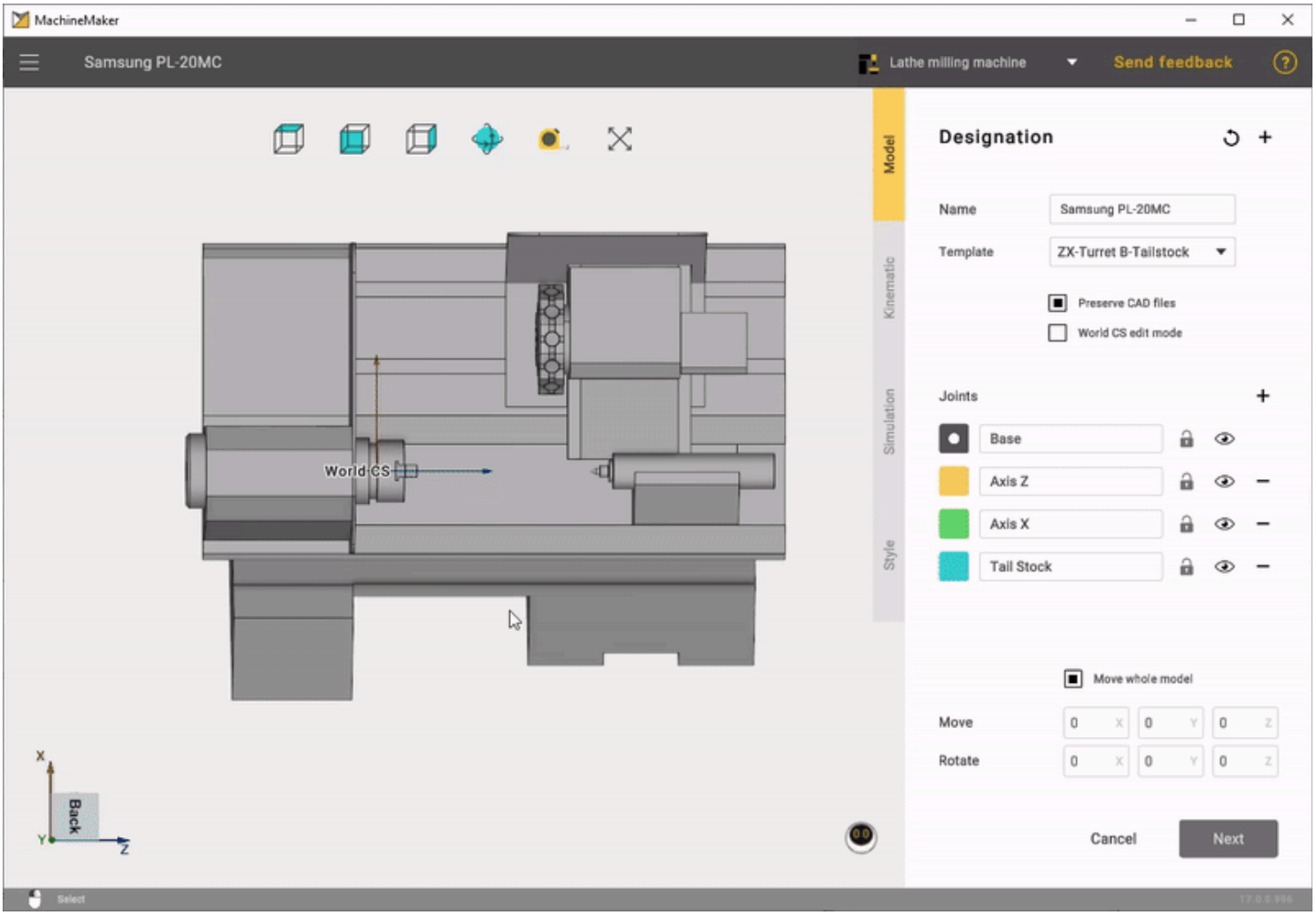


Robots





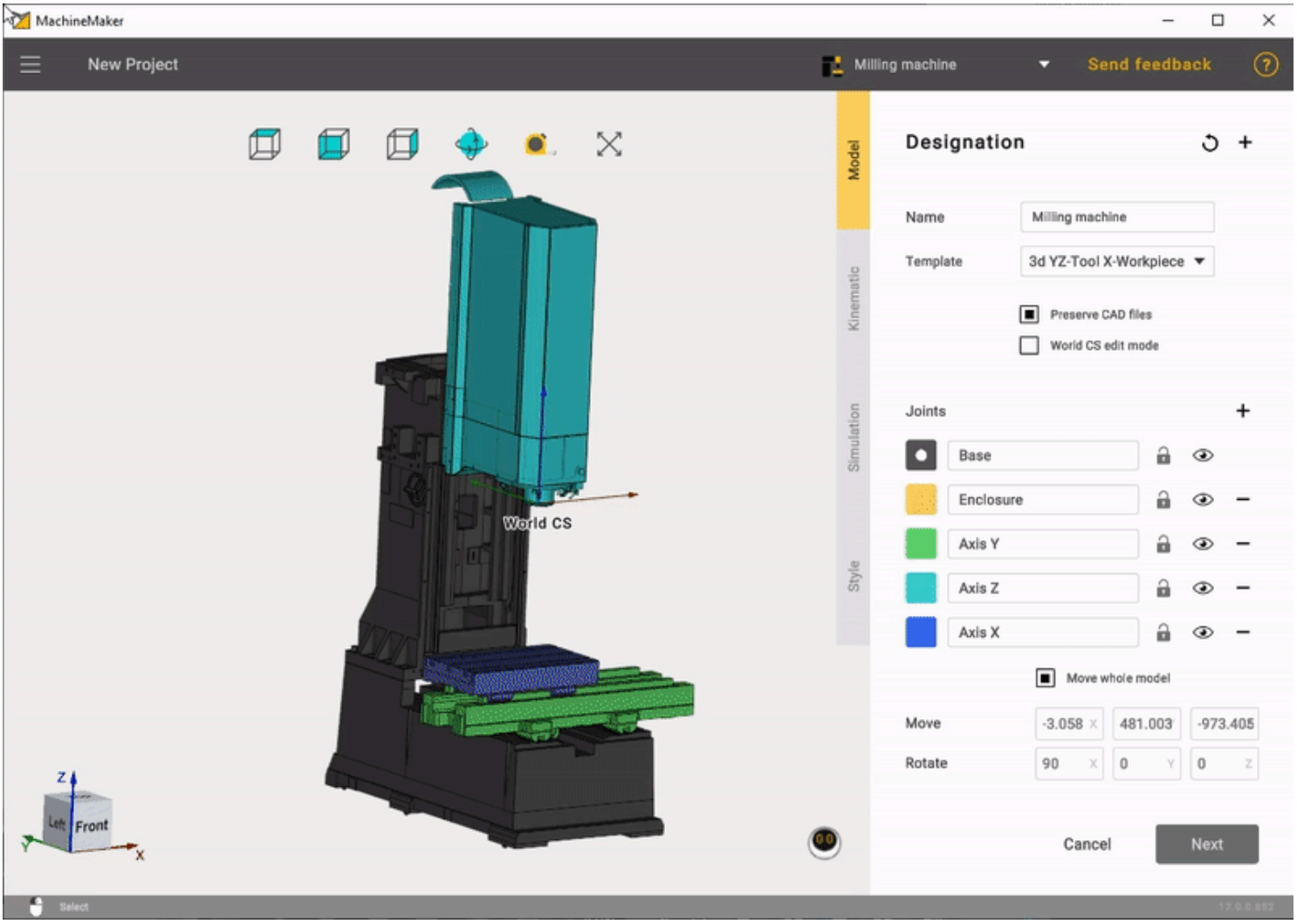
Turn-Milling Machines



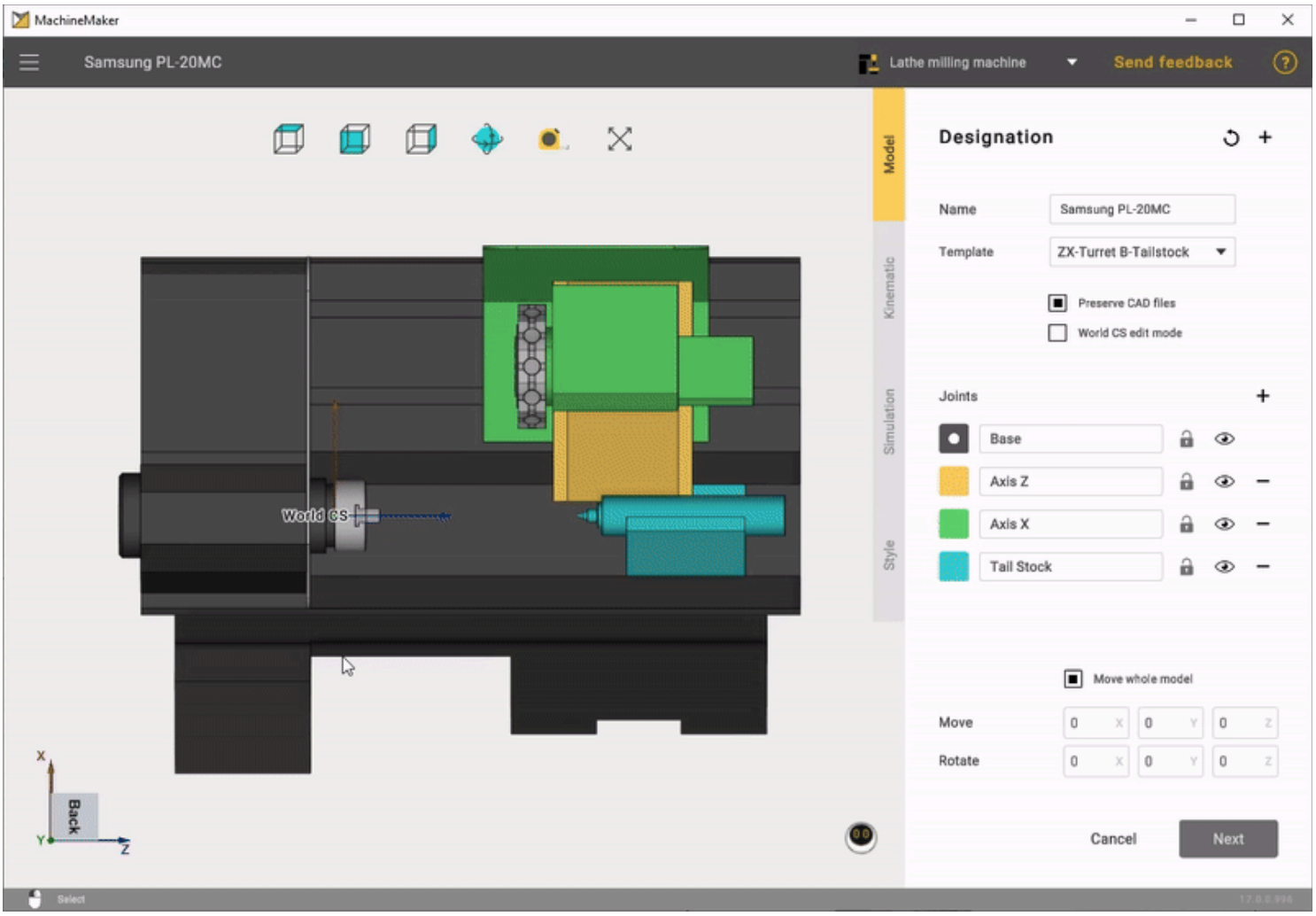
It is not necessary to mark each element. You can keep unnecessary elements unmarked to exclude them from mechanism. MachineMaker also saves source CAD file, so it is possible to change elements groups anytime.

Click marked element again to clear the color or use right mouse button to unmark 3D model element. Note that you can unmark only currently selected node elements. You can also use the keyboard shortcut "Ctrl + z" to roll back changes.

Milling Machines:

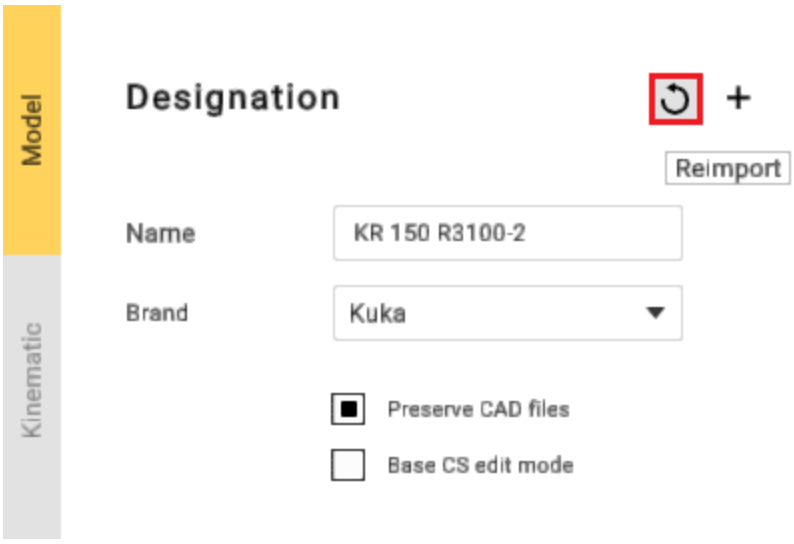


Turn-Milling Machines:

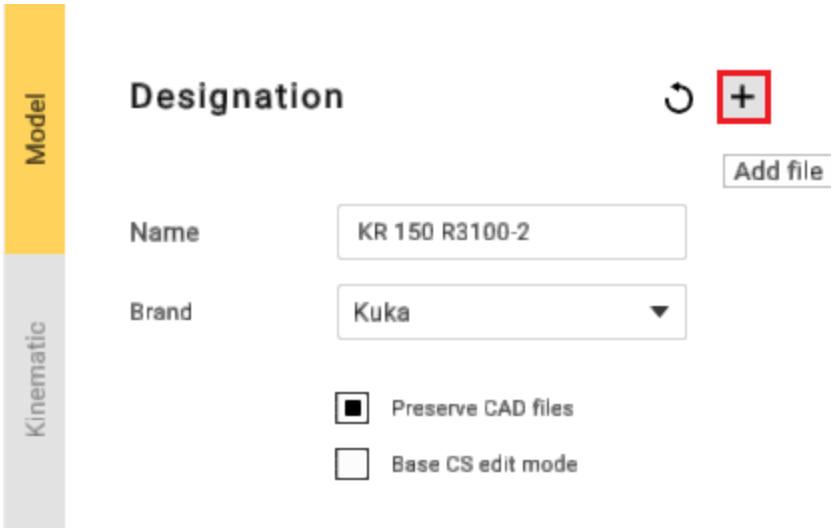


It is possible to delete unnecessary elements from the 3D model using Del key. Use Ctrl+Z to undo element deletion.

MachineMaker stores all imported 3D models in the CAD Files folder. You can always reimport the 3D model using Reimport button. Turn off Copy imported CAD files checkbox to disable saving original CAD models.



Add file - function for adding additional files.



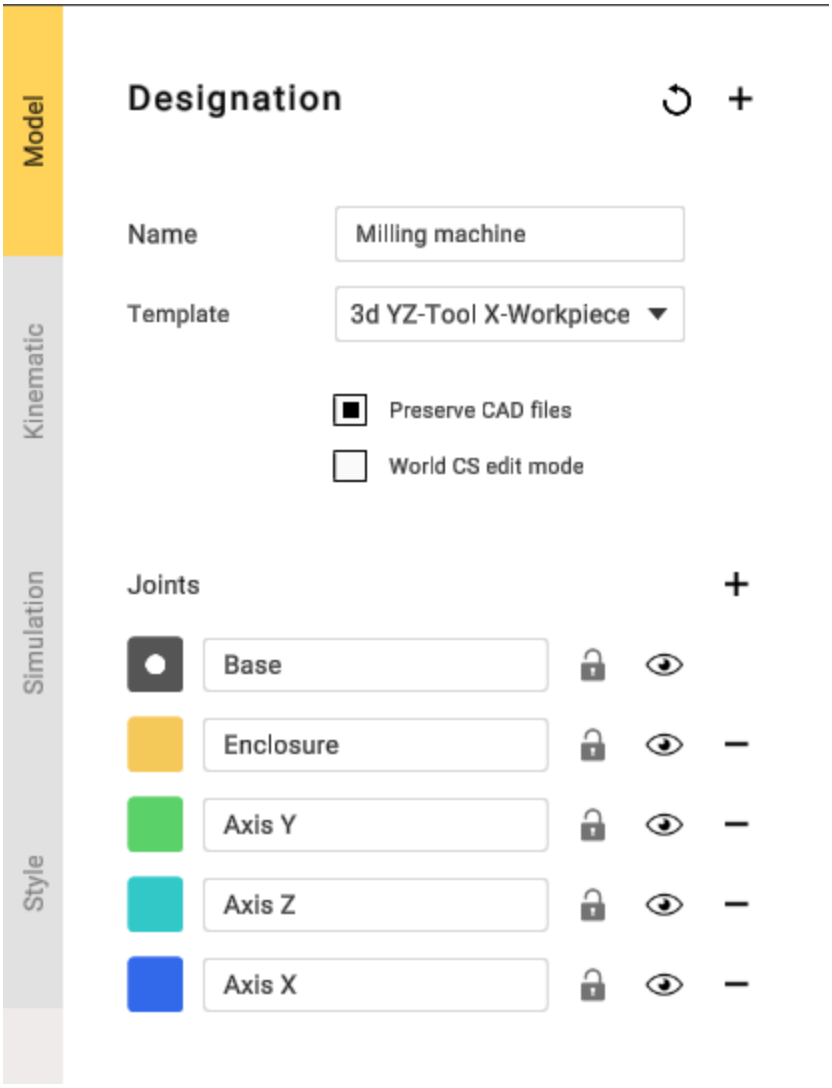
MachineMaker automatically groups all elements to Base node in jointless mechanisms such as Fixed Tables, Fixed Objects and End Effectors.

If MachineMaker can't group elements correctly, see how to fix your CAD models.

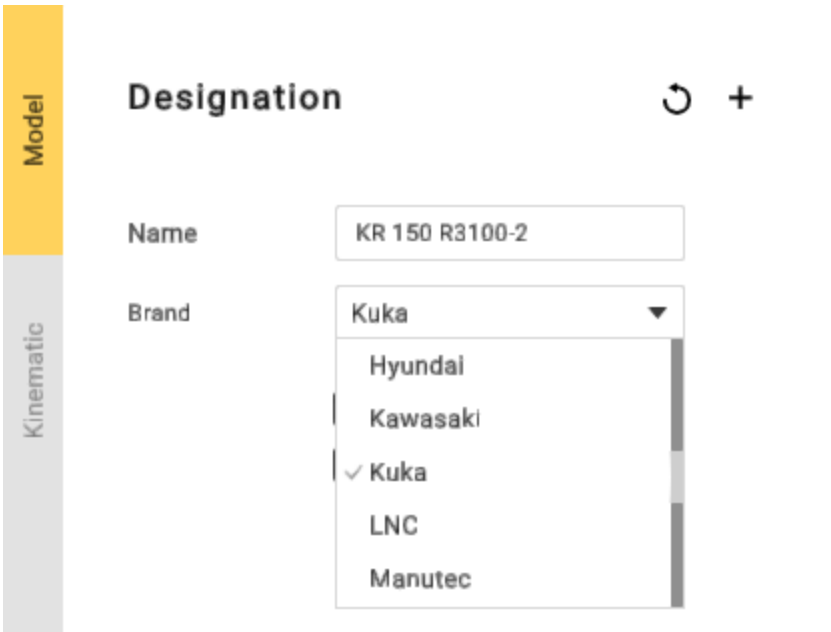
Mechanism name and type

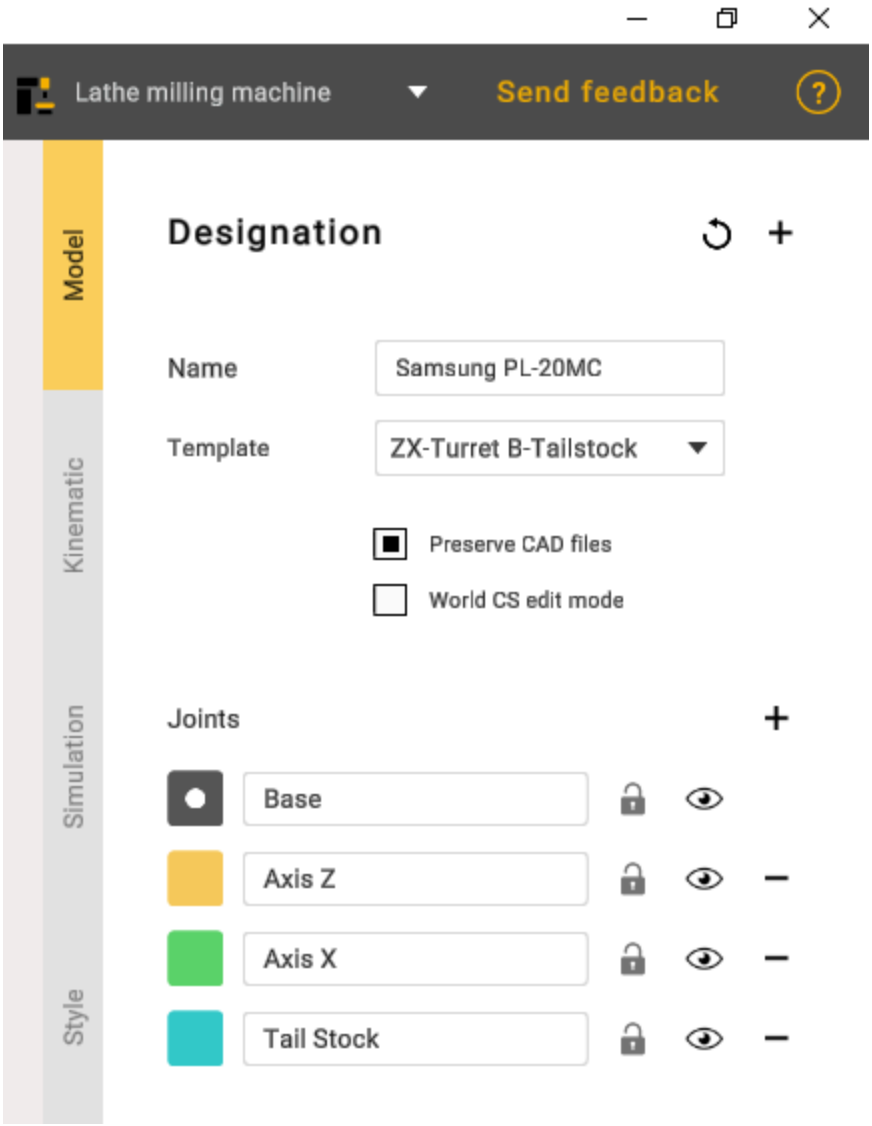
It is necessary to enter Mechanism name. MachineMaker uses 3D model filename as default name. For robots, also select the mechanism type. MachineMaker automatically selects the brand for the robot, but if you need to replace it, you can easily do so using the drop-down list.

Milling Machines



Robots



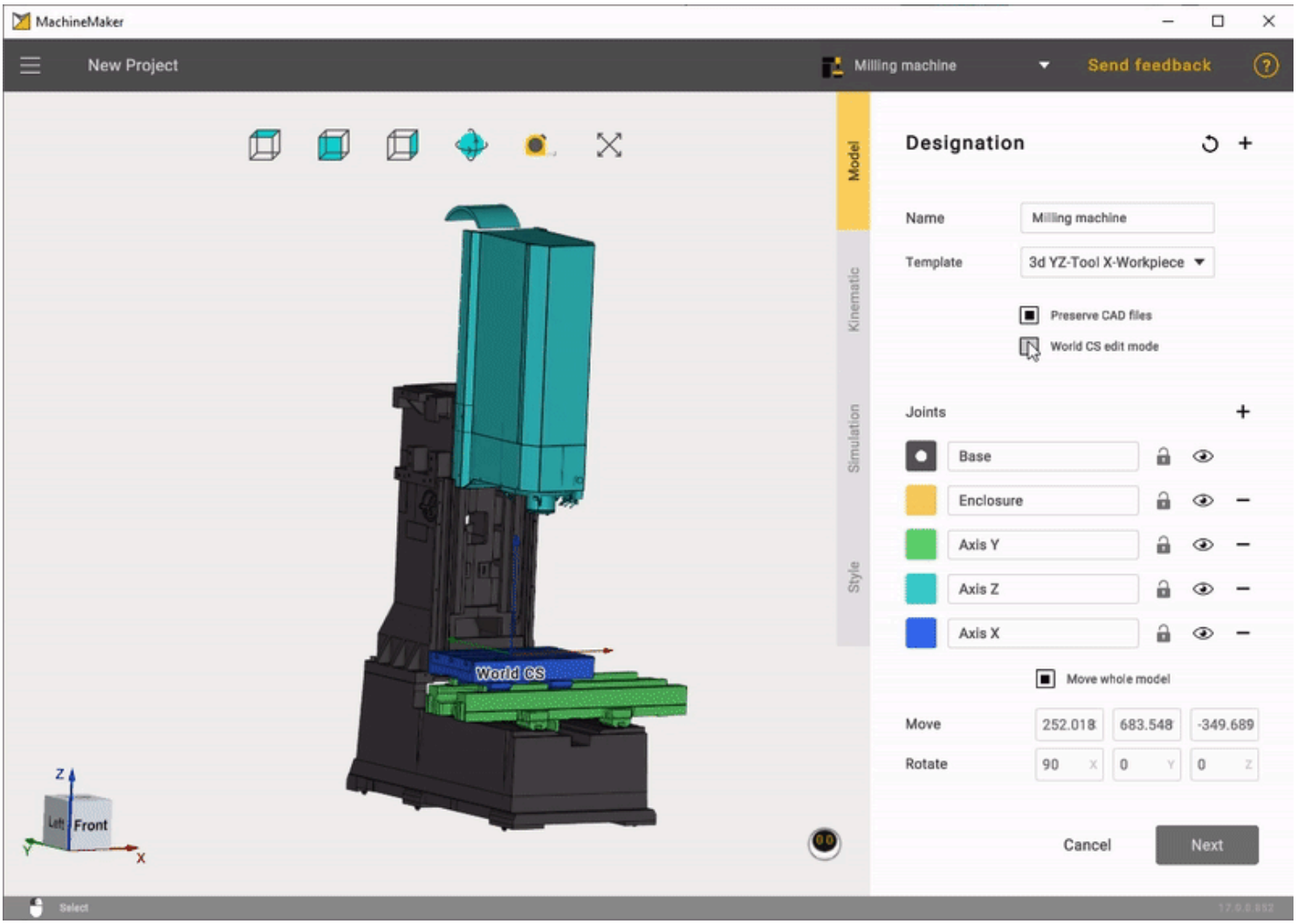


MachineMaker will use the Mechanism name as the Project name by default.

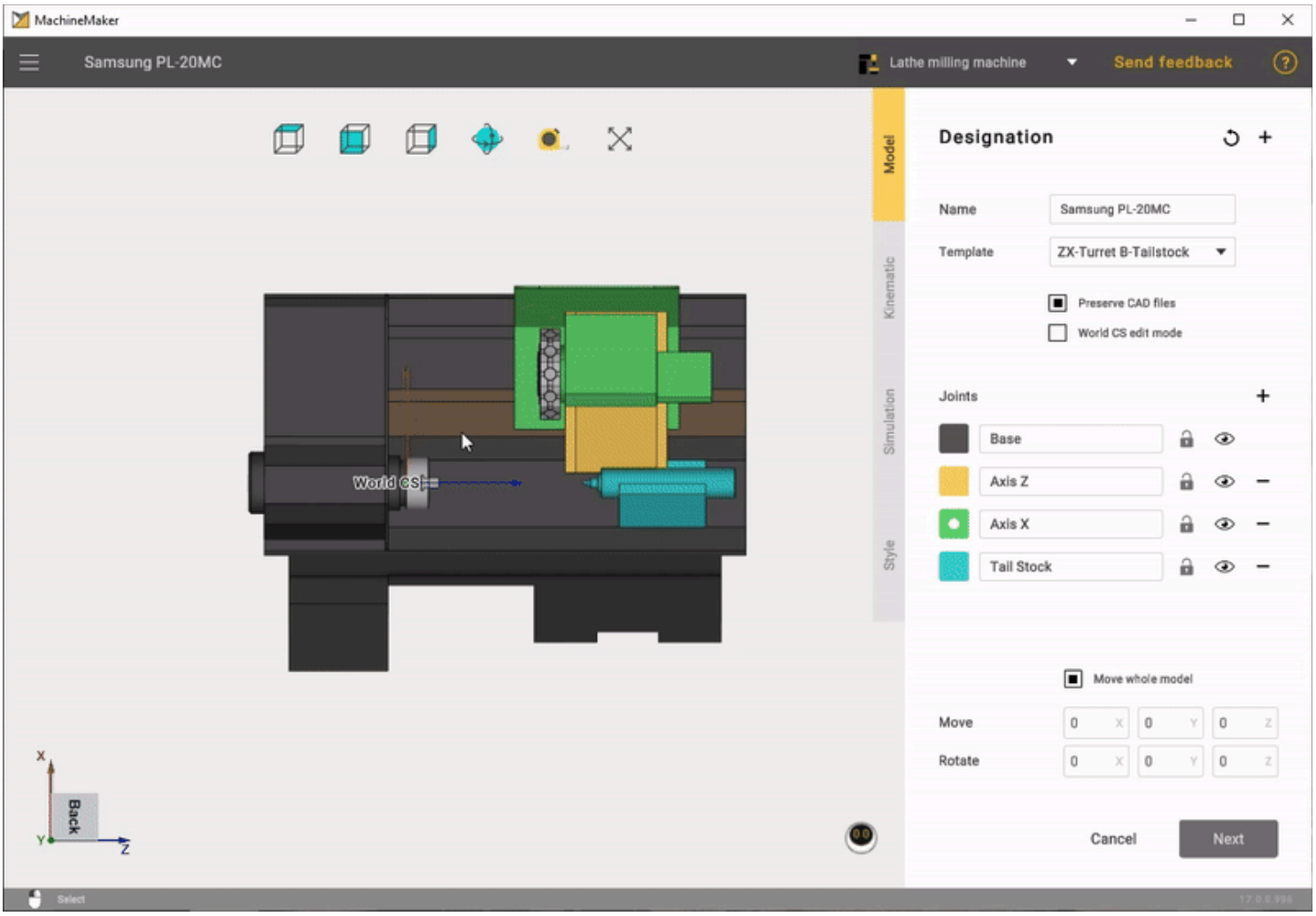
World CS position

For machines, it is necessary to specify Machine CS position. Turn on Machine CS editing mode, then hold Left Ctrl key and drag you Machine CS into the correct position. For robots, the Base CS is set as described in Base CS transformation.

Milling Machines:

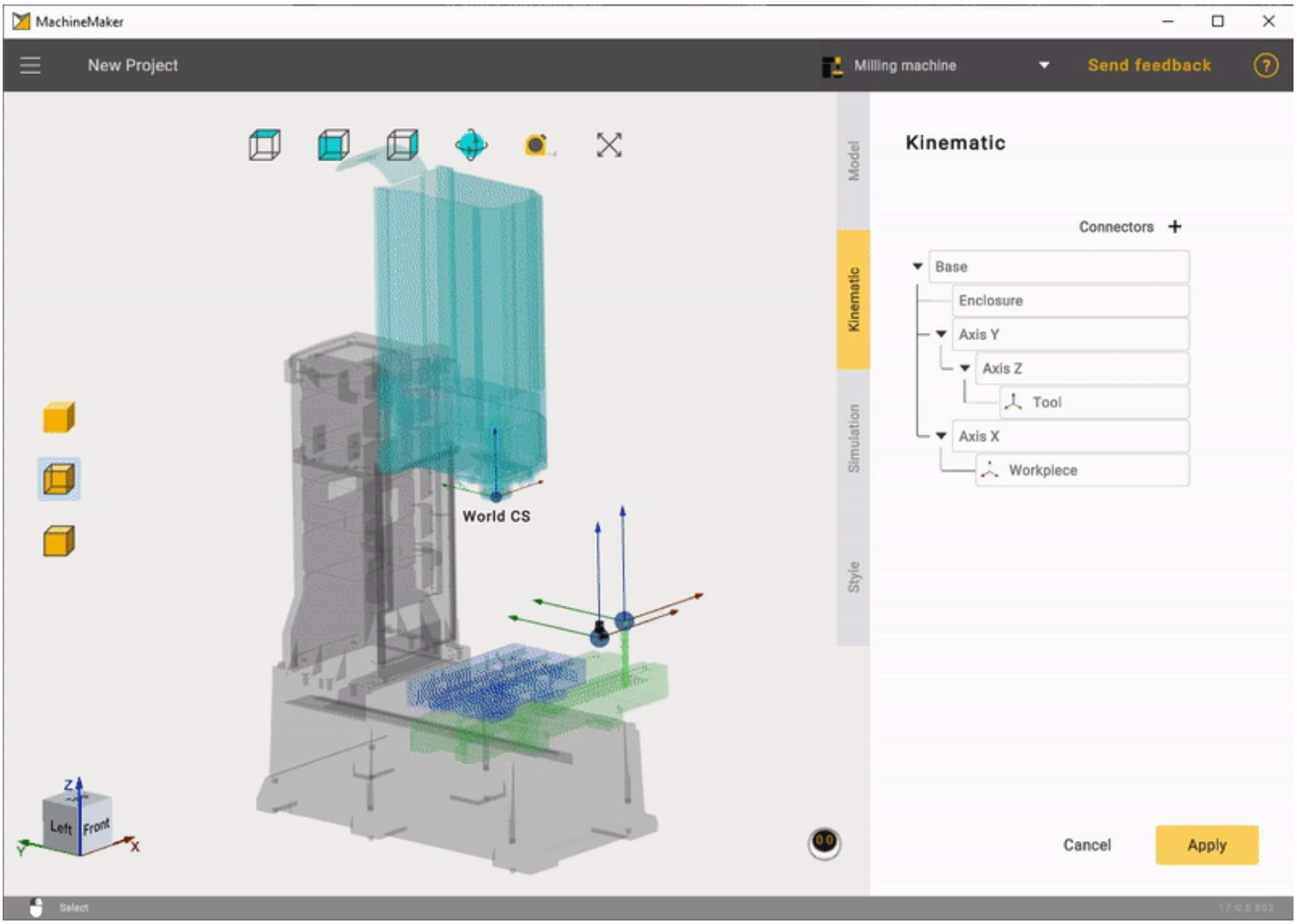


Turn-Milling Machines:



Tool and Workpiece position

For milling machines, open the Kinematic tab. Hold down the Left Ctrl key and drag the Tool and Workpiece to the desired position.


MachineMaker
New Project
Milling machine
Send feedback
Model
Kinematic
Simulation
Style
Kinematic
Connectors
Base
Enclosure
Axis Y
Axis Z
Tool
Axis X
Workpiece
World CS
Left
Front
Cancel
Apply
Select

Coloring

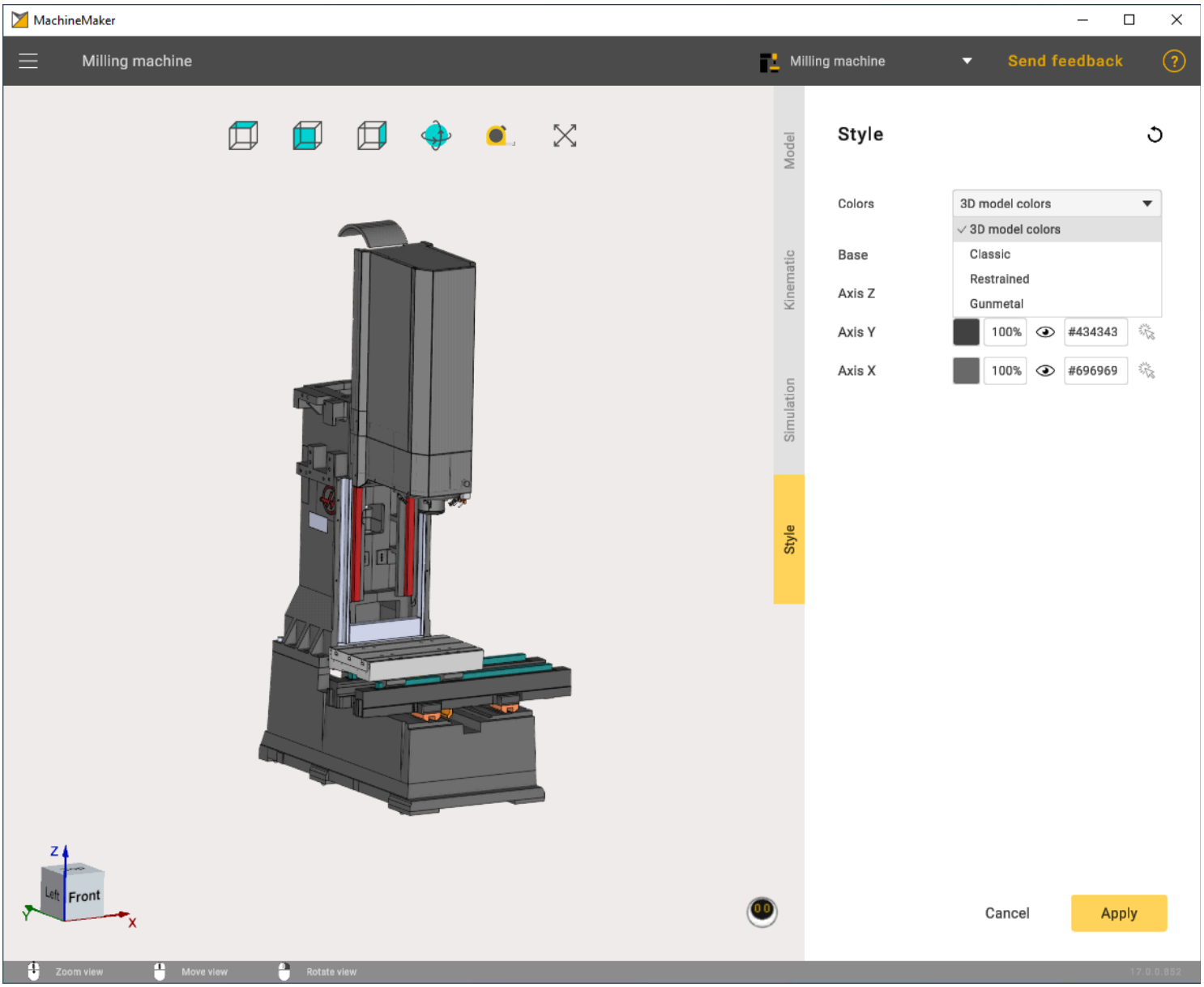
By default, MachineMaker uses the 3D model's color. Using the 3D model's colors gives a detailed representation. It is also possible to define the node's (machine element) color manually.

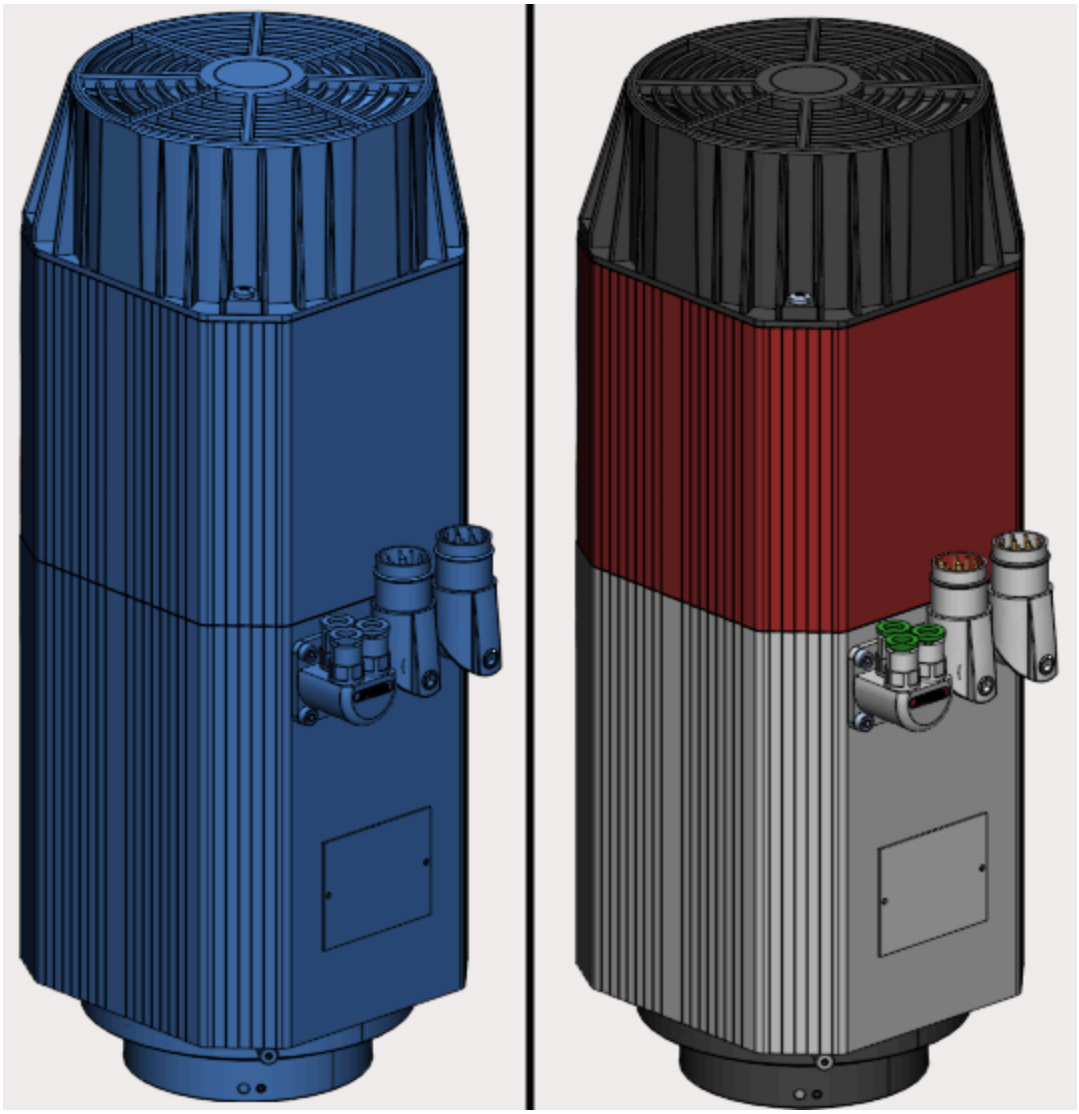
Use the Style tab to open the Color parameters. You can select a predefined color set or specify node colors manually.

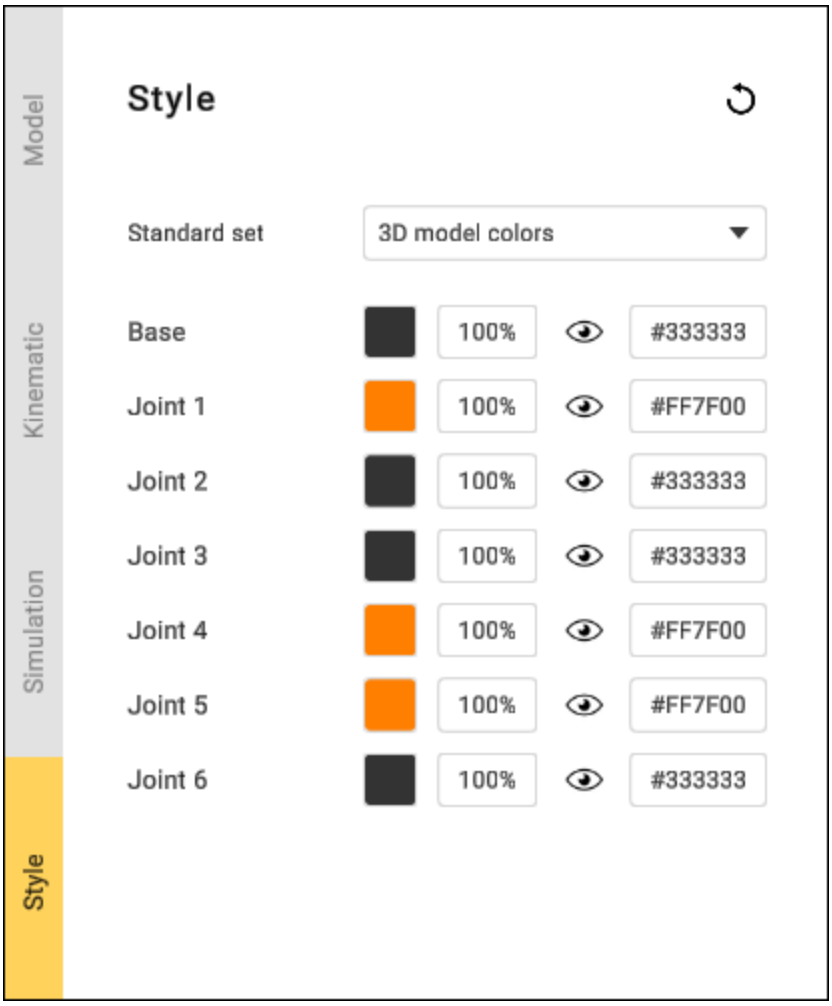
In addition to the default color, you can select 3 available sets of colors to paint the machines.

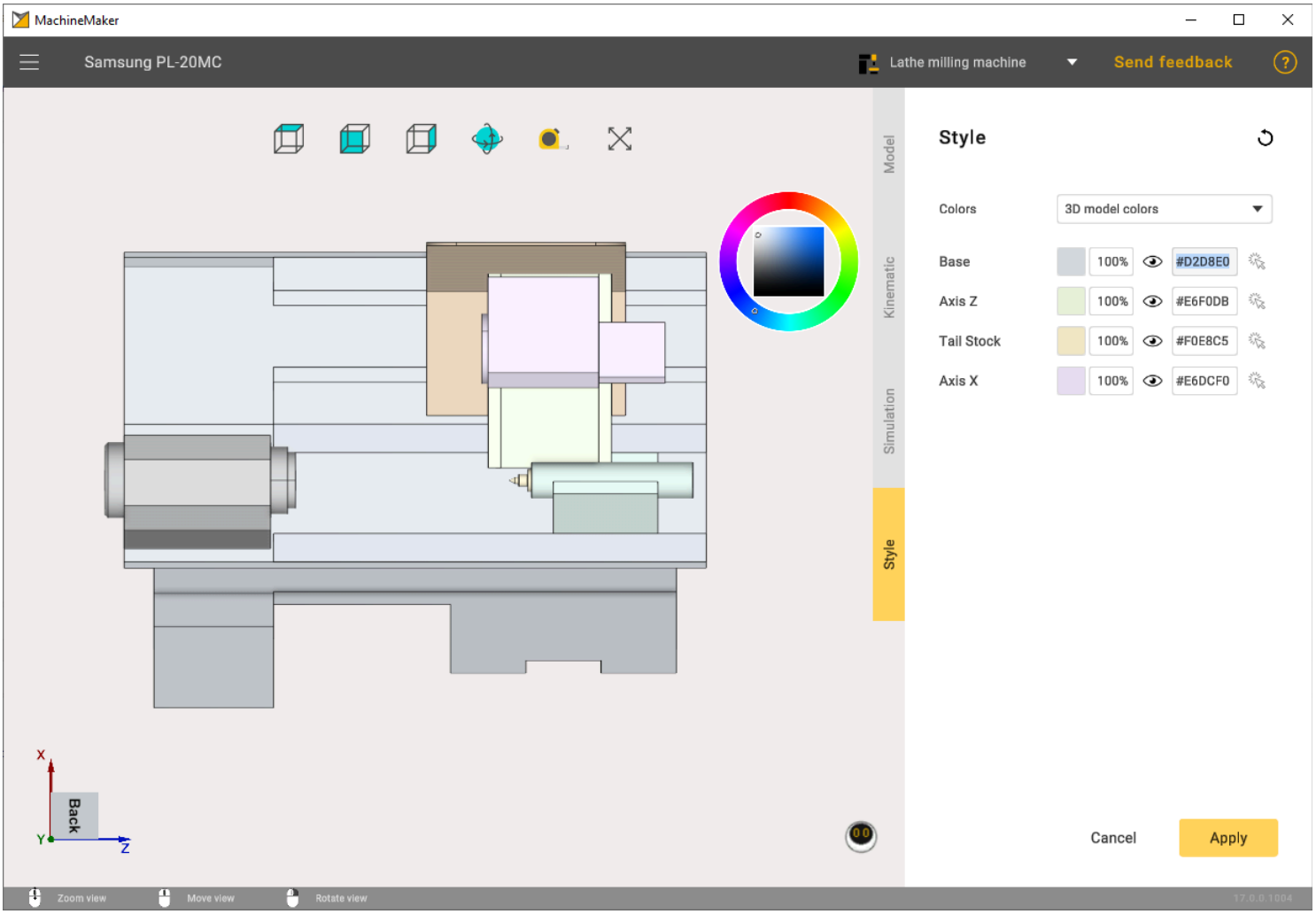
1. Classic
2. Restrained
3. Gunmetal

Milling Machines



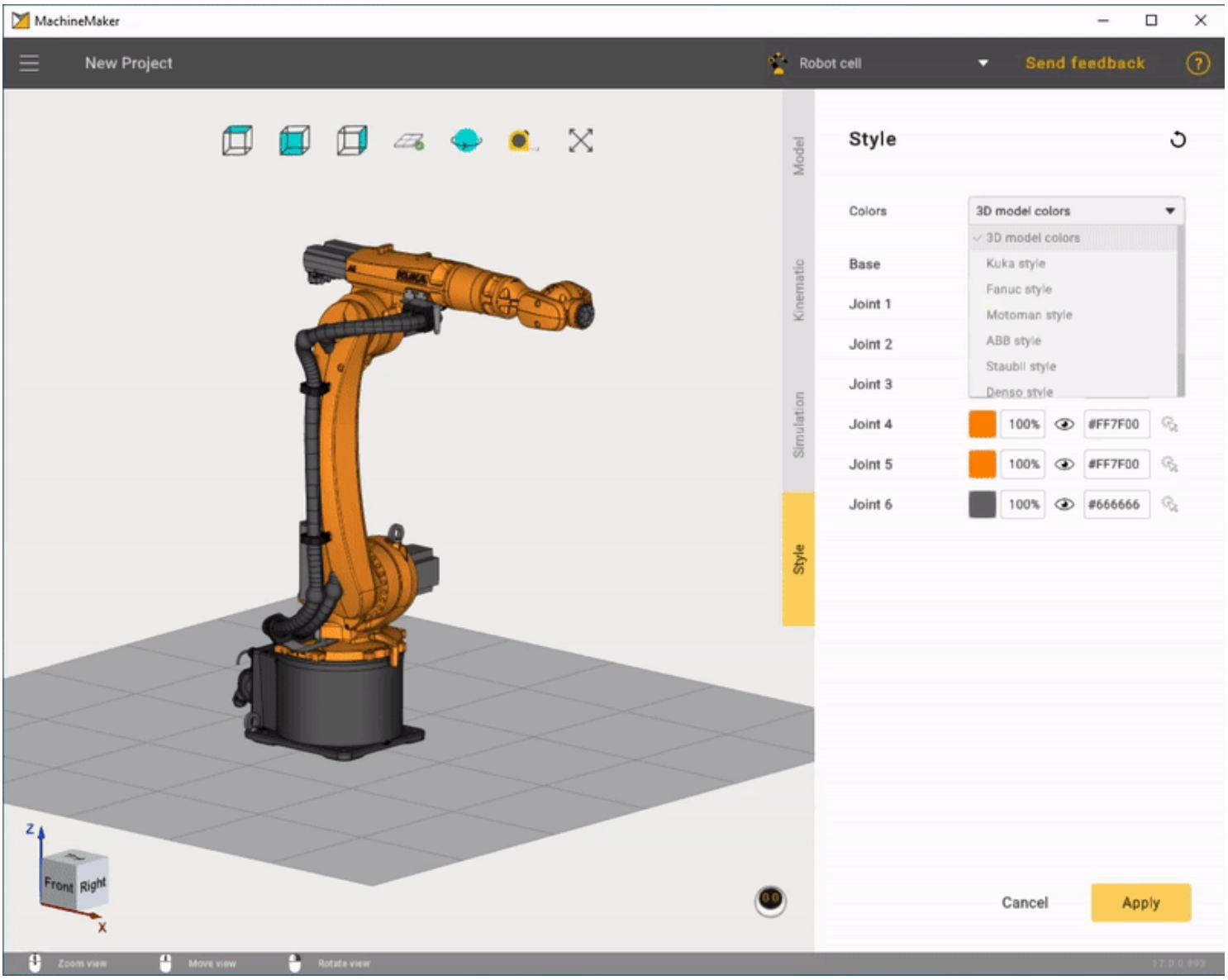



Model
Kinematic
Simulation
Style
Style
Standard set
3D model colors
Base
100%
#333333
Joint 1
100%
#FF7F00
Joint 2
100%
#333333
Joint 3
100%
#333333
Joint 4
100%
#FF7F00
Joint 5
100%
#FF7F00
Joint 6
100%
#333333

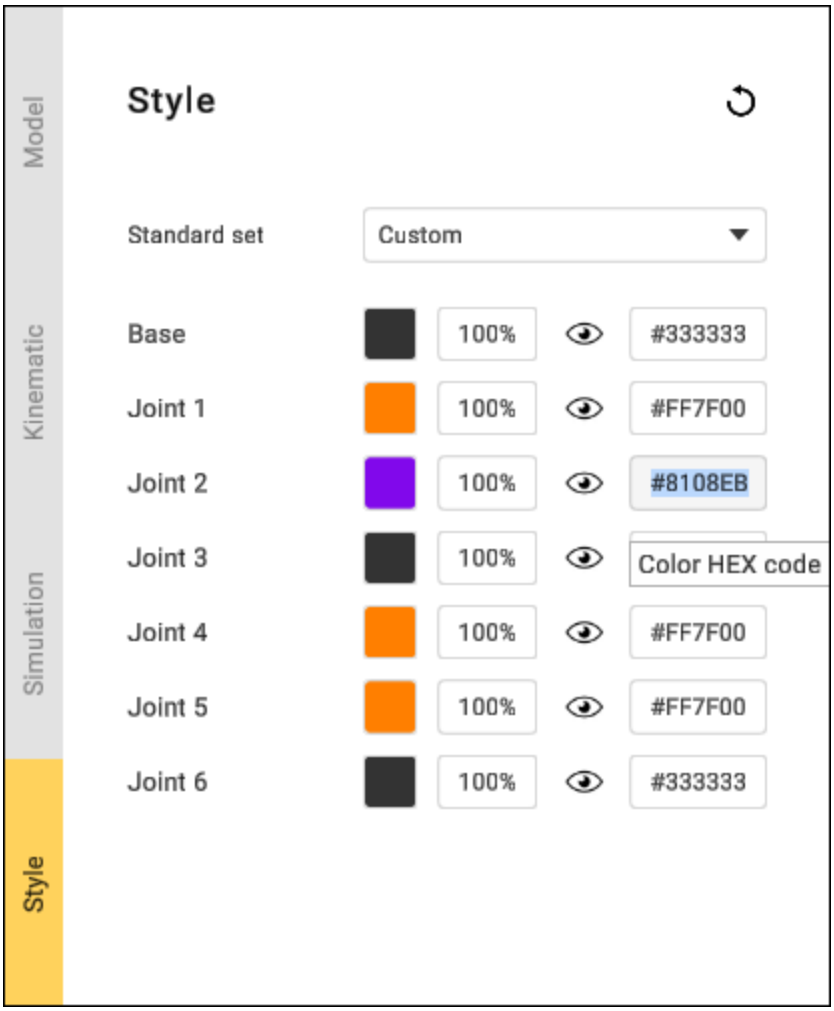


Use Mouse wheel scroll with the mouse cursor on the combobox to switch between styles

Select the 3D Models colors style to reset the colors of all the nodes to the 3D model's values. Select Current style to reset the colors of all the nodes to the saved values.

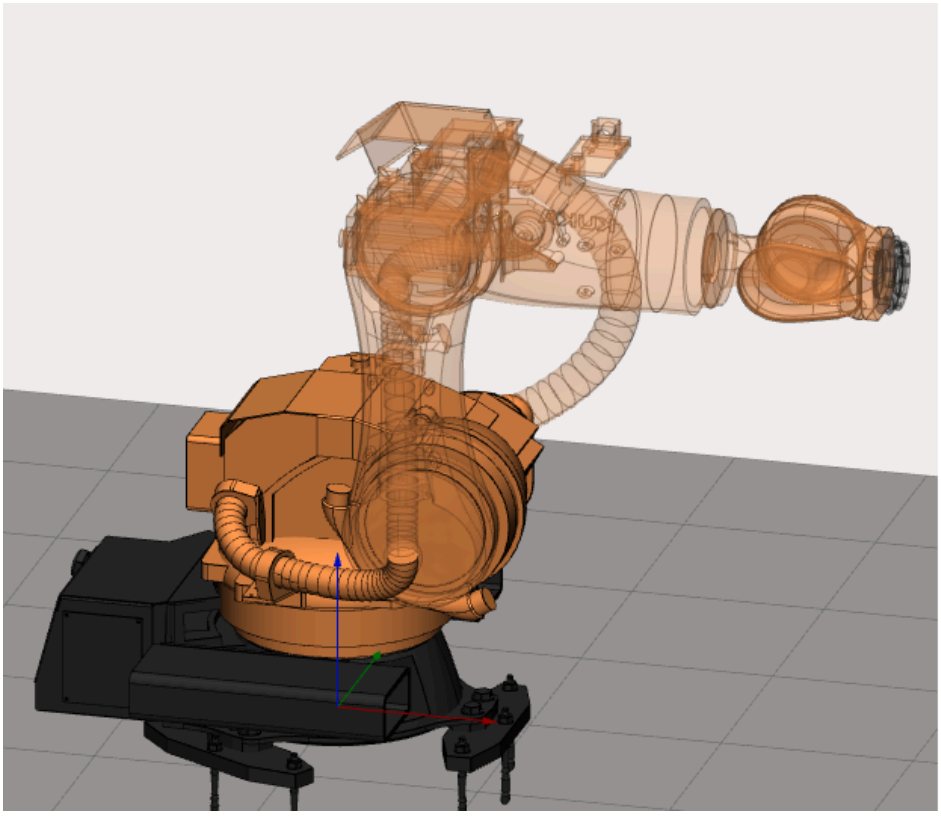


Click on the color hex code input field on the right to open the color selector. It is possible to copy and paste hex codes manually.

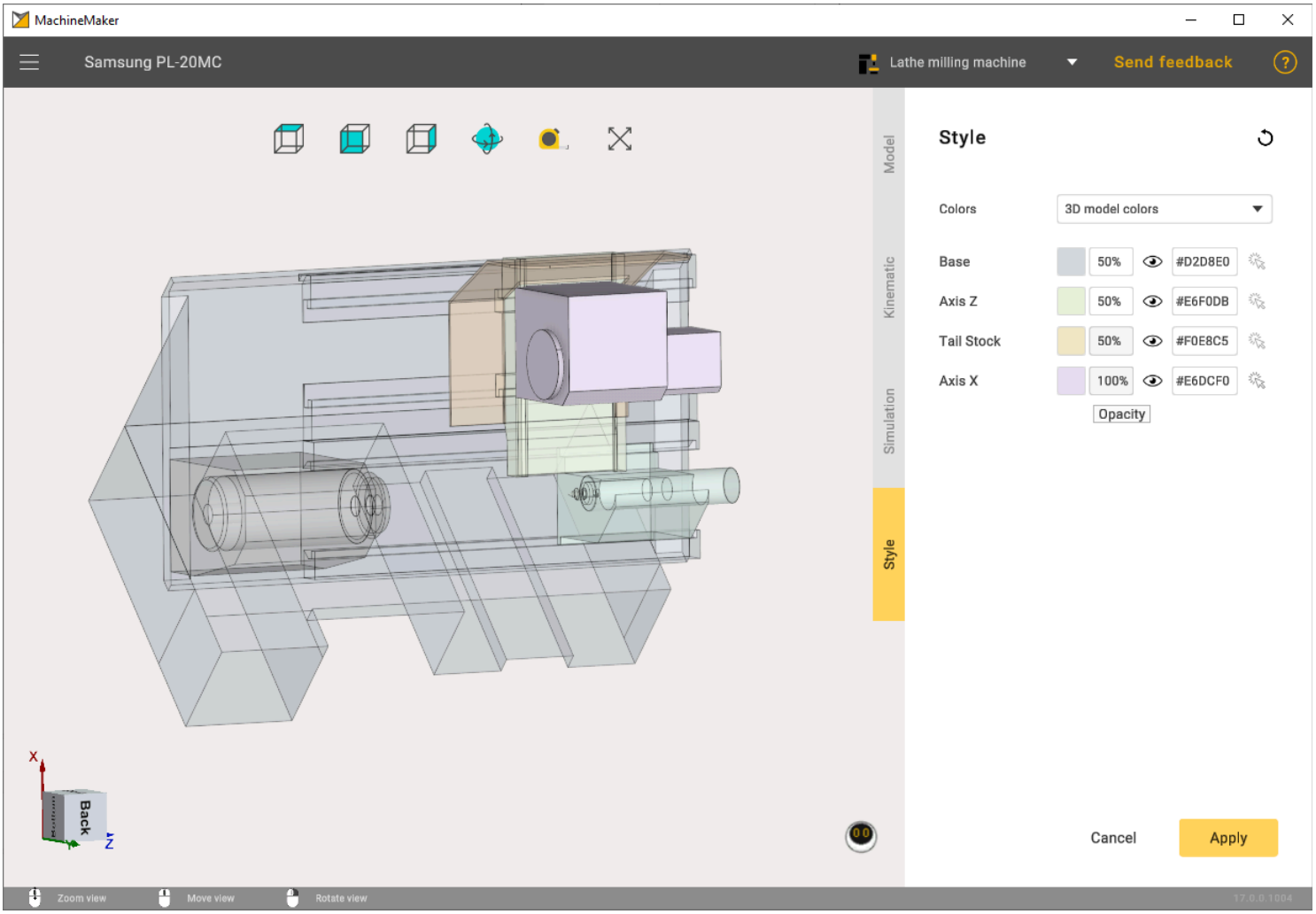


It is also possible to change the node's transparence.

Robots:

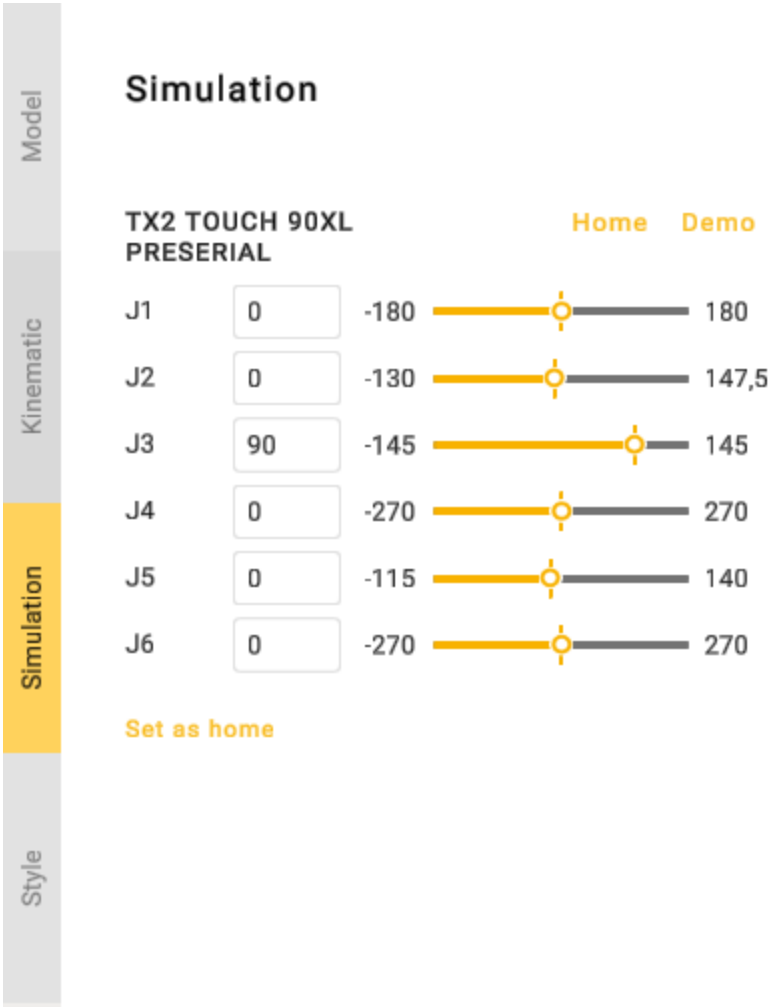


Turn-Milling Machines:



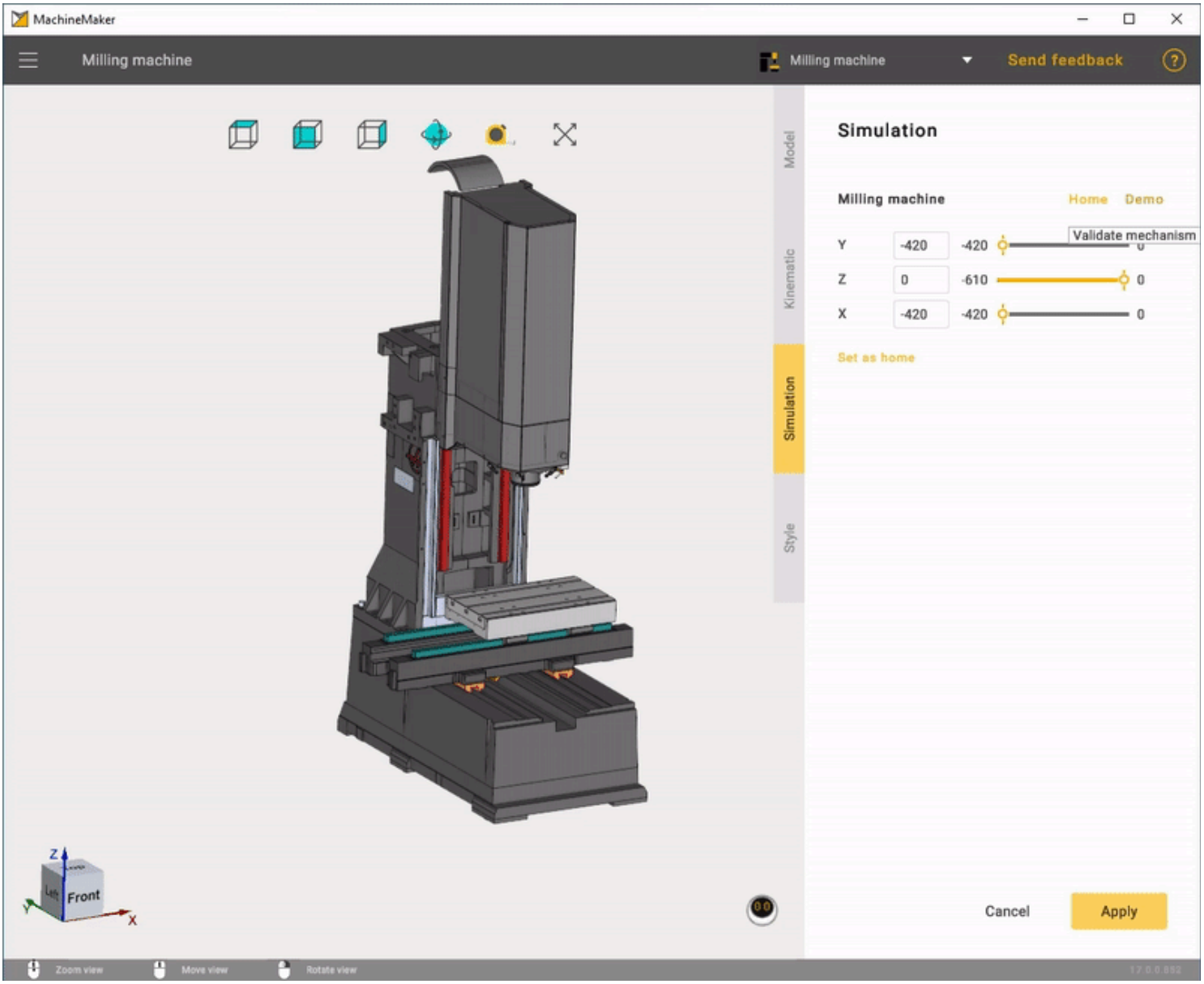
Mechanism Simulation and Validation

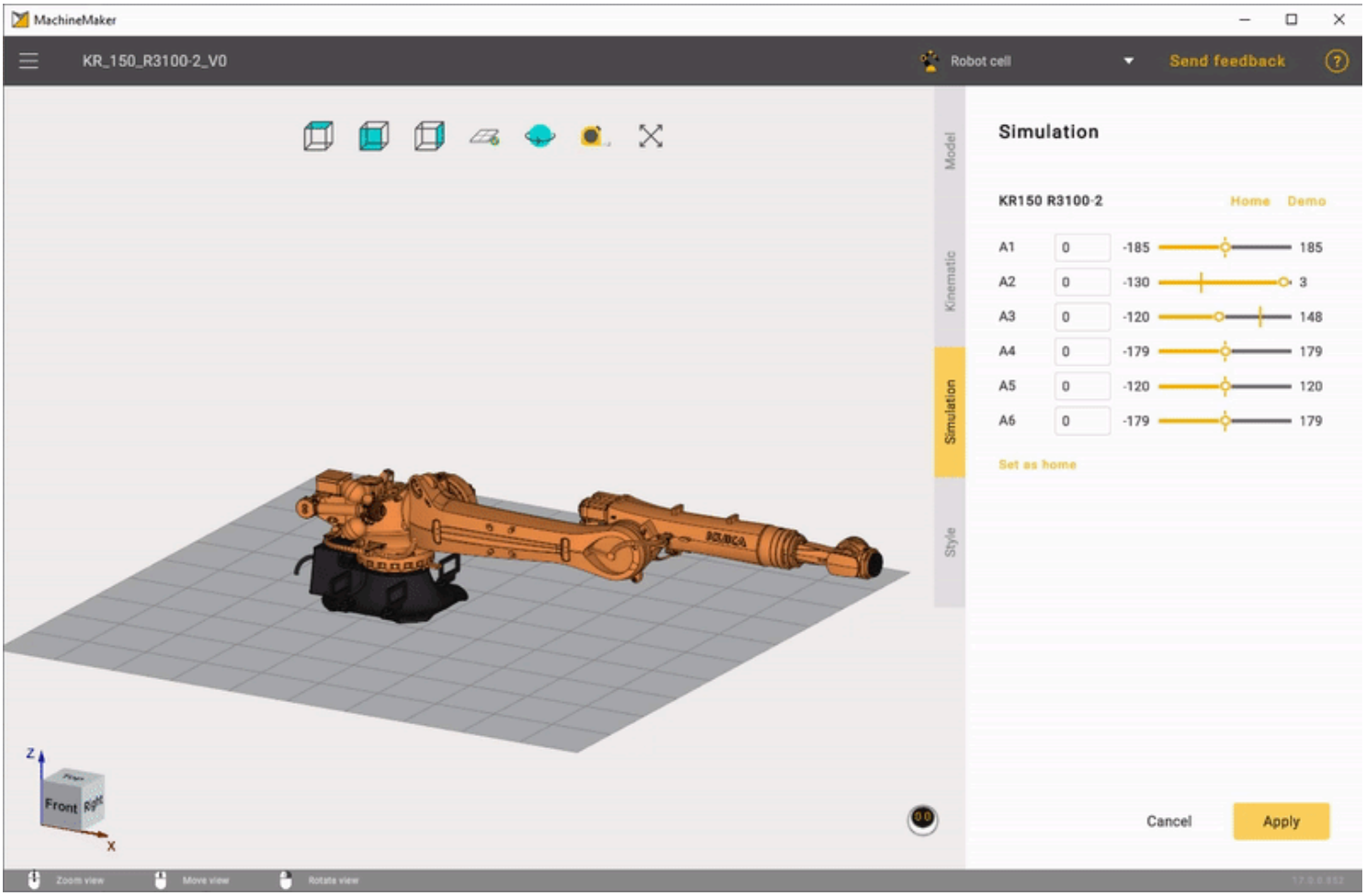
Select Simulation tab to validate the mechanism's kinematics. Use the trackbar to change the axis coordinates or enter values in the input box manually.

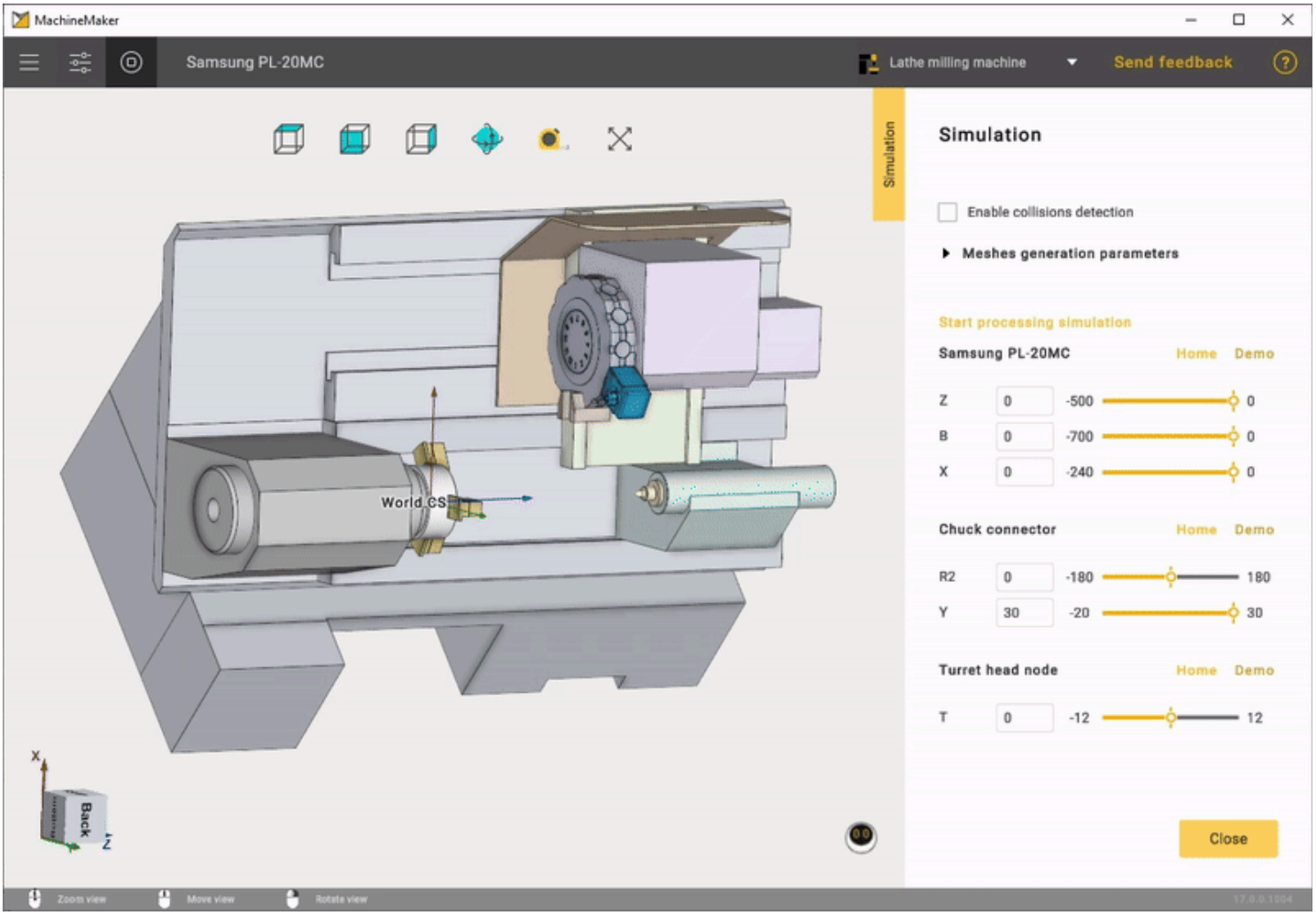


Click Demo button to check all nodes.

Click Home button to return the mechanism to the Home position. Use Set As Home button to save the current mechanism position as Home position.


MachineMaker
Milling machine
Milling machine
Send feedback
Model
Kinematic
Simulation
Style
Simulation
Milling machine
Home
Demo
Validate mechanism
Y
-420
-420
0
Z
0
-610
0
X
-420
-420
0
Set as home
Cancel
Apply
Front
Zoom view
Move view
Rotate view


MachineMaker
KR_150_R3100-2_V0
Robot cell
Send feedback
Model
Kinematic
Simulation
Style
Simulation
KR150 R3100-2
Home
Demo
A1 0 -185 185
A2 0 -130 3
A3 0 -120 148
A4 0 -179 179
A5 0 -120 120
A6 0 -179 179
Set as home
Cancel
Apply
Front
Zoom view
Move view
Rotate view



If something looks wrong in the simulation, please check the "Building a kinematic scheme" page of your section: Milling Machines, Robots or Turn-Milling Machines.

If you see nodes collisions, please check the Grouping elements into nodes.

Use  button on the Toolbar to validate whole assembly.

Assemblies

Connectors

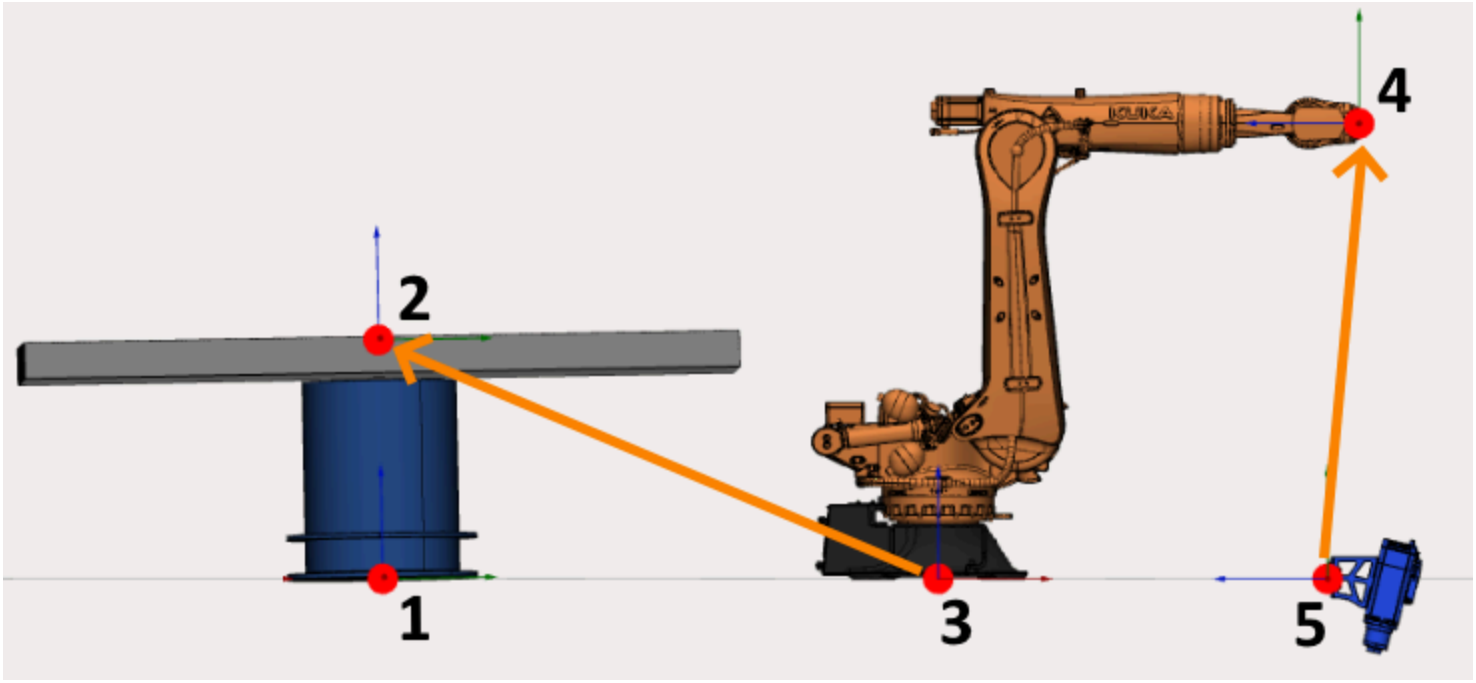
Each mechanism or object has at least one connector. It is possible to connect two mechanisms using their connectors.

A robot always has 2 connectors: first one at the base coordinate system (3) and the second one at the flange (4).

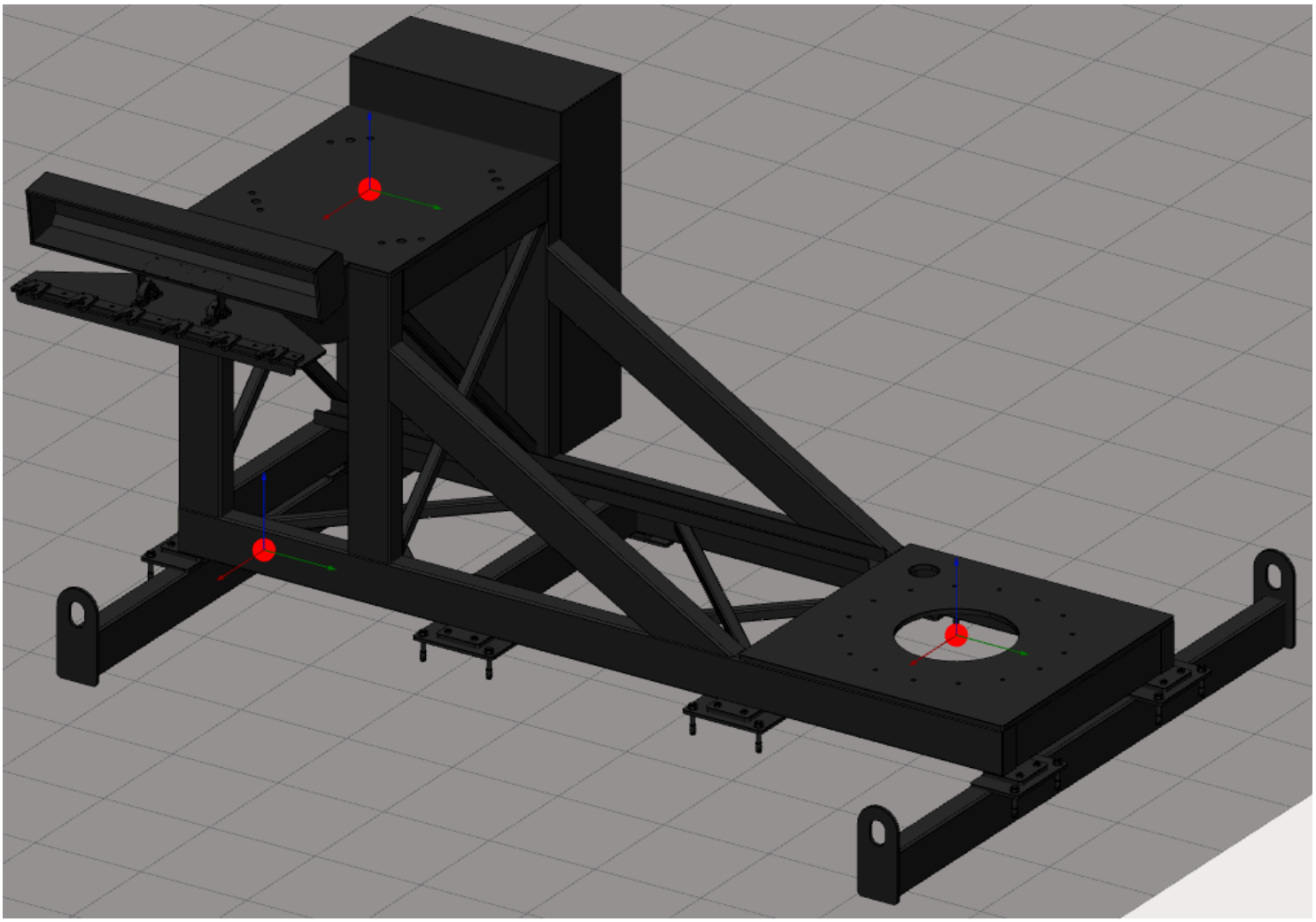
A table has at least 2 connectors: at the base (1) and at the table top (2).

End effector has one connector at the base (5).

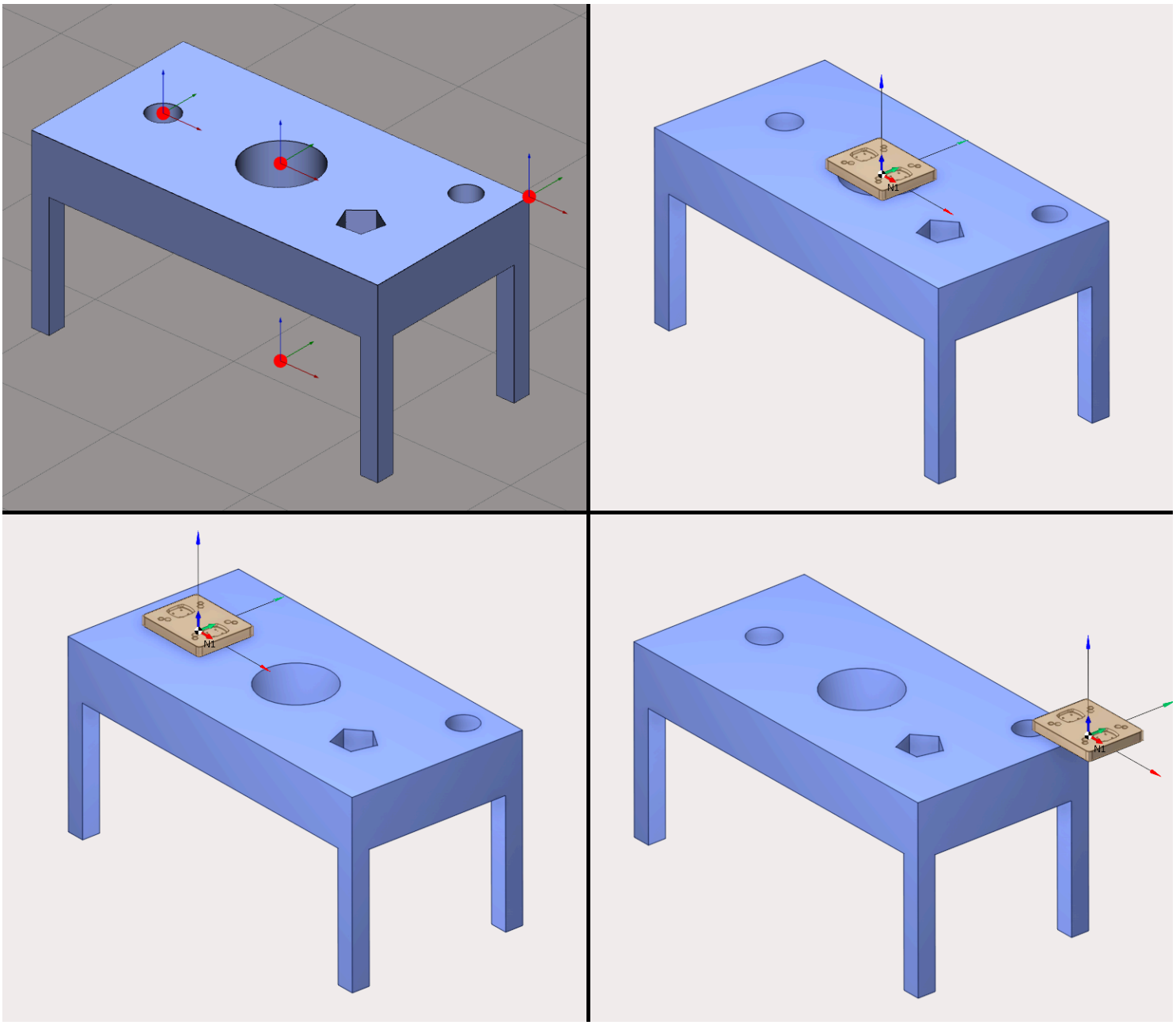
It is possible to place the robot on the table by linking the robot connector (3) to the table connector (2). It is also possible to place an end effector on the robot flange by linking the end effector connector to the robot flange connector.



A table can hold several mechanisms. If this is the case, it must have several connectors.

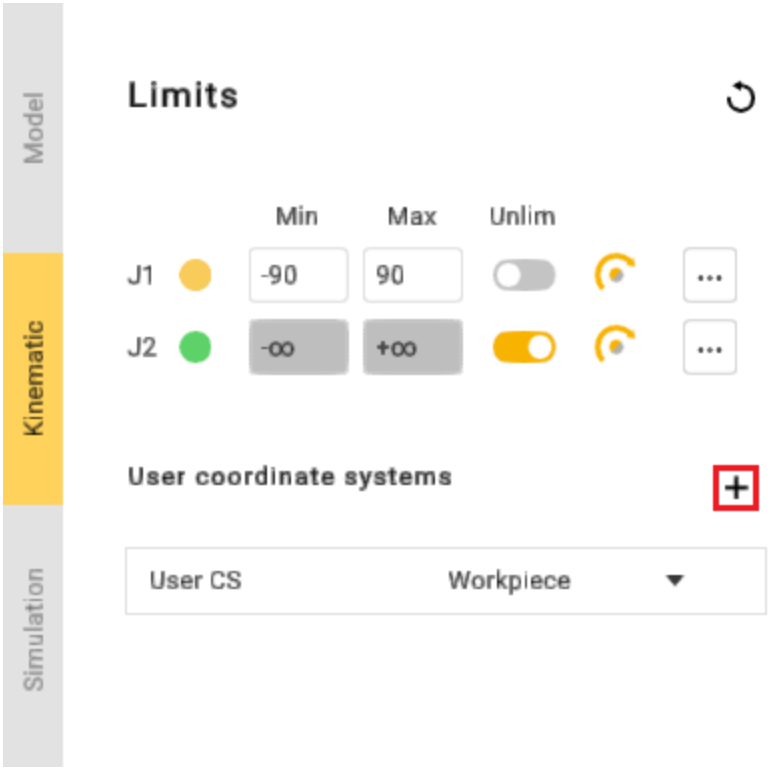


All empty connectors will be used as workpiece connectors in CAM system.

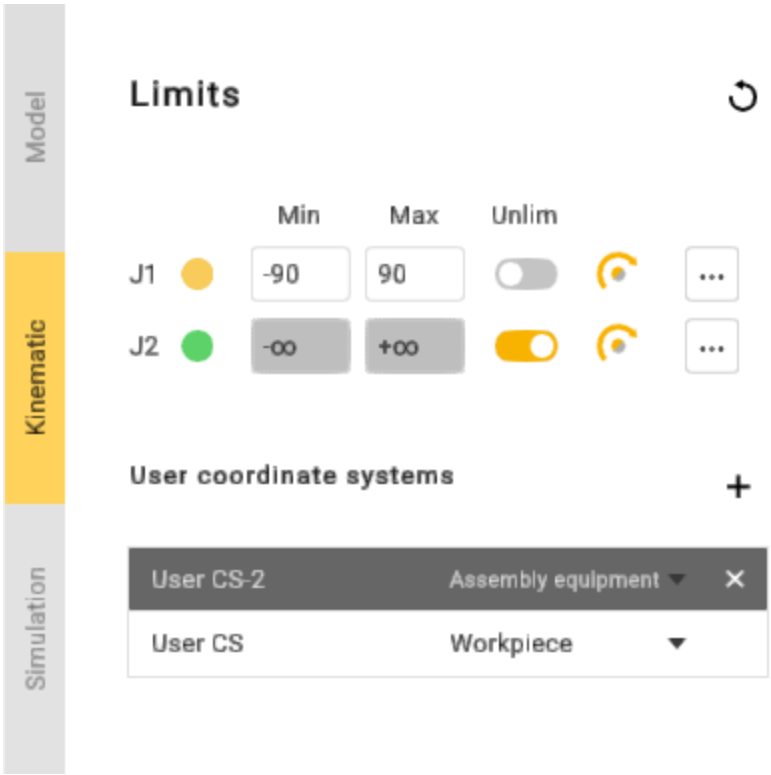


Manage table connectors

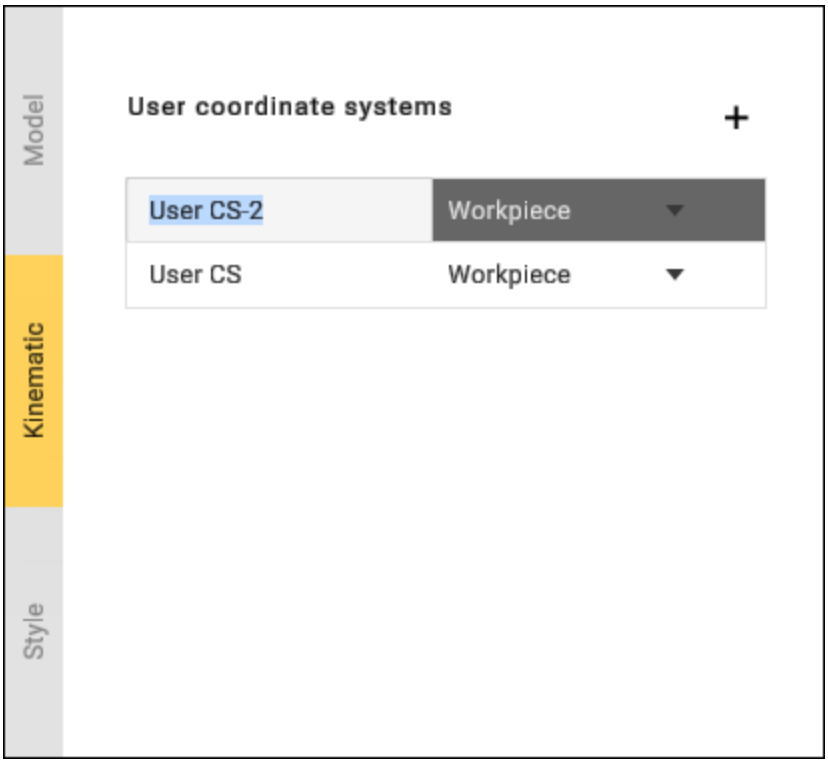
It is possible to add several connectors. Create a new table or edit an existing one and open the kinematics panel. You can check User coordinate systems panel to manage connectors.



Use + button to add a new connector.



Click on a connector to select it. It is also possible to select a connector in 3D View. Double-click on the connector name to modify it. Use Enter key to validate the new name and Esc key to cancel.



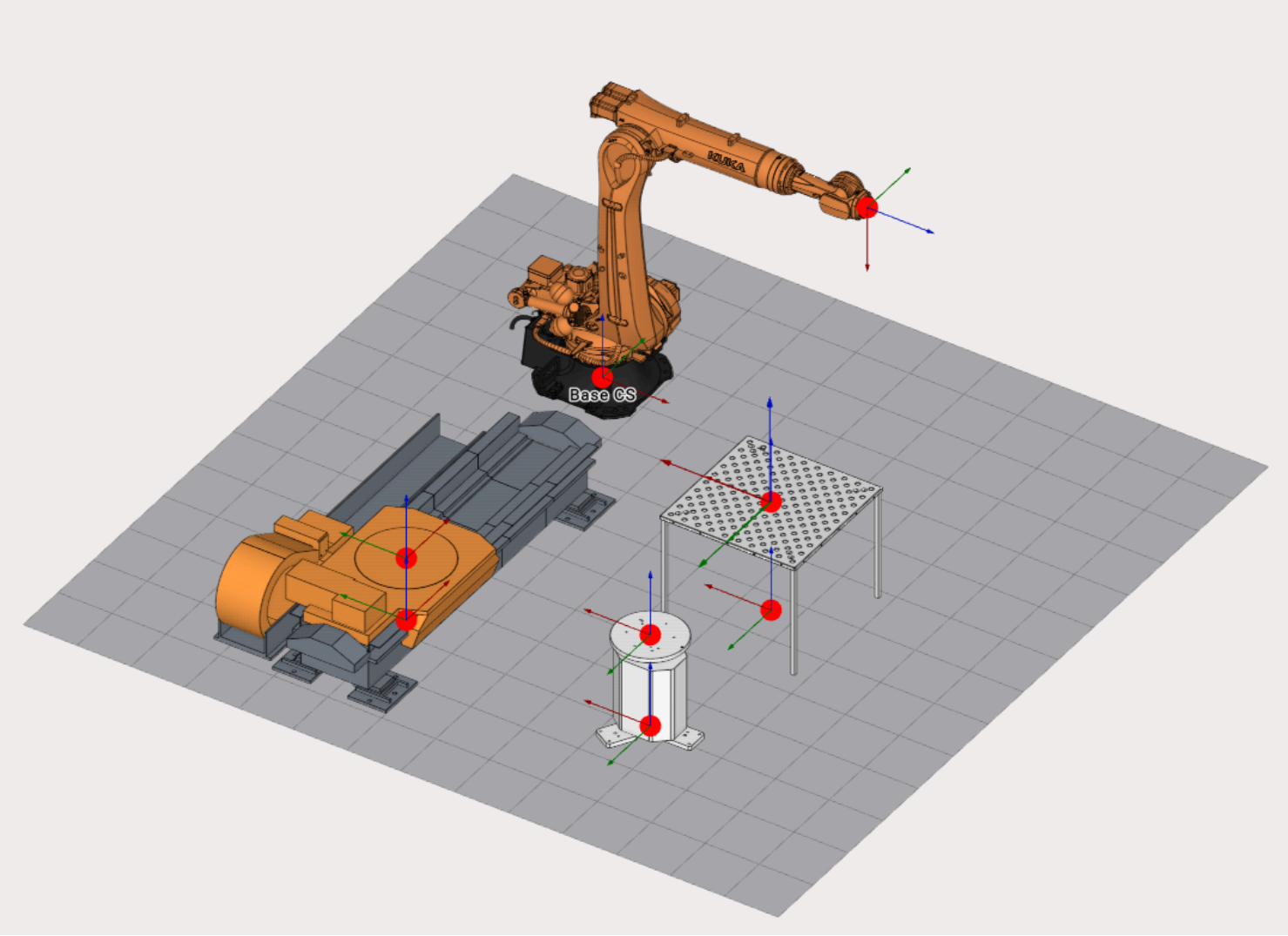
Use ✕ button to delete the connector.

A table must have at least one connector (user CS), so it is impossible to delete the last one.

It is possible to change connector position using transformation panel, dimensions or drag&drop.

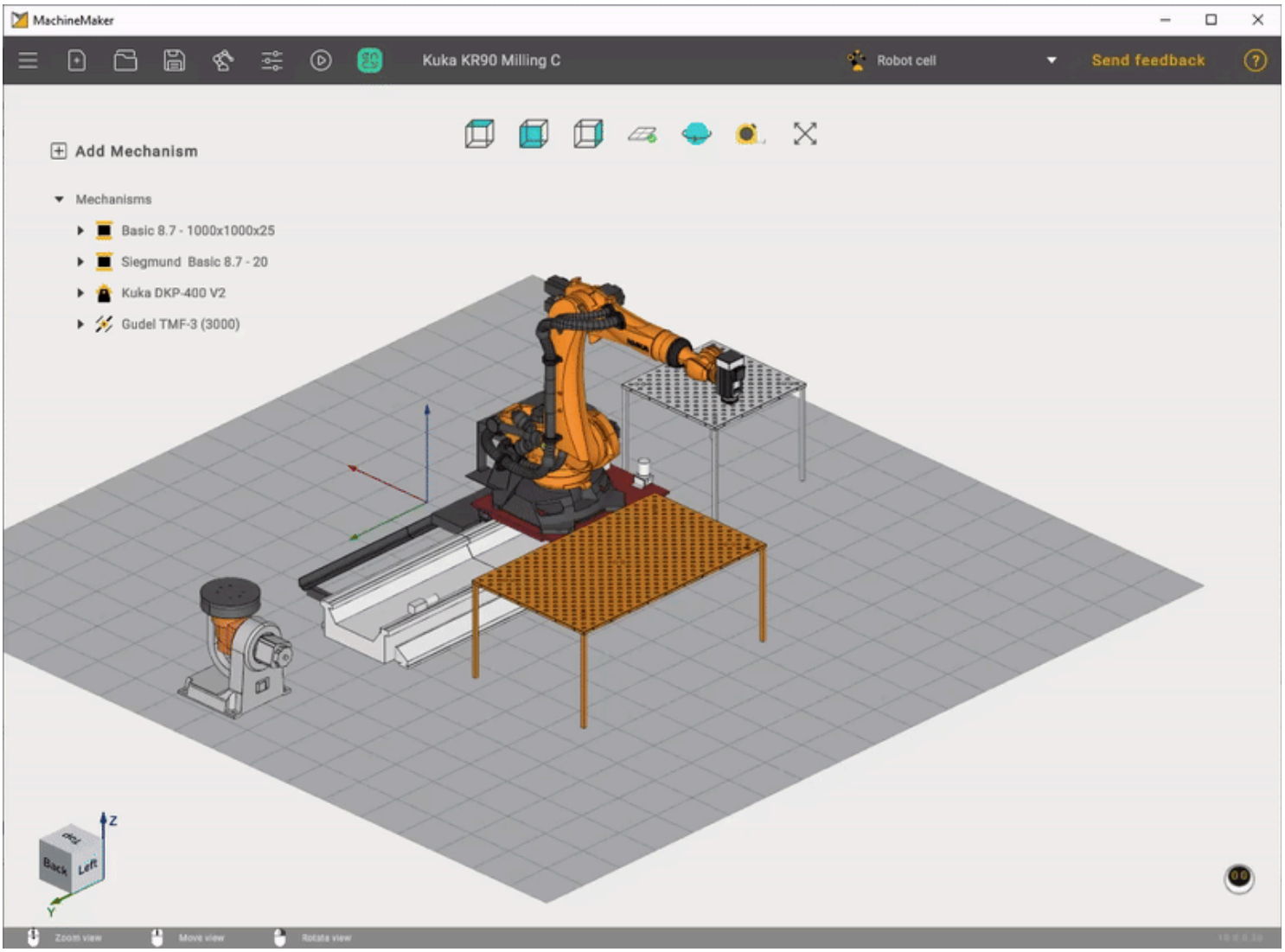
Connect mechanisms to assembly

Hold down Left Ctrl key in Assembly view to show all connectors. Empty connectors will be shown as red dots and busy connectors will be shown as green dots.



Click on a busy connector (green dot) to break the connection between mechanisms.

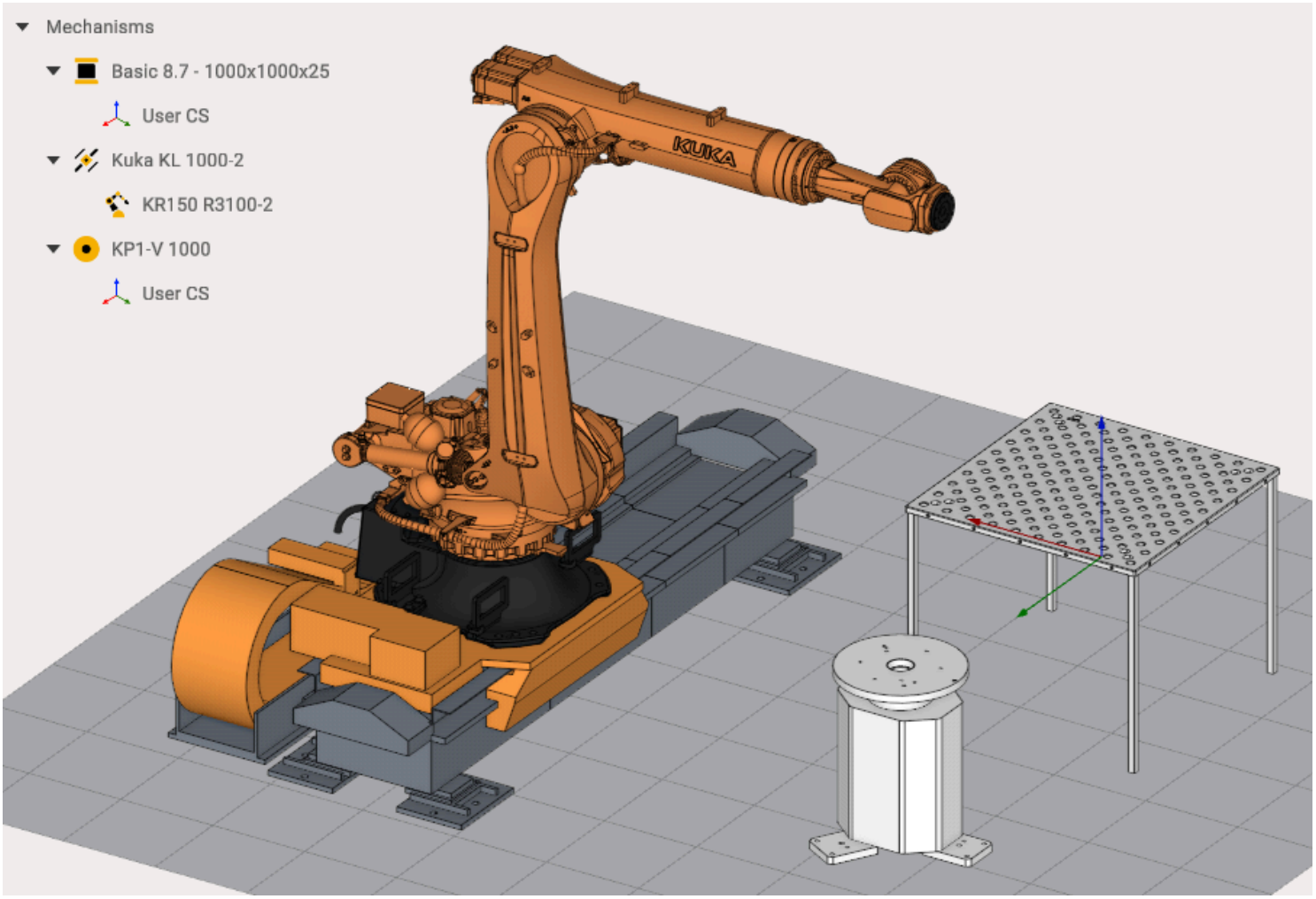
Hold down Left Ctrl key, drag any mechanism and drop onto to another one. MachineMaker will show a sticky arrow between linking connectors.



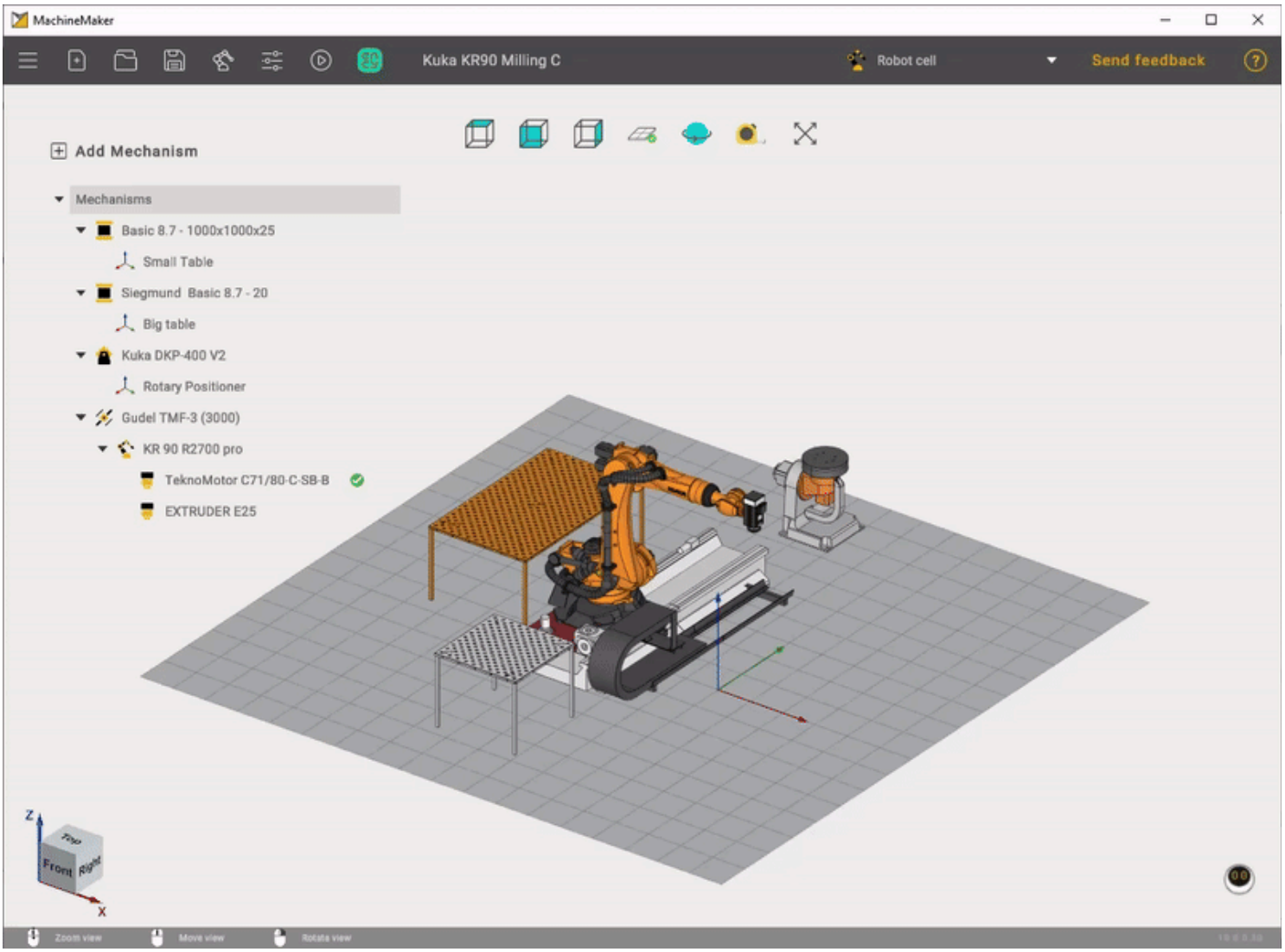
Use Left Alt key to use drag and drop function without snapping mechanisms to each other.

Using assembly tree

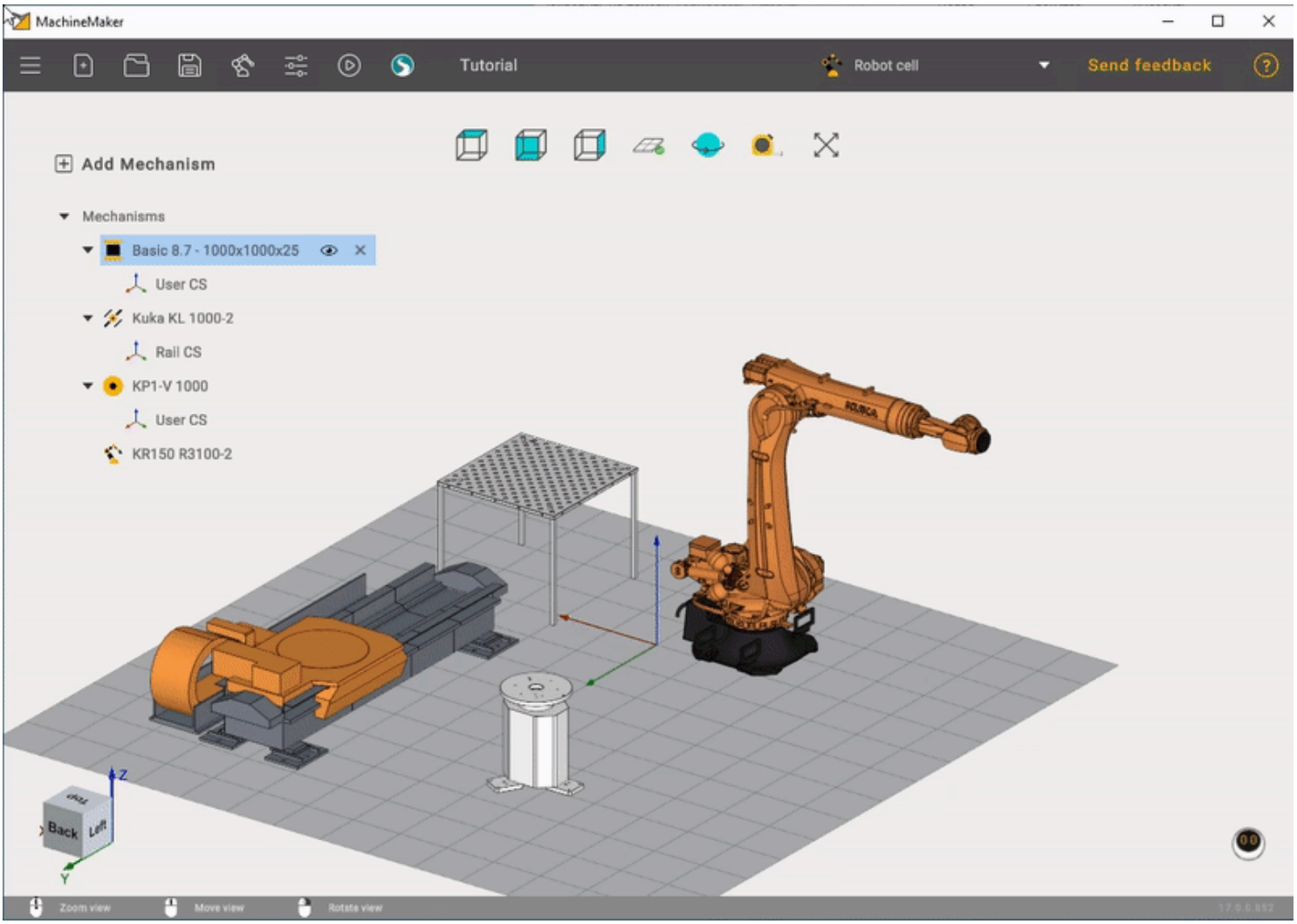
Assembly tree shows all mechanisms and connectors.



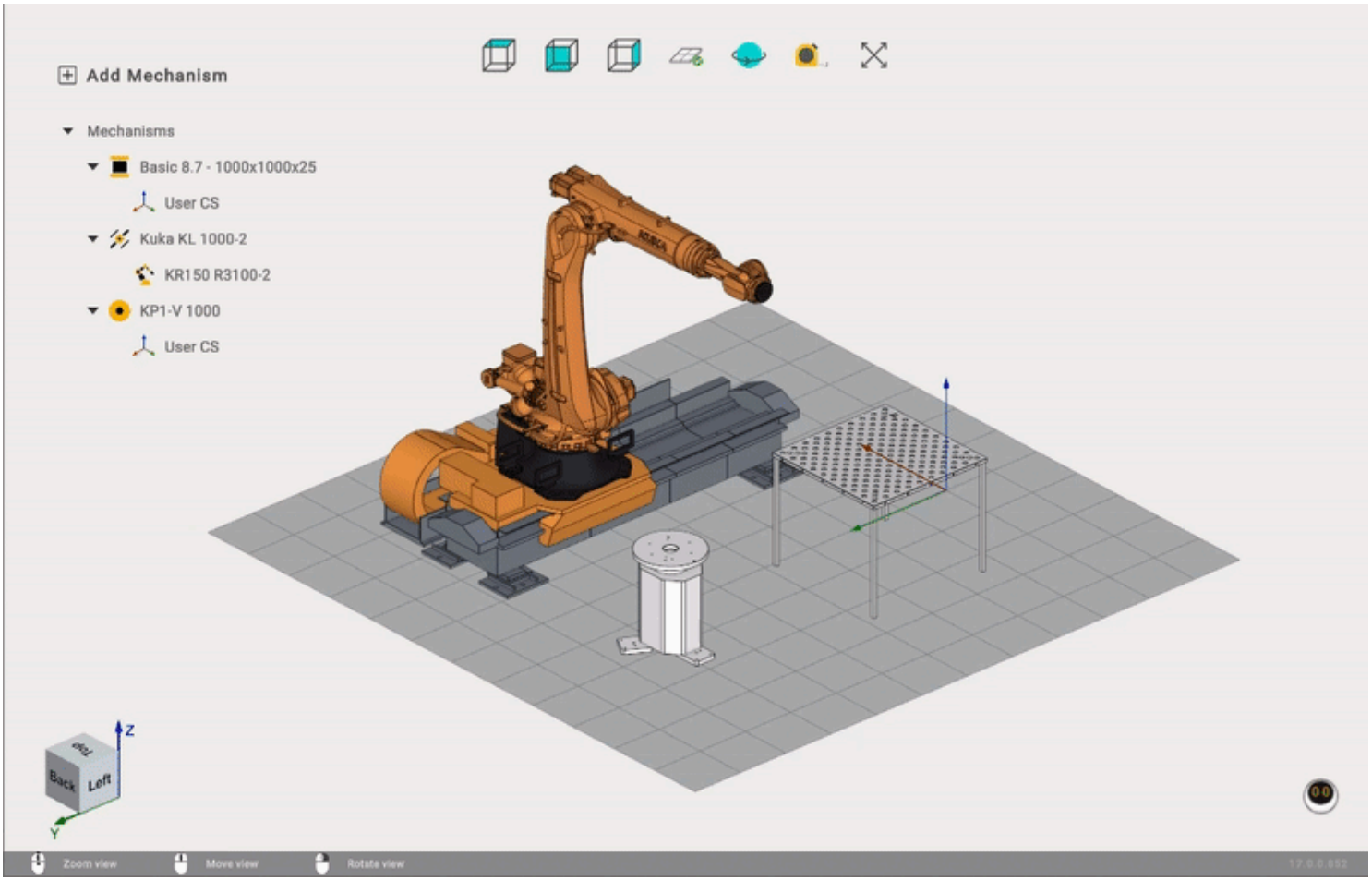
It is possible to use Drag&Drop in the assembly tree. Drag Kuka Robot and drop it to the Mechanisms node to unlink it from the Rail.



Drag Kuka Robot and drop it to the Rail node to connect mechanisms again.



Use  button to switch mechanism visibility.



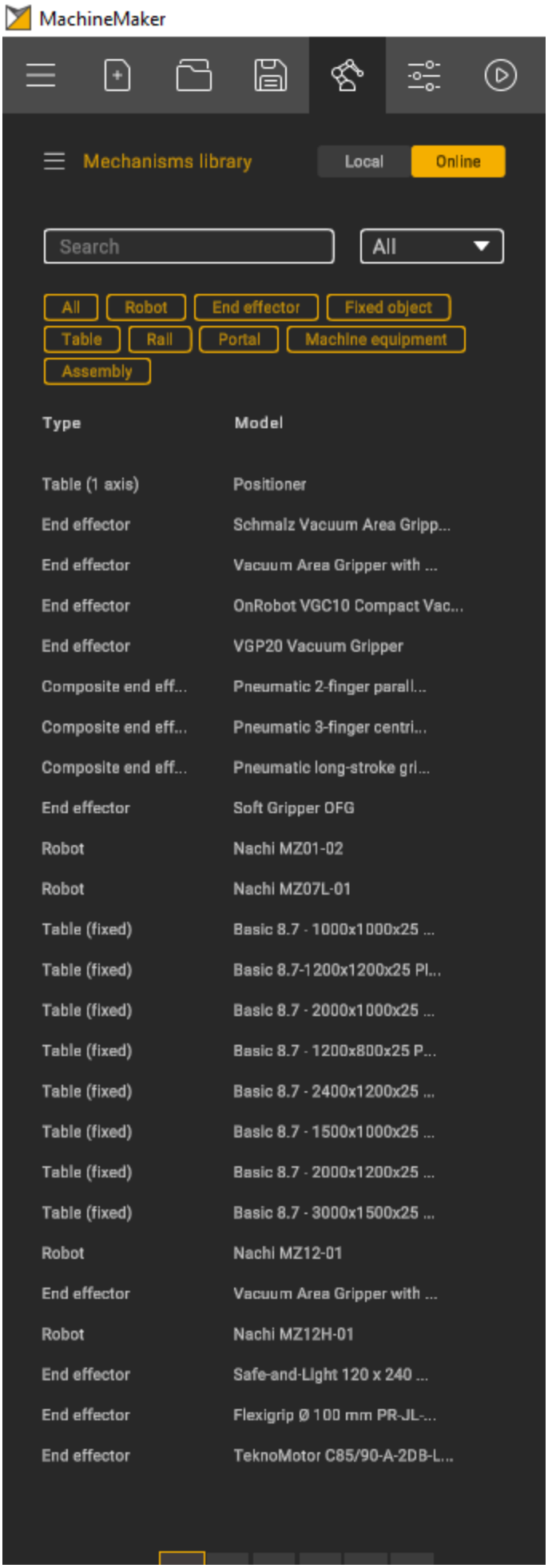
Use × button to delete a mechanism.

Be careful when deleting mechanisms. All connected mechanisms also will be deleted. Unlink all child mechanisms if you want to delete only one mechanism.

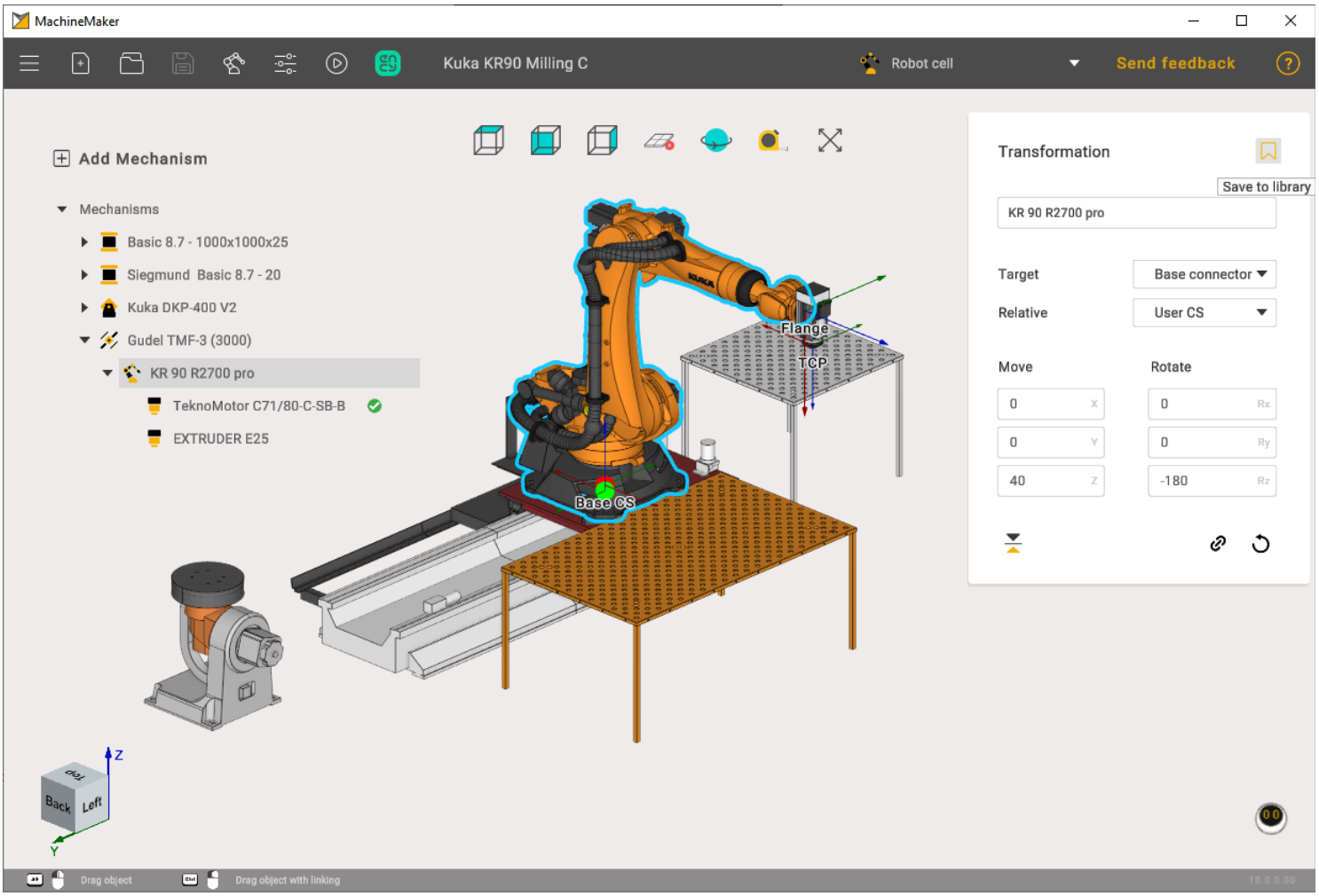
It is possible to add several end effectors and select the active end effector using ✓ button.

Mechanisms Library

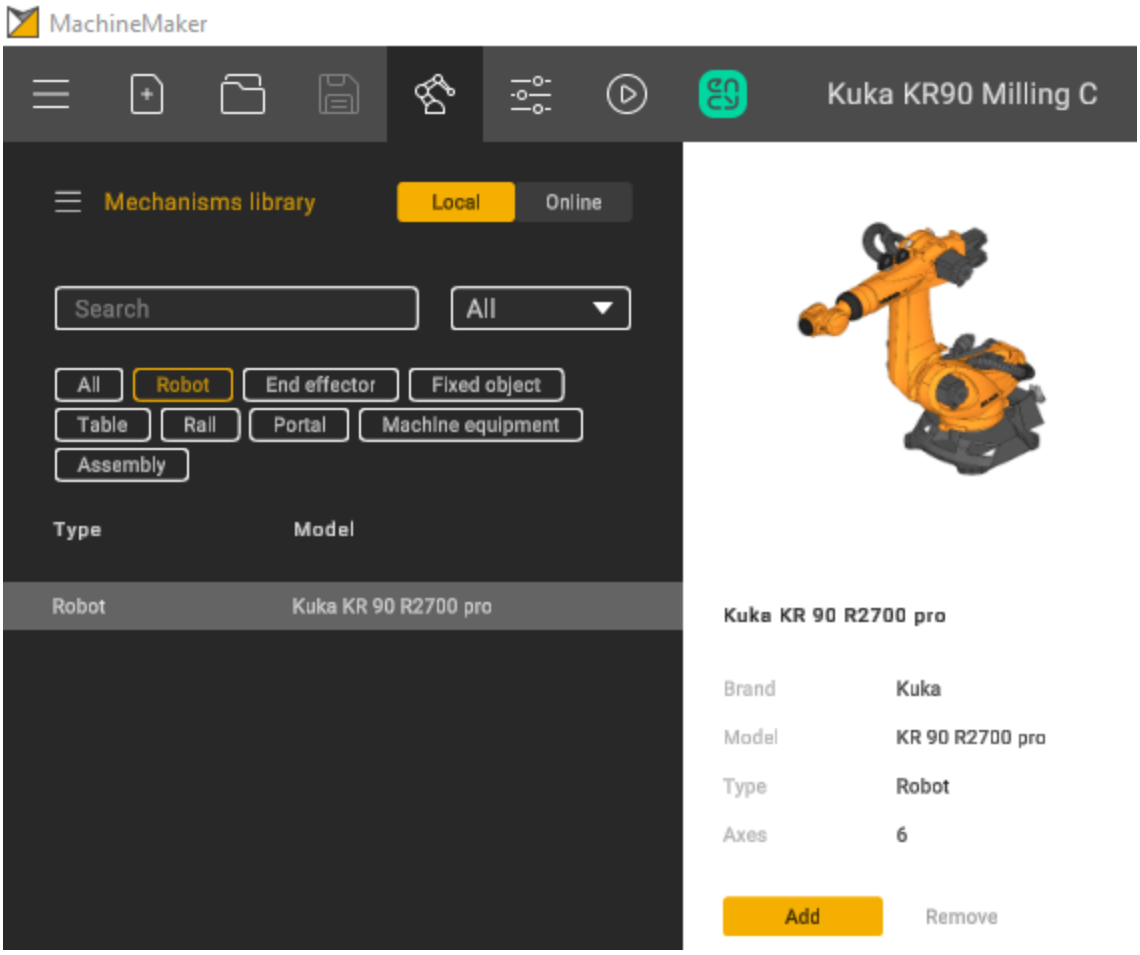
Use  button to open Mechanisms library.


MachineMaker
Mechanisms library
Local
Online
Search
All
All
Robot
End effector
Fixed object
Table
Rail
Portal
Machine equipment
Assembly
Type
Model
Table (1 axis)
Positioner
End effector
Schmalz Vacuum Area Gripp...
End effector
Vacuum Area Gripper with ...
End effector
OnRobot VGC10 Compact Vac...
End effector
VGP20 Vacuum Gripper
Composite end eff...
Pneumatic 2-finger parall...
Composite end eff...
Pneumatic 3-finger centri...
Composite end eff...
Pneumatic long-stroke gri...
End effector
Soft Gripper OFG
Robot
Nachi MZ01-02
Robot
Nachi MZ07L-01
Table (fixed)
Basic 8.7 - 1000x1000x25 ...
Table (fixed)
Basic 8.7-1200x1200x25 Pl...
Table (fixed)
Basic 8.7 - 2000x1000x25 ...
Table (fixed)
Basic 8.7 - 1200x800x25 P...
Table (fixed)
Basic 8.7 - 2400x1200x25 ...
Table (fixed)
Basic 8.7 - 1500x1000x25 ...
Table (fixed)
Basic 8.7 - 2000x1200x25 ...
Table (fixed)
Basic 8.7 - 3000x1500x25 ...
Robot
Nachi MZ12-01
End effector
Vacuum Area Gripper with ...
Robot
Nachi MZ12H-01
End effector
Safe-and-Light 120 x 240 ...
End effector
Flexigrip Ø 100 mm PR-JL-...
End effector
TeknoMotor C85/90-A-2DB-L...

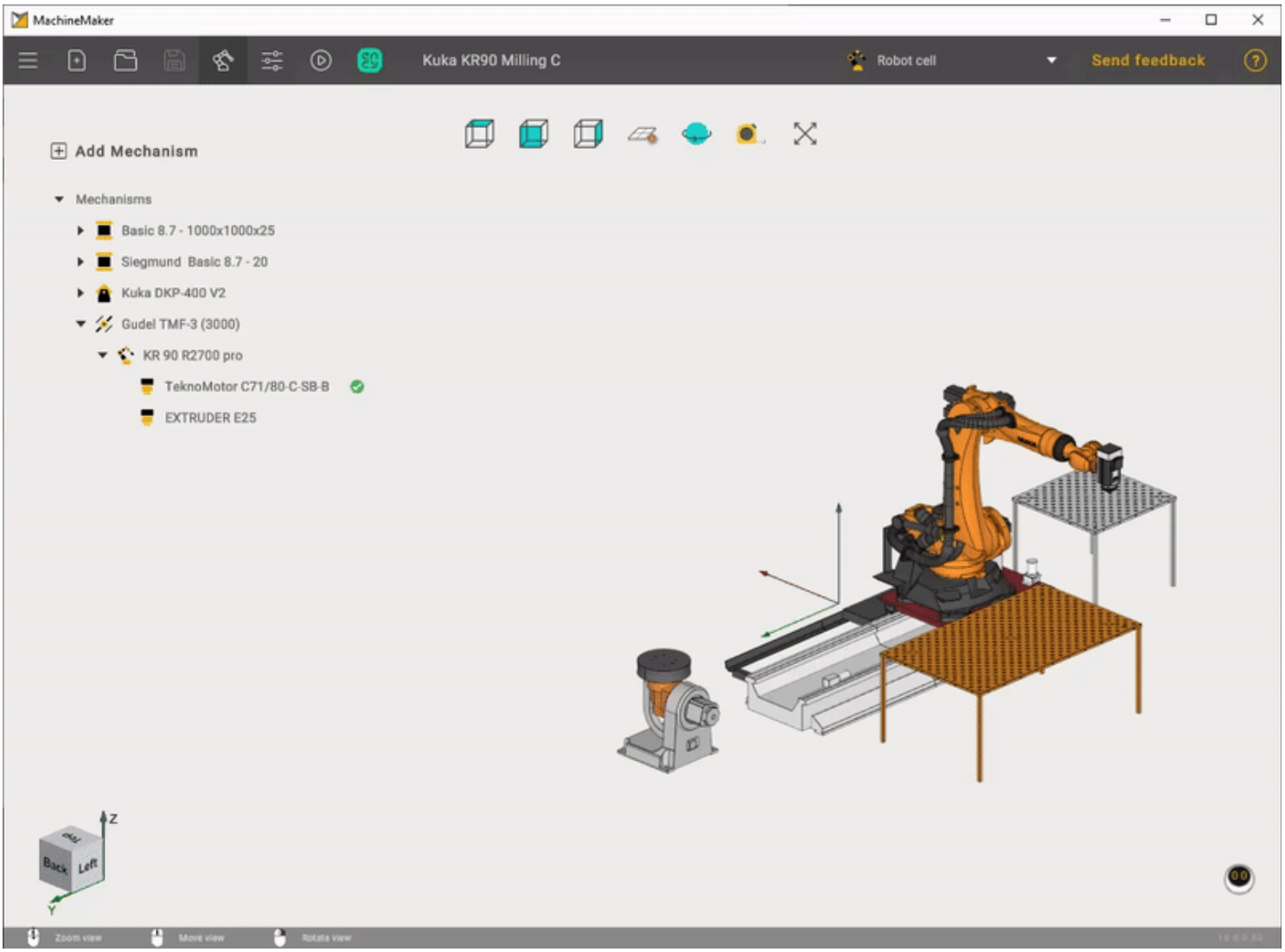
It is possible to switch between a Local and Online libraries. Any mechanism can be saved to your local library. Select mechanism in assembly and click Save to library button.



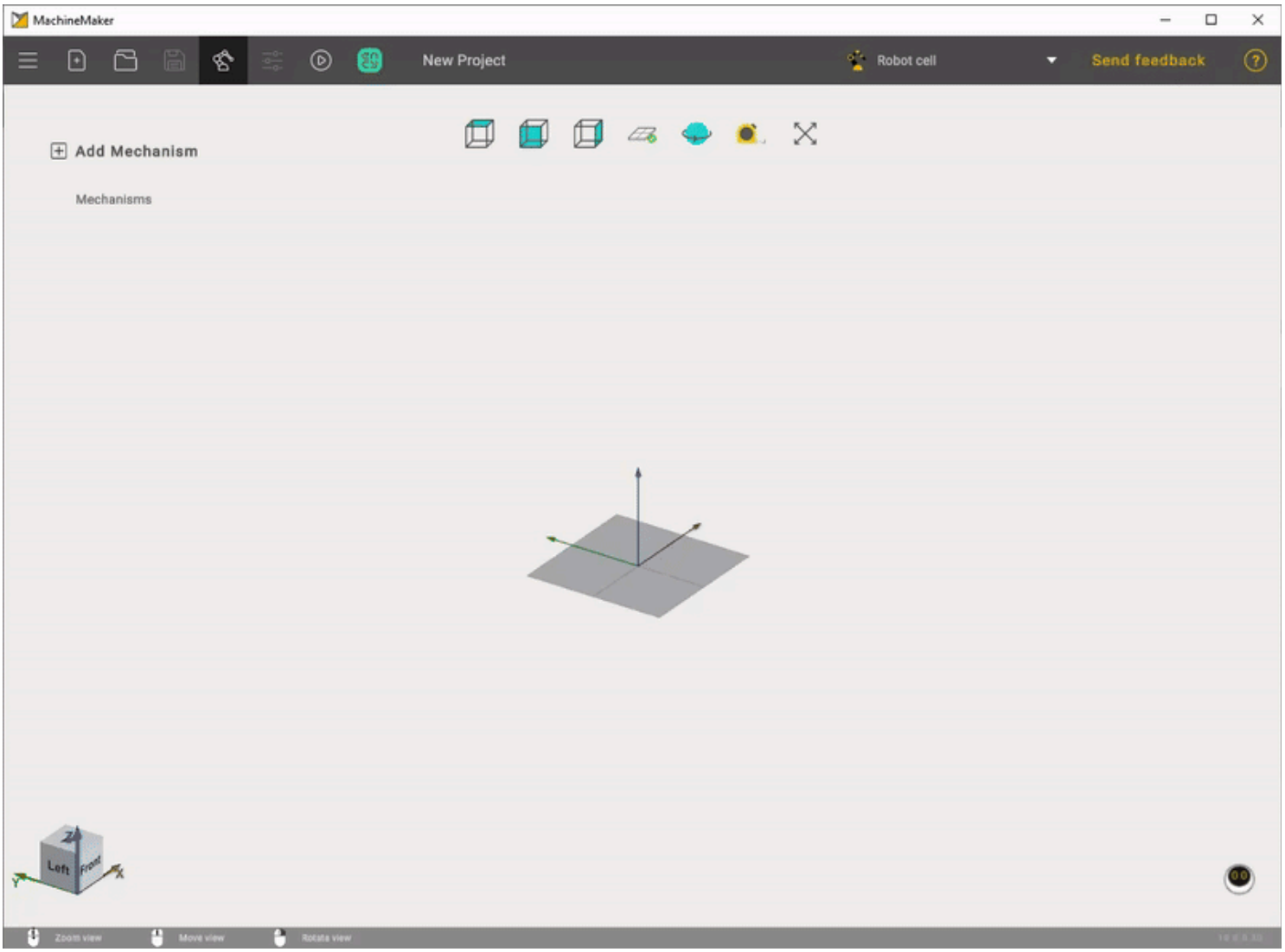
Use Search field and OEM field to find a desired machine/robot.



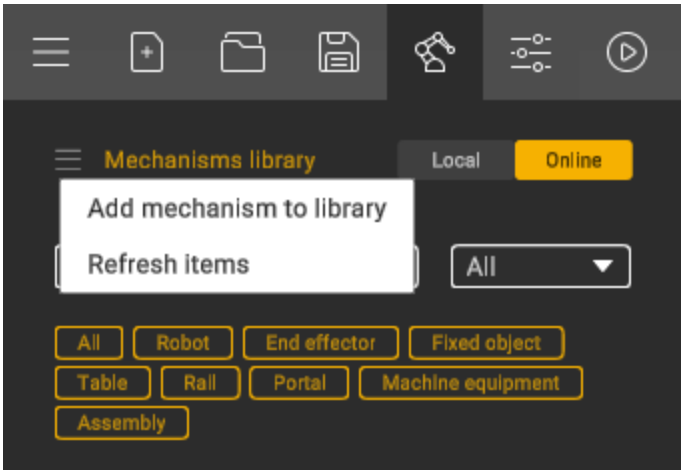
It is also possible to specify the mechanism type.



Finally, click the Add button to add selected the mechanism to your assembly.



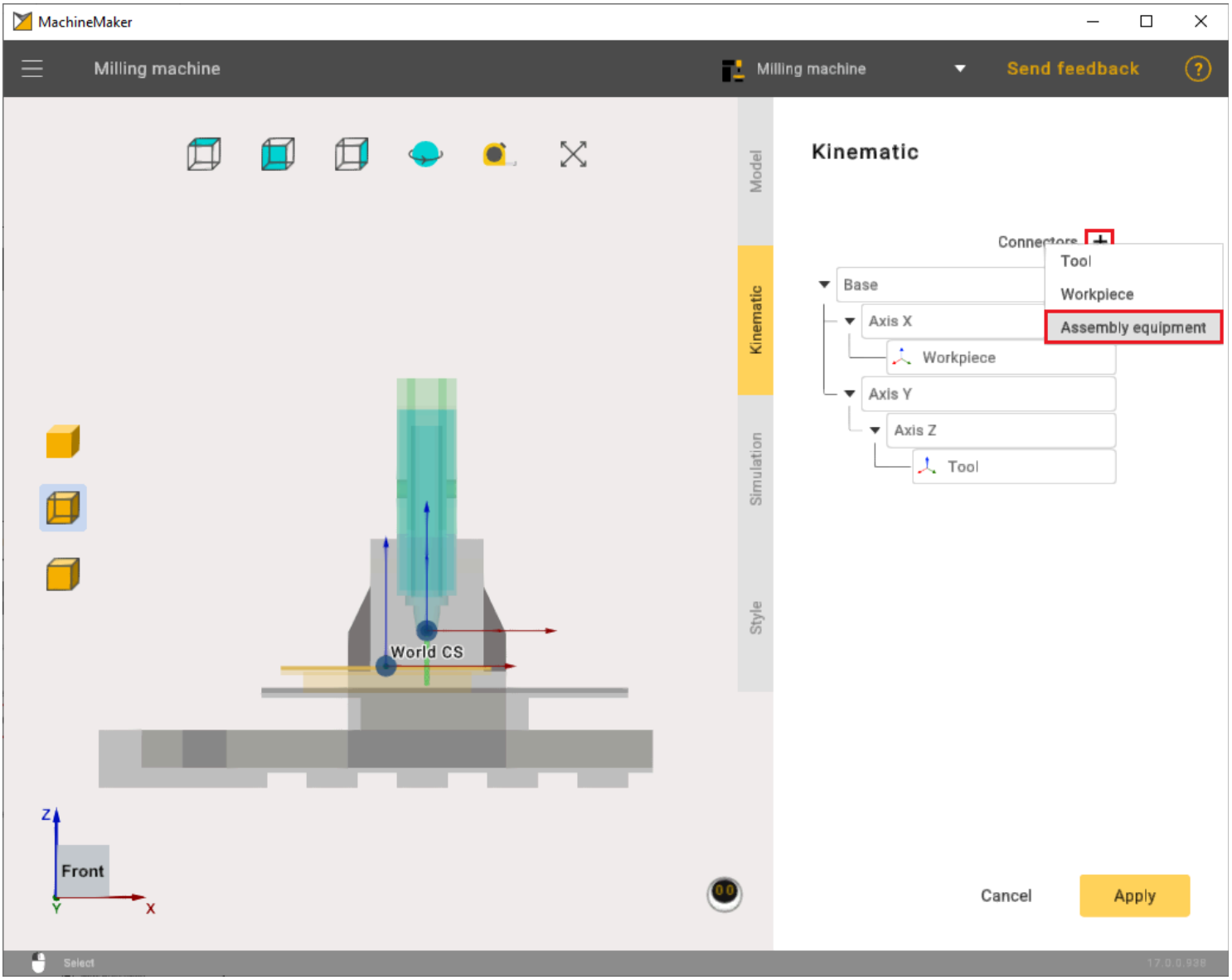
It is possible to add MachineMaker mechanism file (.mmm) to your local library manually using ☰ menu.



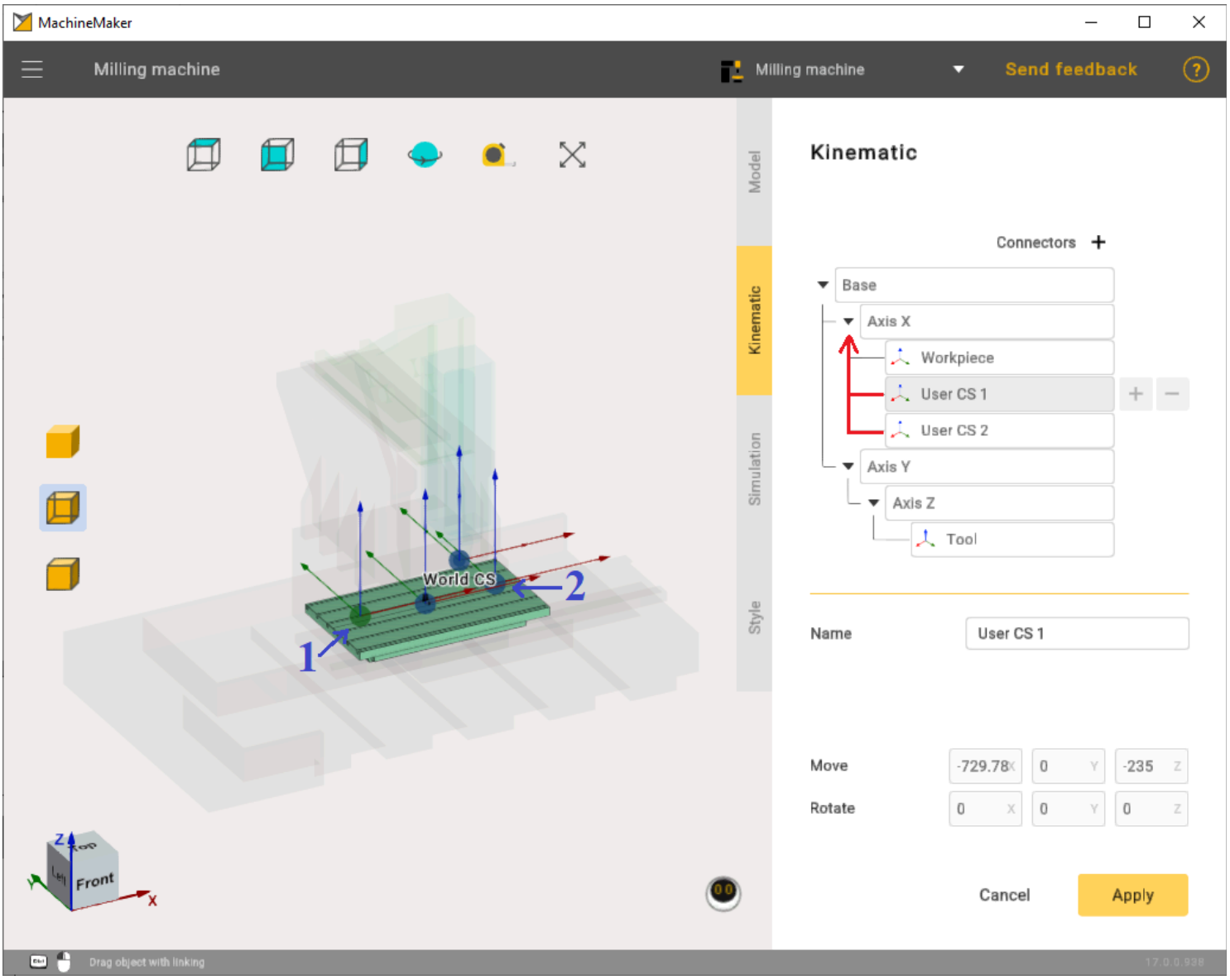
Machine equipment configuration

At the very beginning, before adding the machine equipment, we should prepare our machine and add the attachment points for our machine equipment.

To add connection points, click the plus button in the kinematics tab when editing your machine and select the desired connection.



After that, in the kinematics tree, you need to attach the points to the desired axis and position them on the machine.



You can download examples of machine and machine equipment here:

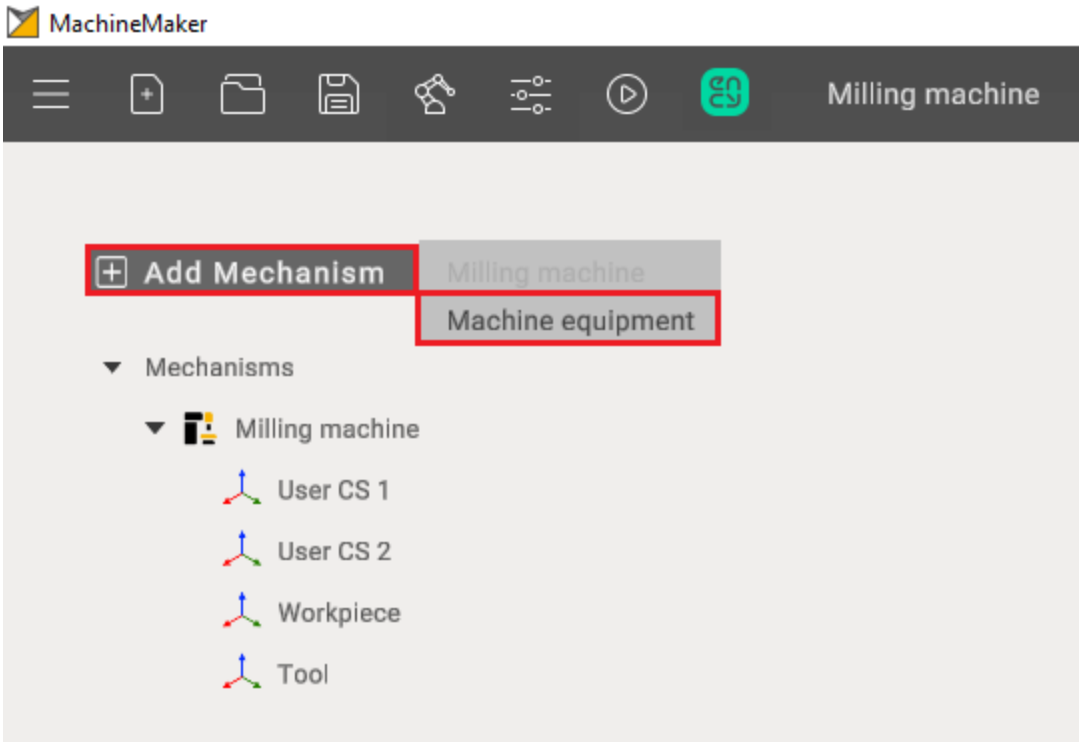
1. Machine equipment 1.rar
2. Machine equipment 2.rar
3. Milling machine.rar

Machine equipment has 2 types of axles:

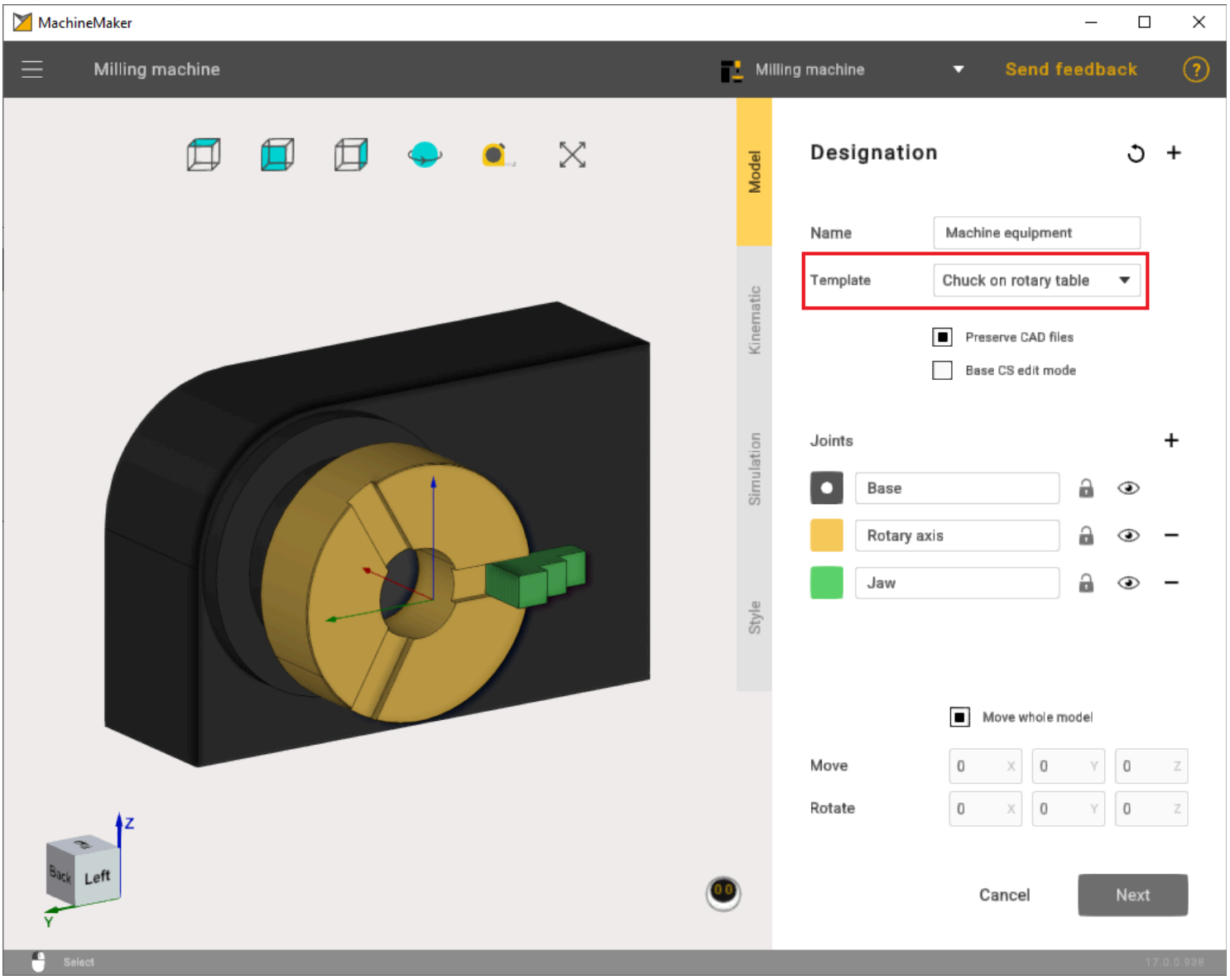
1. Rotary type;
2. Linear type.

In this chapter we will briefly look at the settings of these two types

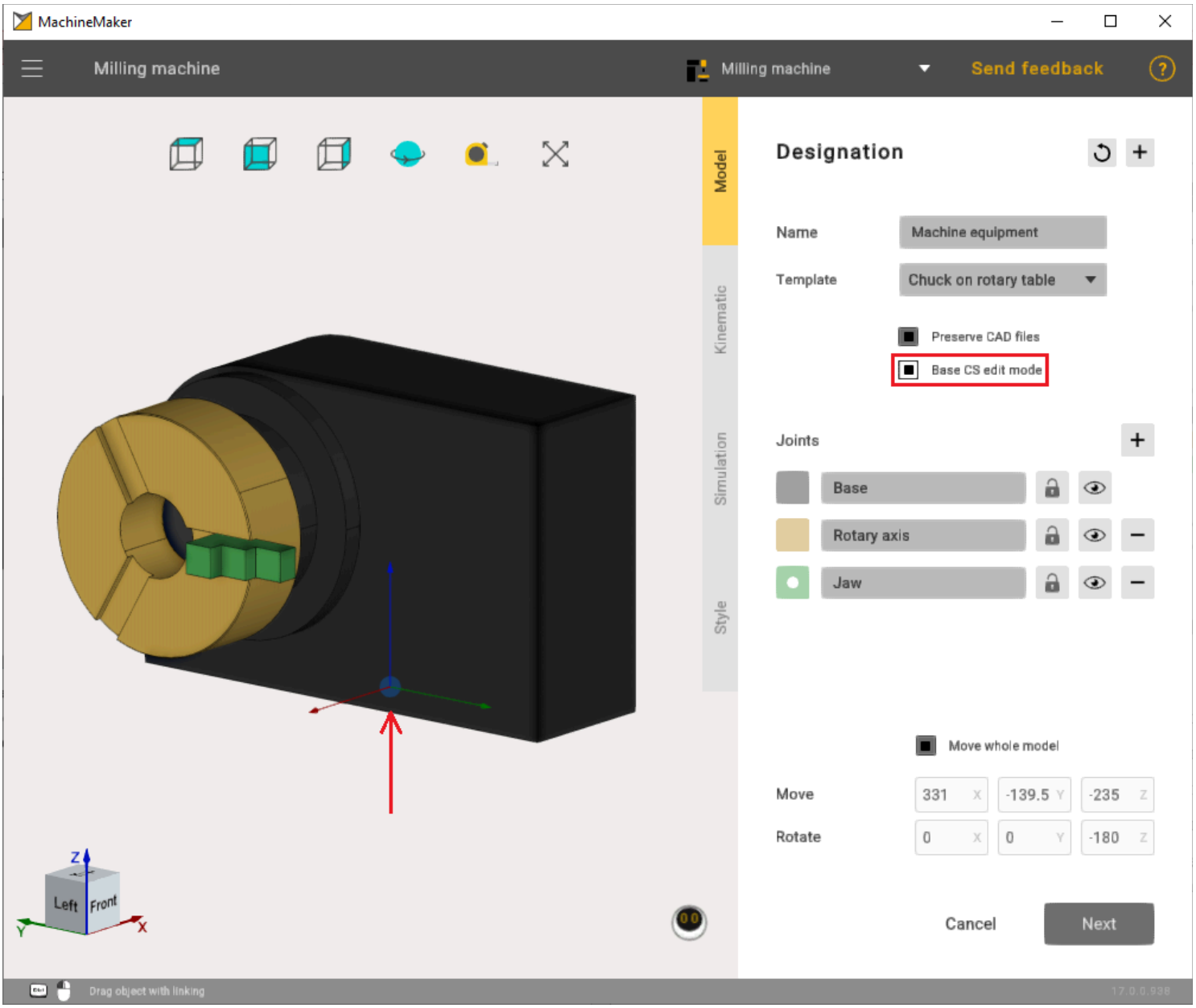
To add machine equipment use the "Add Mechanism" button.



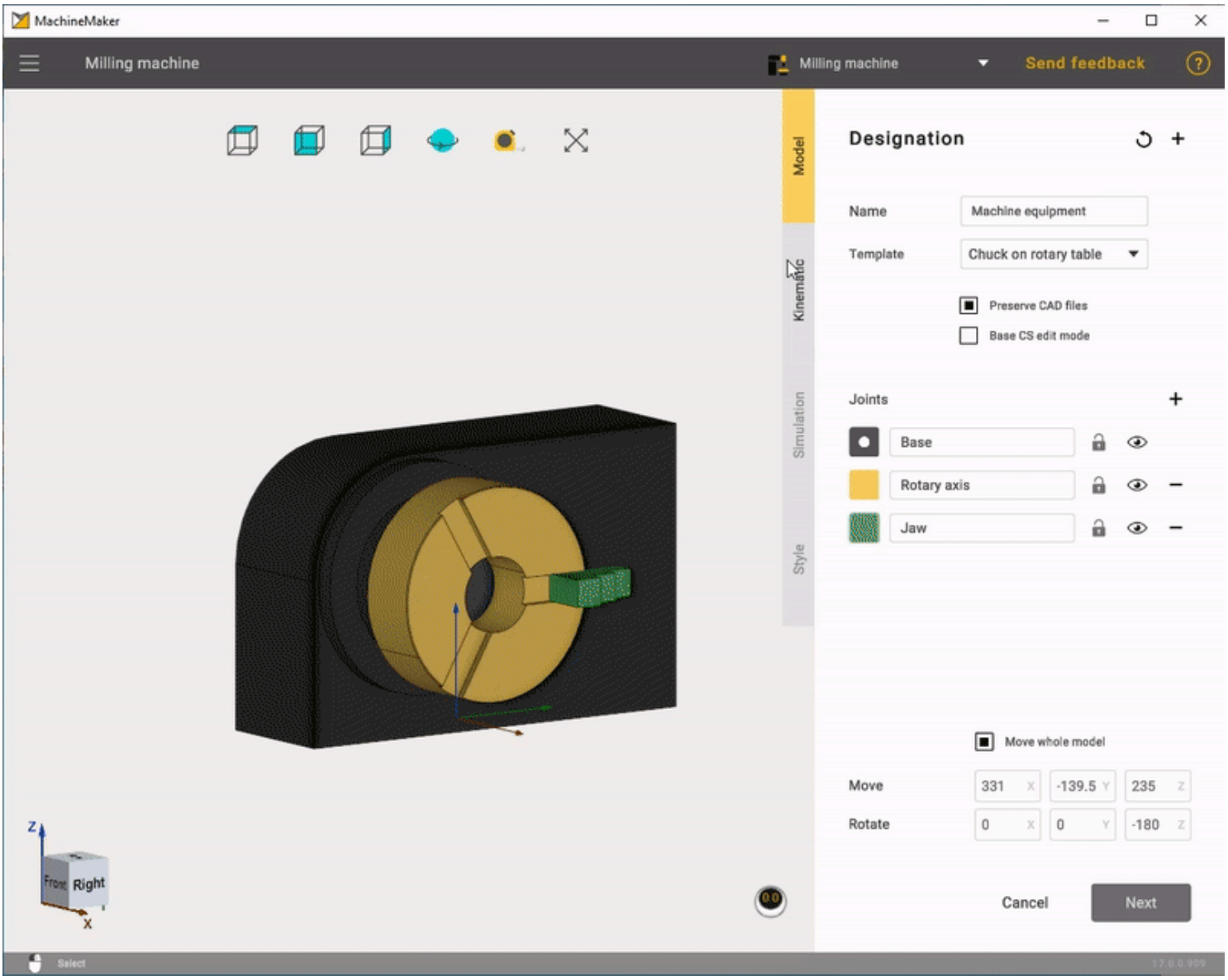
After importing machine equipment, select the appropriate template. Also mark the machine equipment elements with the correct color.



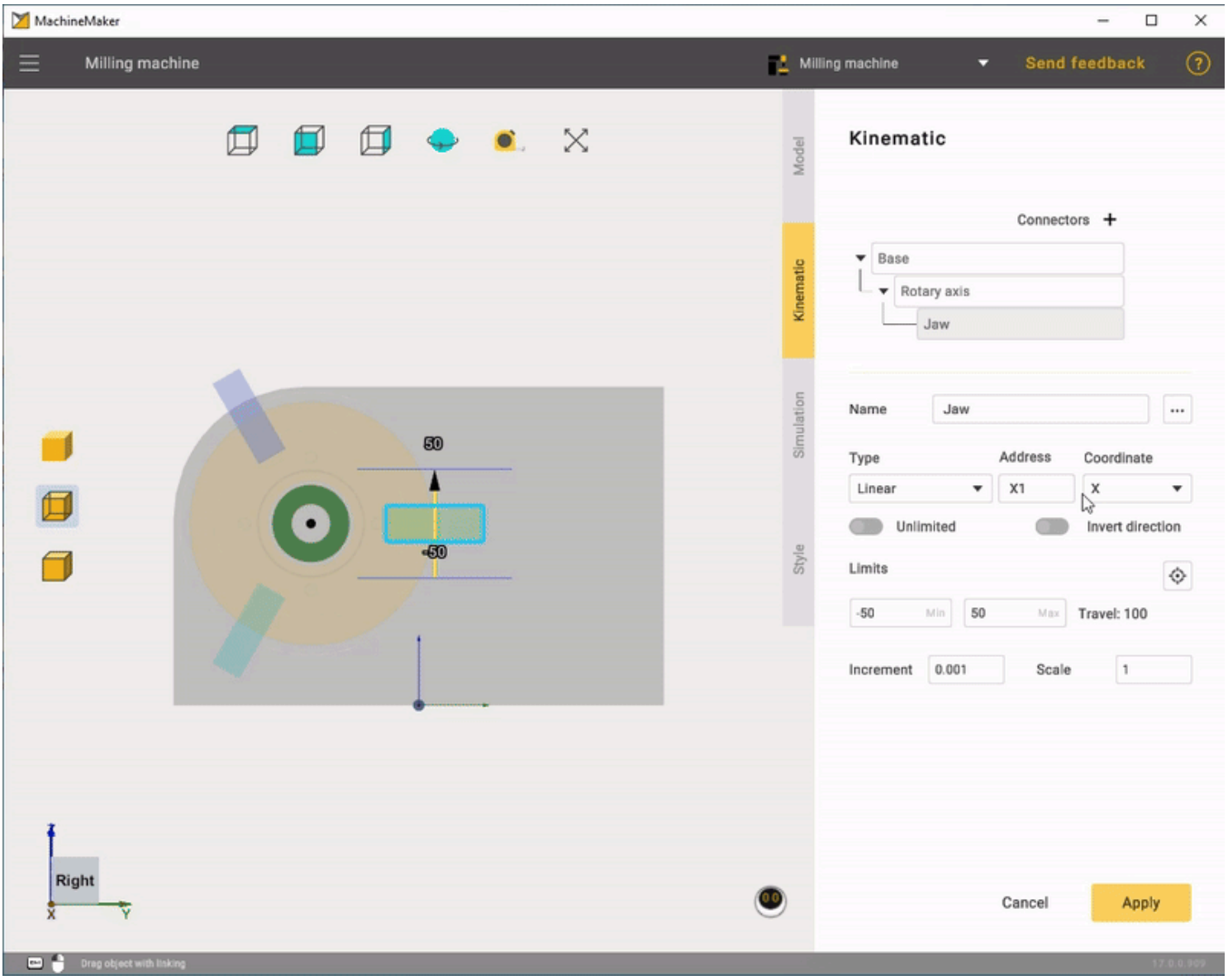
Additionally, if necessary, correctly set the point through the Base CS edit mode to ensure that the machine equipment is properly secured on the machine in the future.



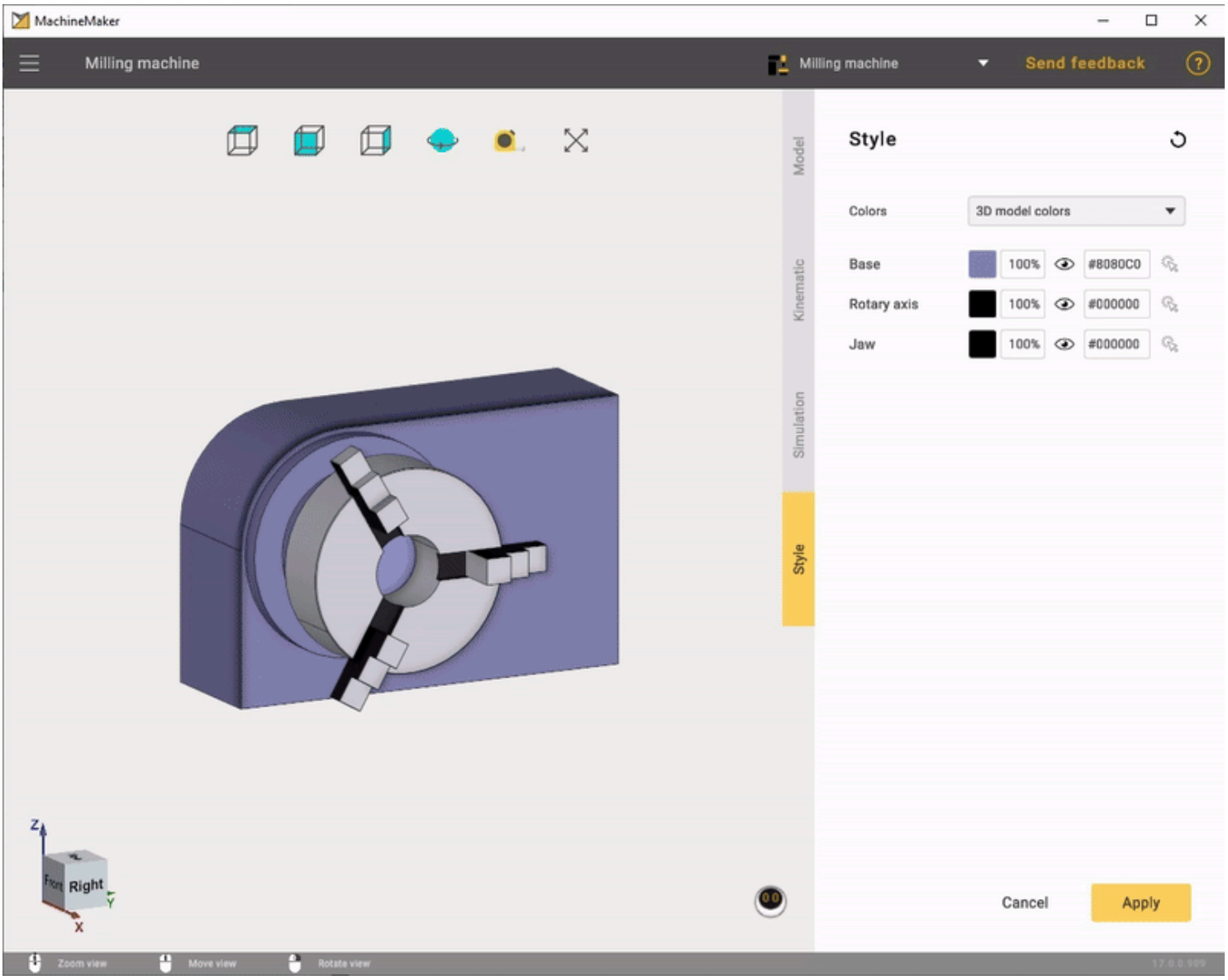
In the Kinematic settings, it is important to correctly set the rotary axis.



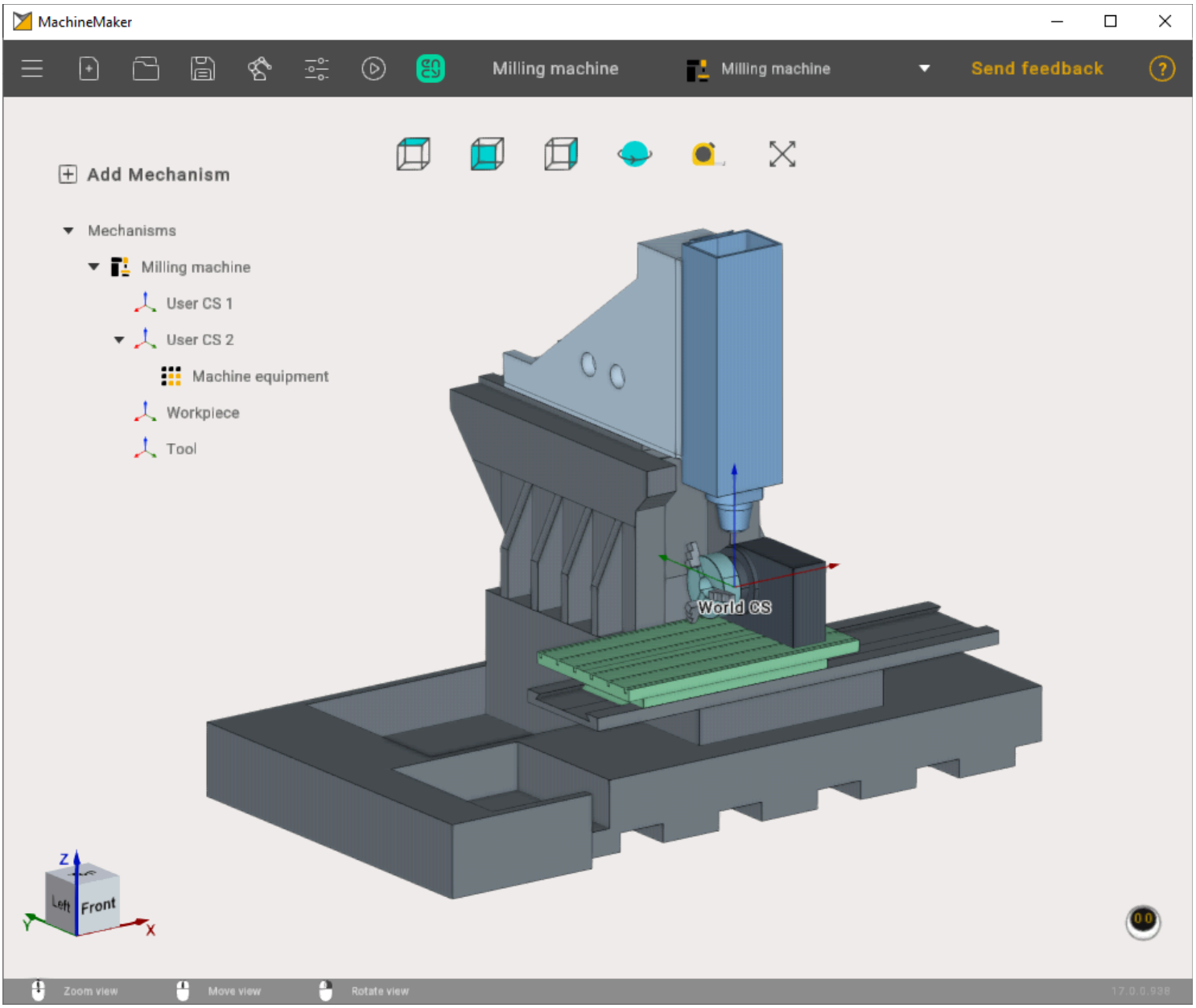
It's also crucial to provide the correct coordinates for the jaws.



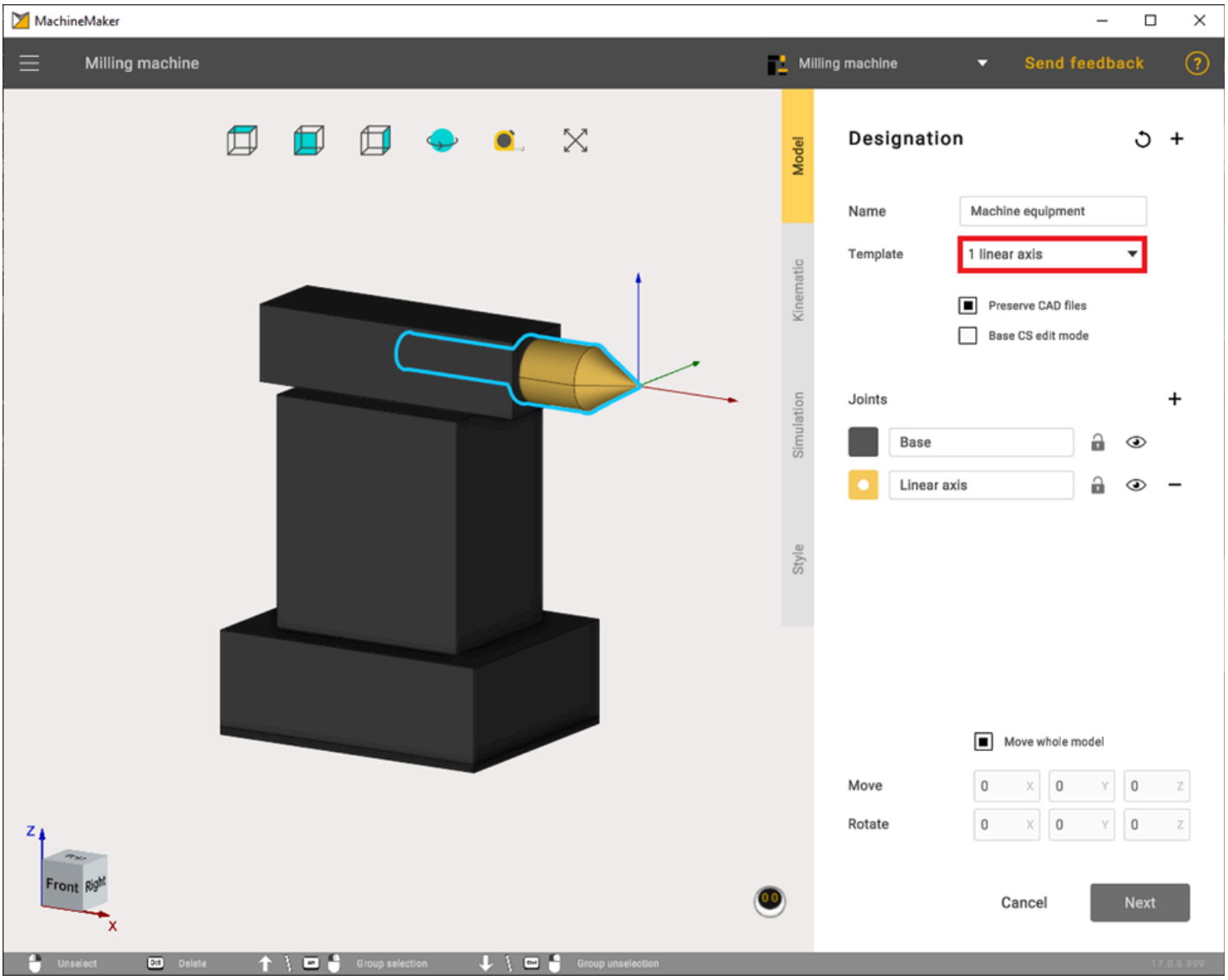
In the Style mode, you can adjust colors to match the machine or choose a custom color.



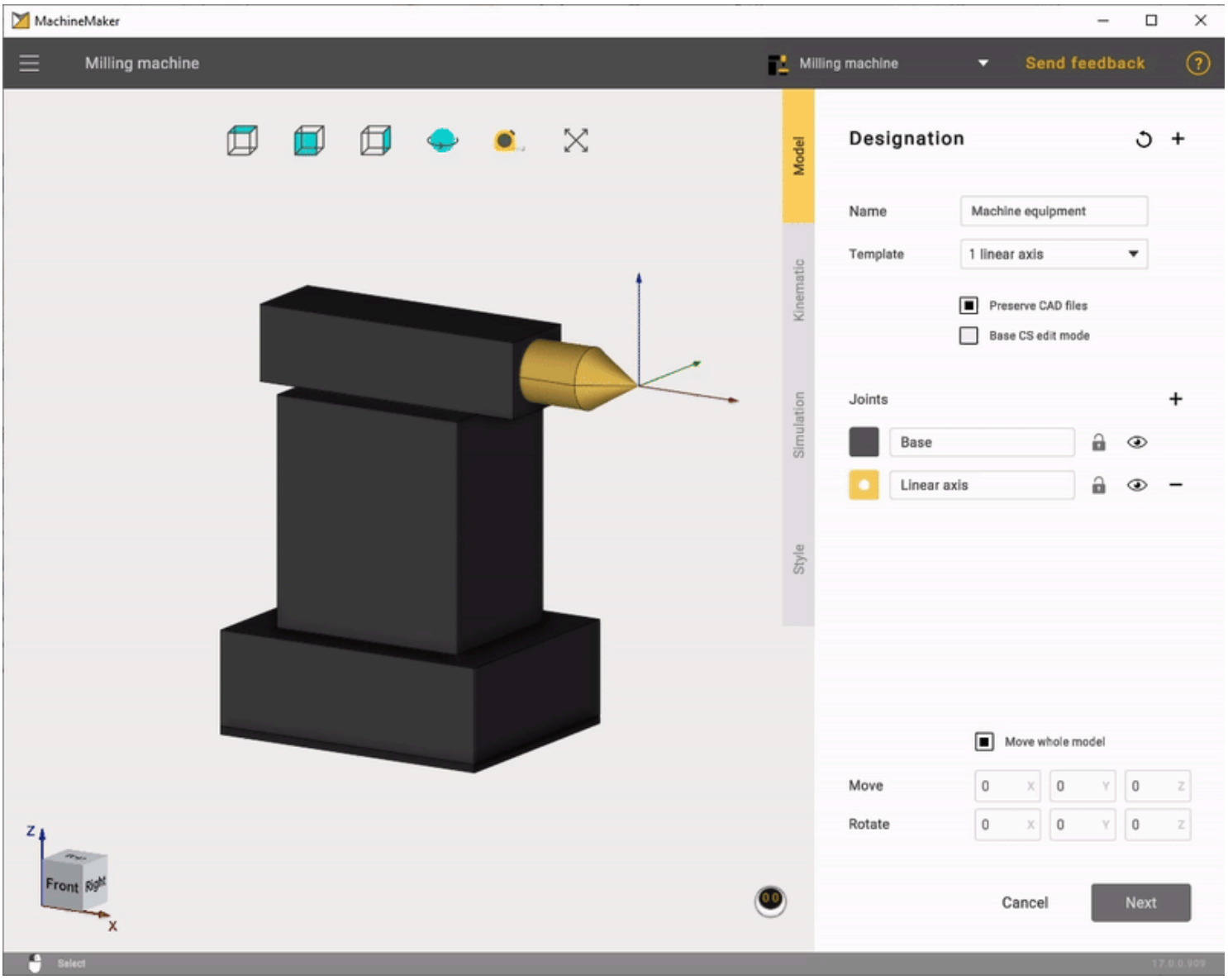
After all settings have been applied, you will need to position the machine equipment on the previously set point.



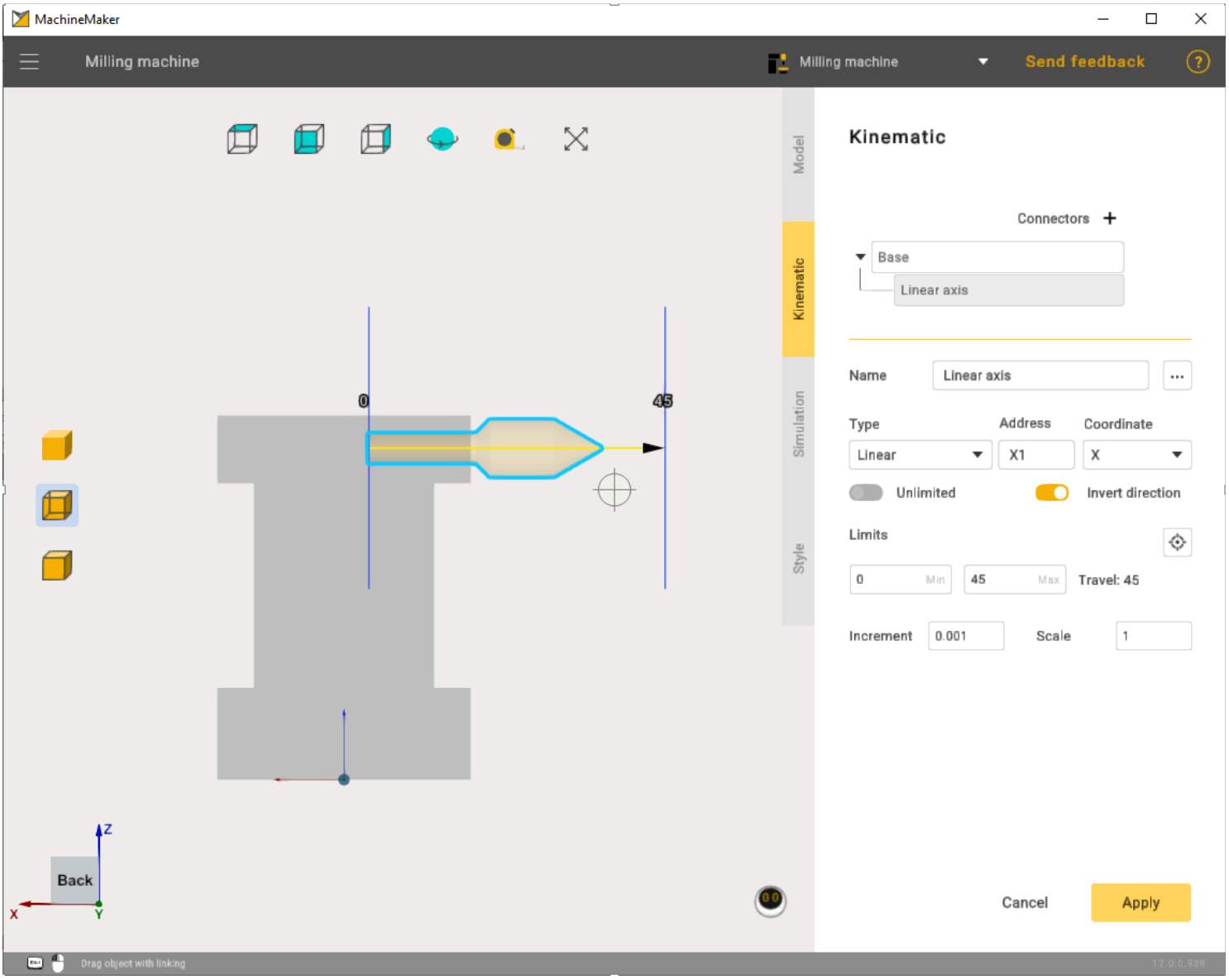
In the second case, let's consider an example of machine equipment with a linear axis. The settings are straightforward. You need to select the appropriate template and configure the motion coordinates of the linear axis.



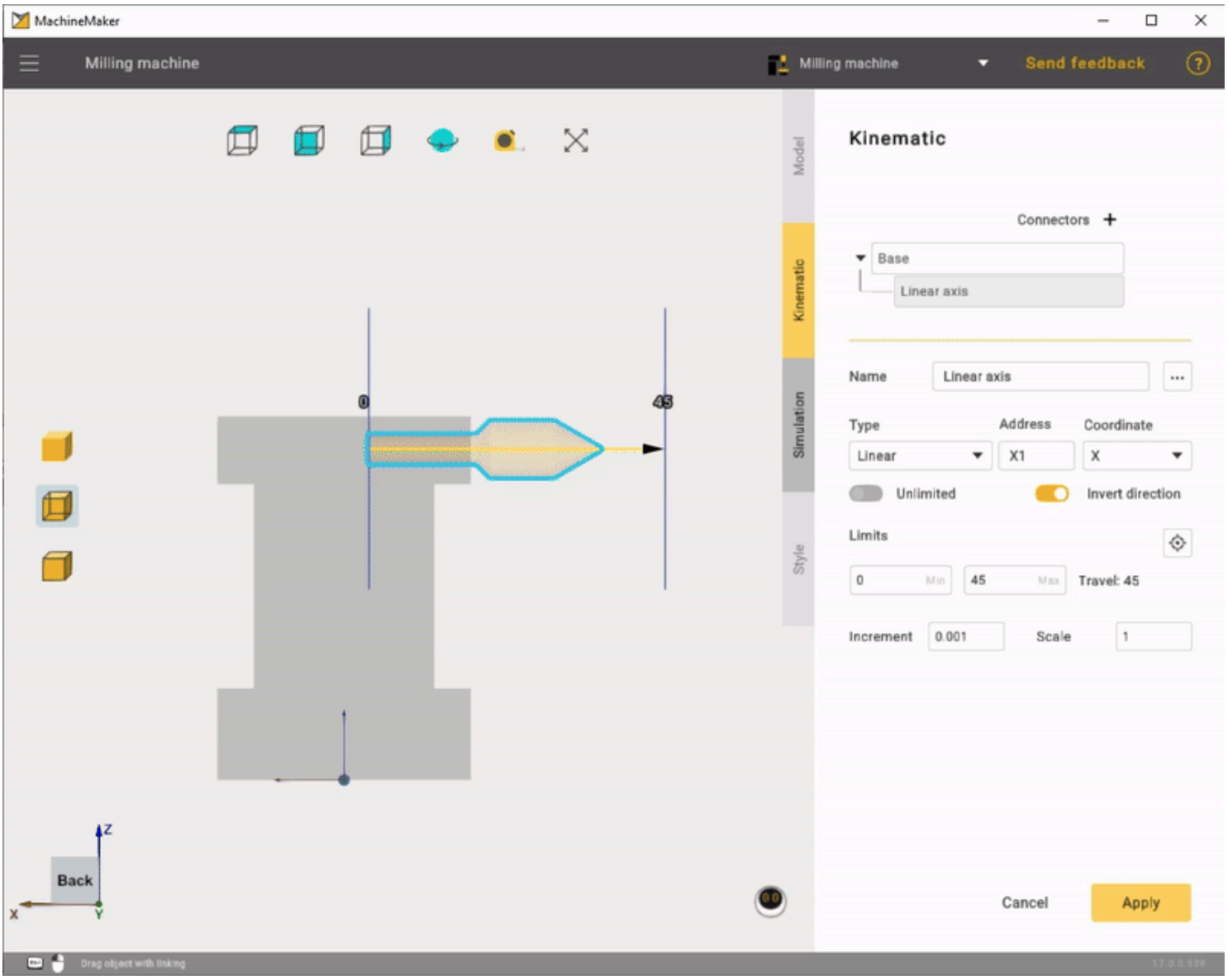
Also, if necessary, it is advisable to correctly set the point through the Base CS edit mode so that the machine equipment is securely attached to the machine in the future.



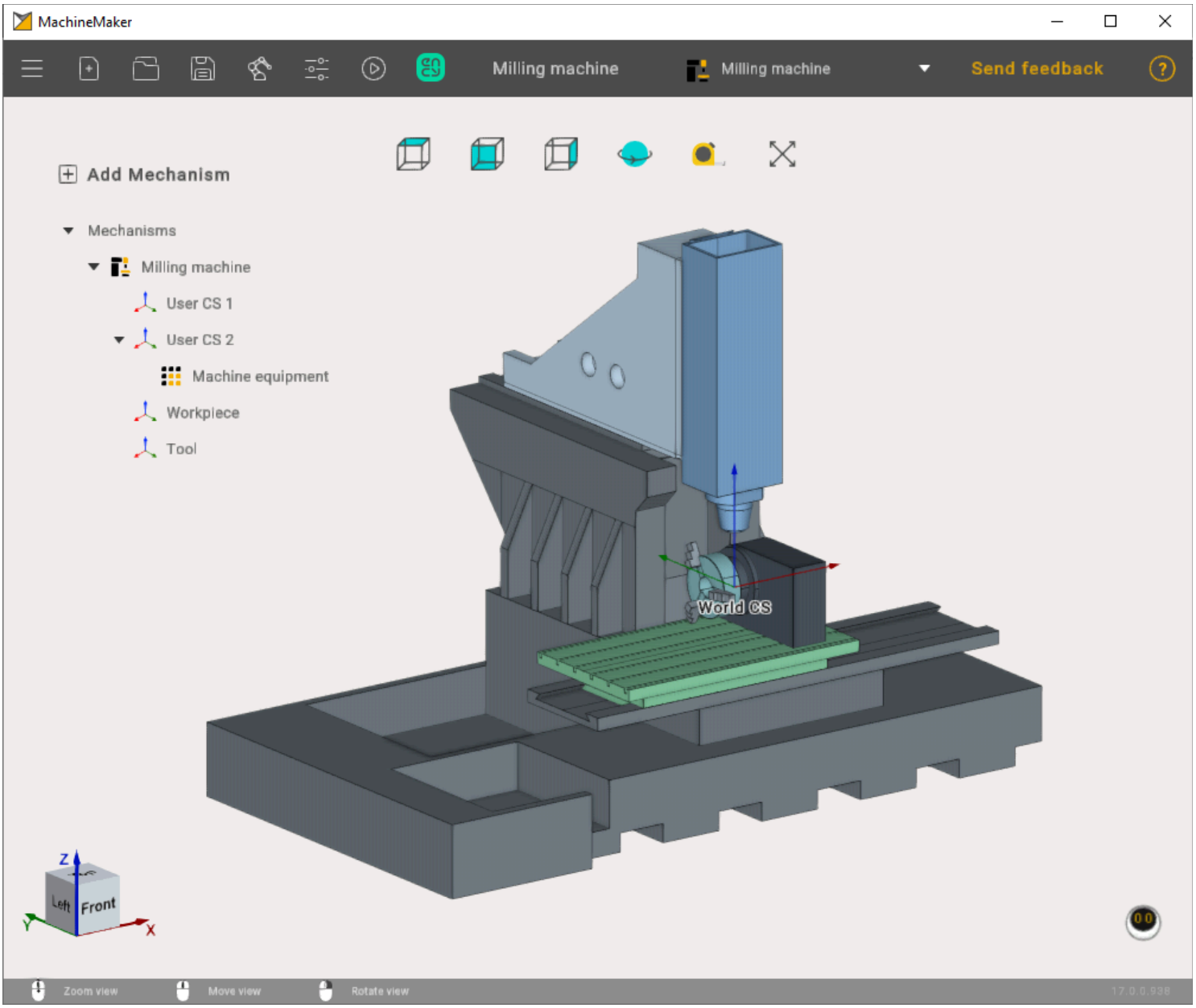
The setting of the linear type is the same as that of the rotary type. You must also set the jaw movement limits.



In simulation mode, check that everything is working correctly.



In the end it was possible to assemble a machine with two machine equipment.


MachineMaker
Milling machine
Milling machine
Send feedback
Add Mechanism
Mechanisms
Milling machine
User CS 1
User CS 2
Machine equipment
Workpiece
Tool
World CS
Z
Left
Front
Y
X
Zoom view
Move view
Rotate view

Milling Machines

This section describes how to create and configure CNC milling machines in MachineMaker. Select the Milling machine context using Application Mode Selector (see Introduction to MachineMaker).

The steps common to all mechanisms are described in Interface and Getting Started: creating a project, adding a mechanism, preparing and importing 3D objects, grouping elements into nodes, coloring, simulation, assemblies and machine equipment.

Build a machine

- Building a kinematic scheme
- Assembly options
- Additional options

Examples

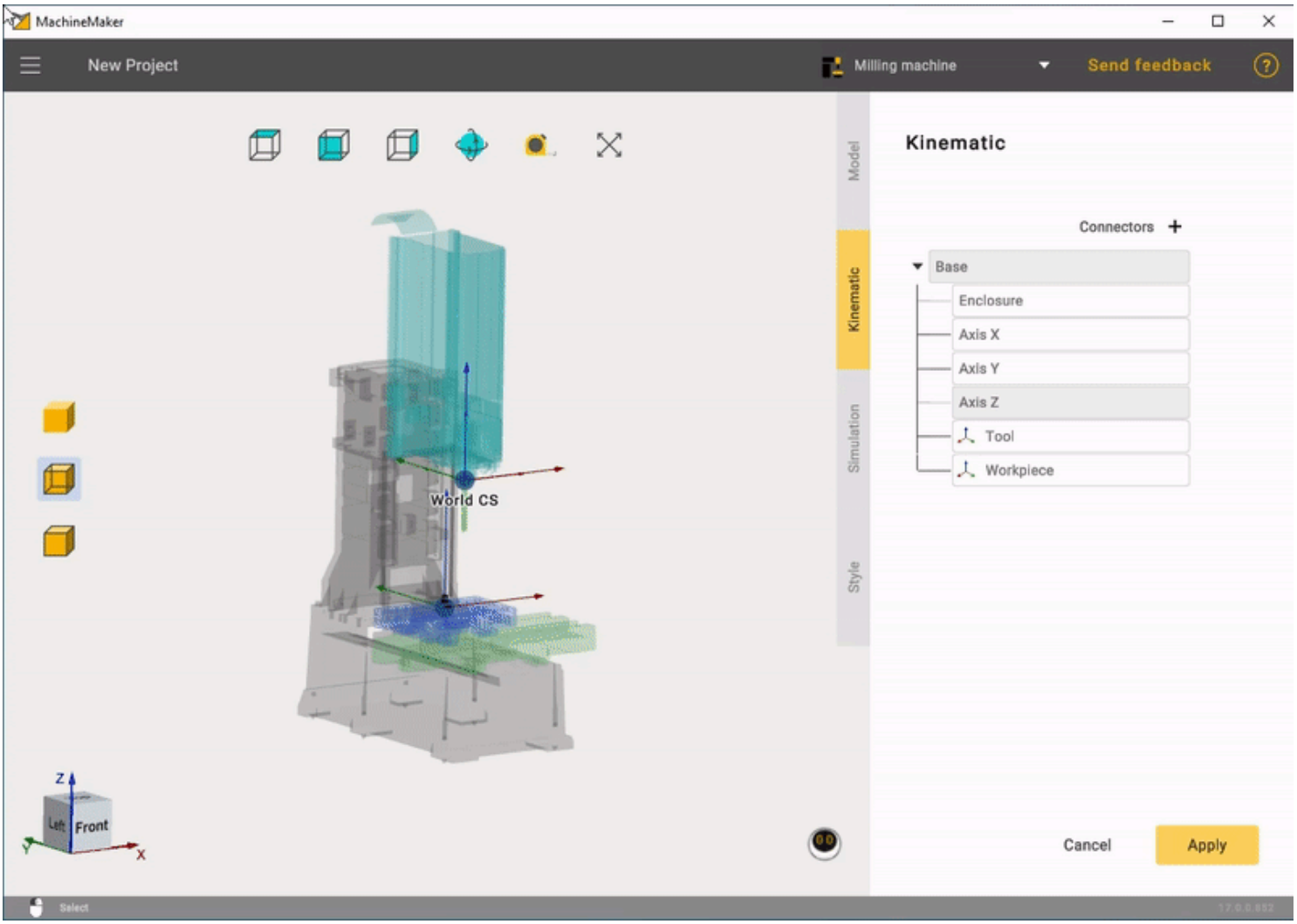
- Examples: Machines
- 3-Axes Milling Machine
- 5-Axes Milling Machine

Building a kinematic scheme

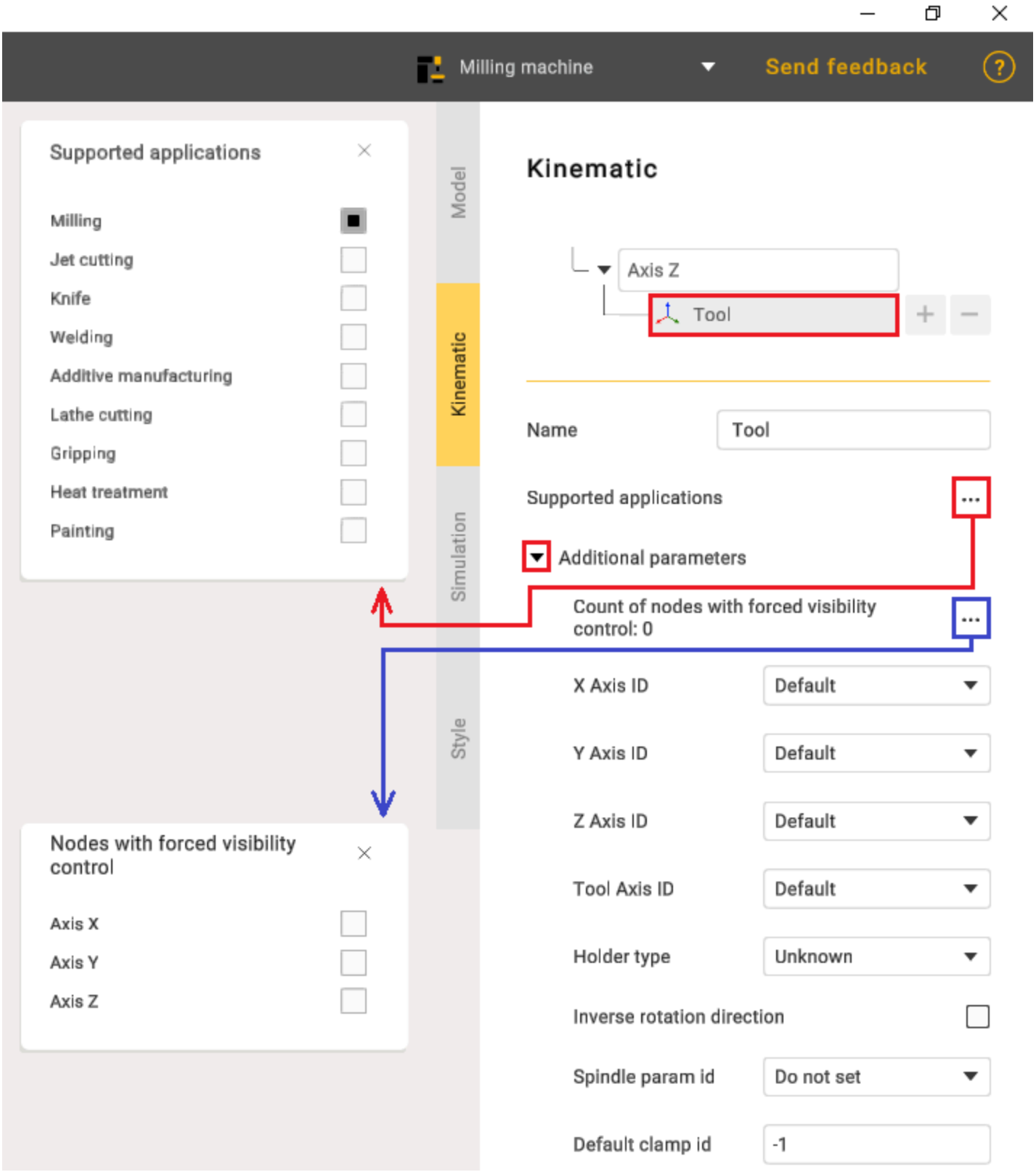
Click Kinematic tab to open kinematic parameters panel.



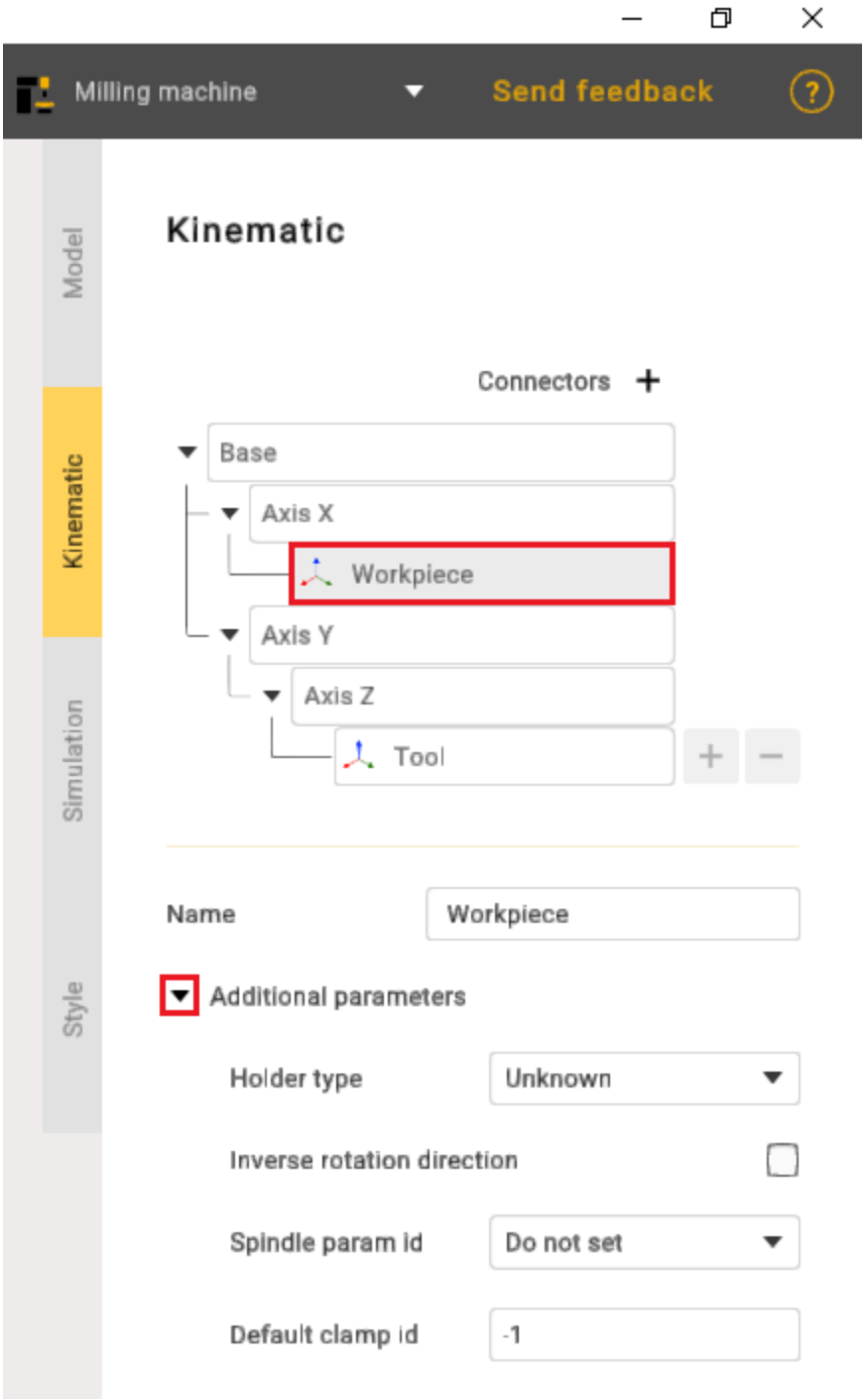
First of all it is necessary to build correct mechanism's kinematic tree, using grag and drop. MachineMaker will show Tool node as a sample tool and Workpiece node as a sample part.



In the Tool settings there is a function to select Supported applications and also additional options.

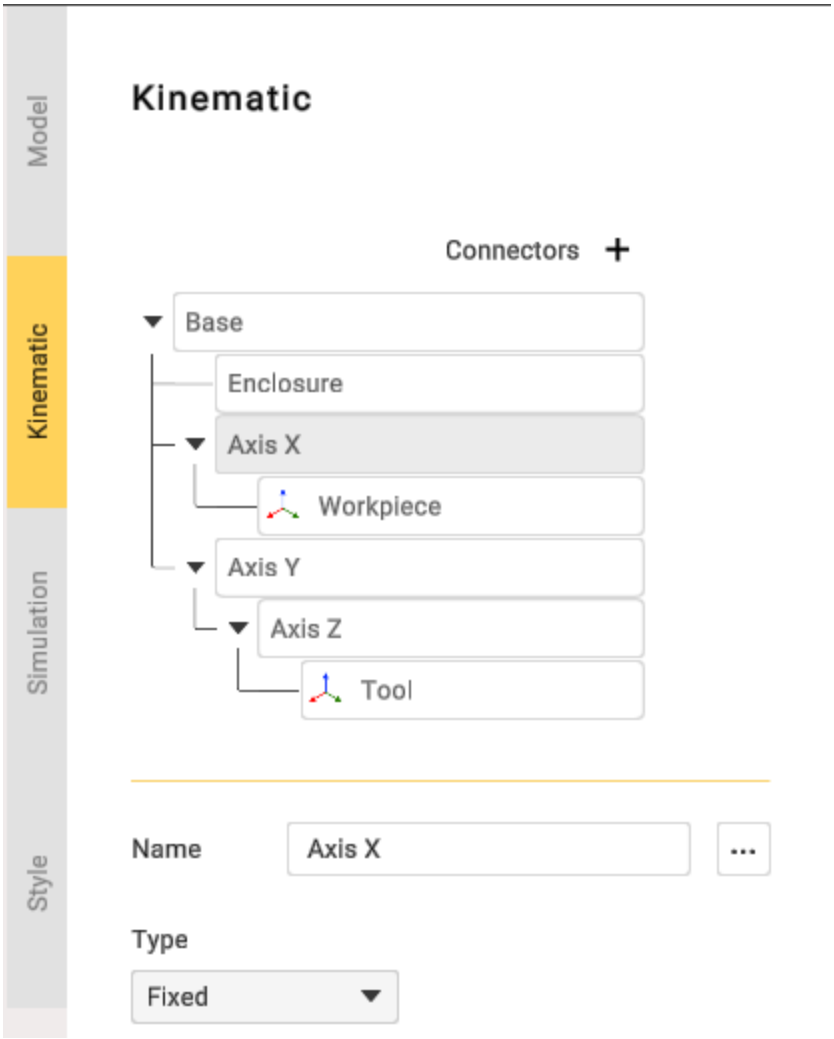


Workpiece also has its own additional parameters.

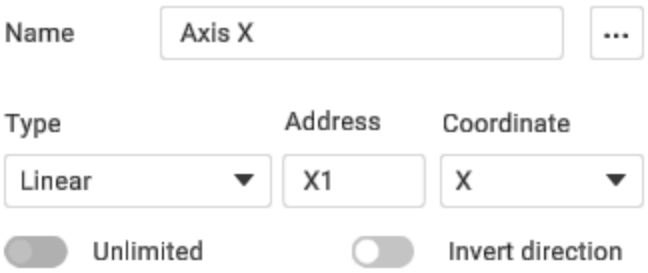


Next it is necessary to specify parameters of each node.

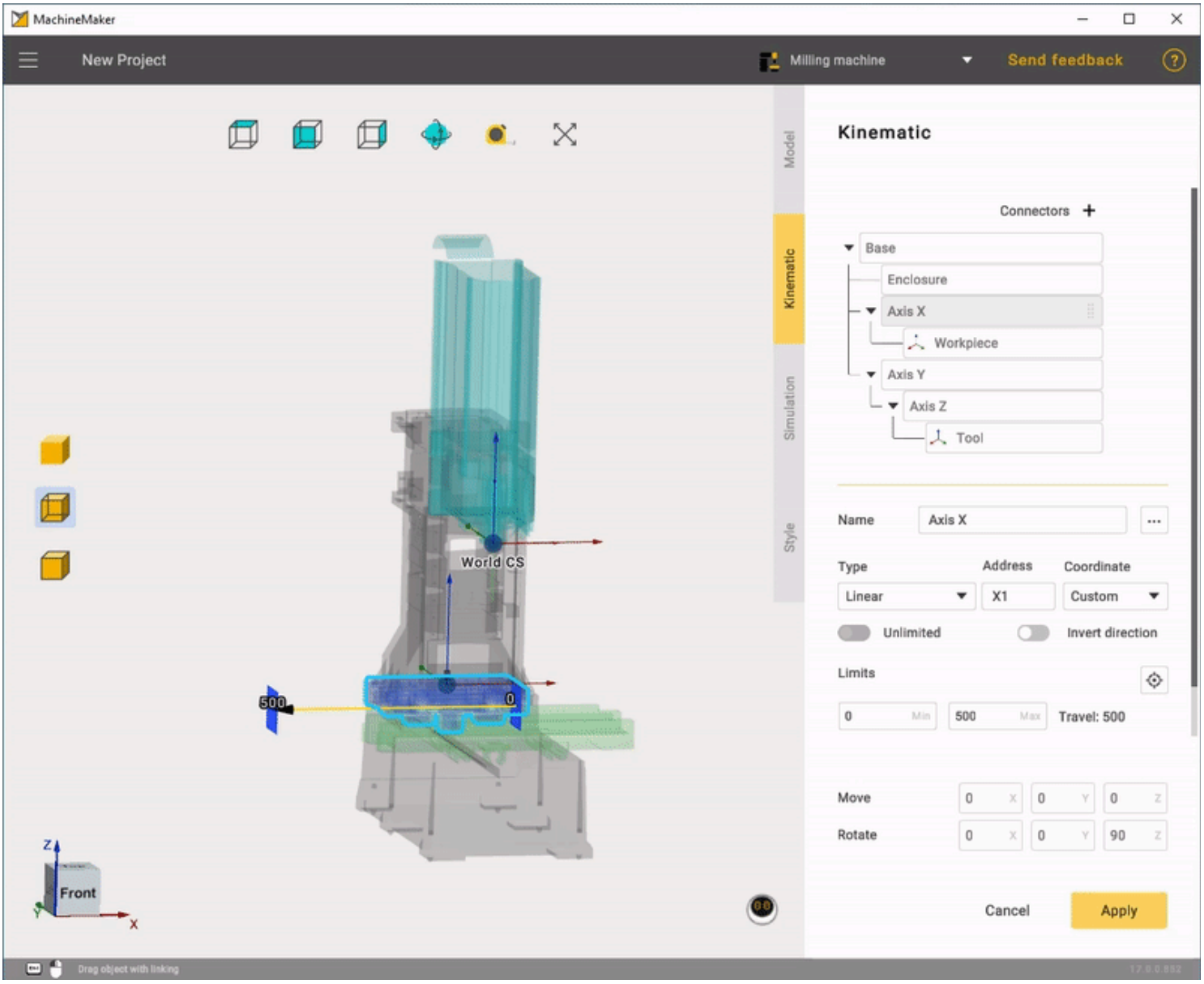
Set node name and type.



Next it is necessary to specify node Address for Linear and Rotary nodes. It will be used in Postprocessors.



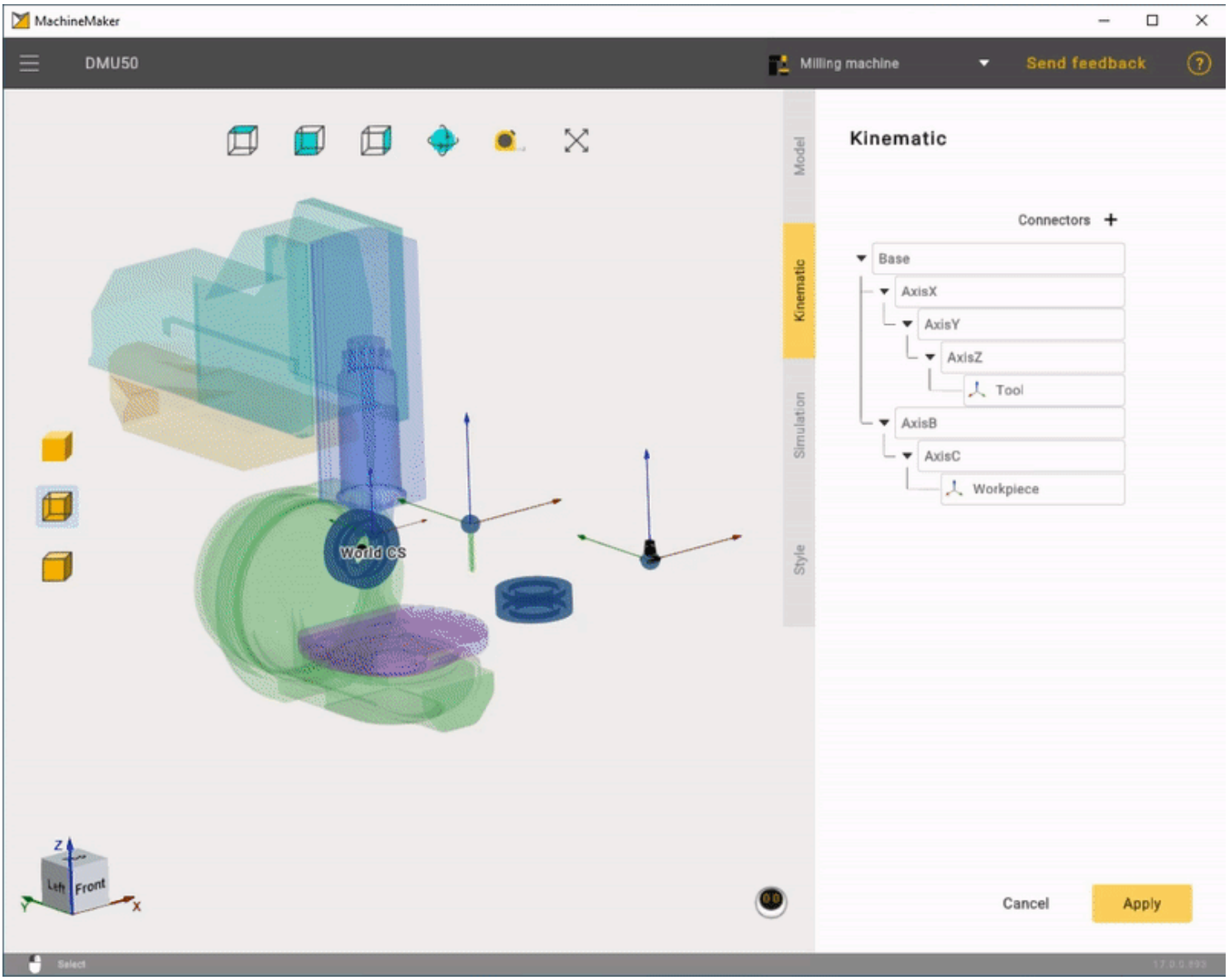
Select linear axis direction. You can select X Y Z or custom. Use Orientation field to define Custom direction vector.



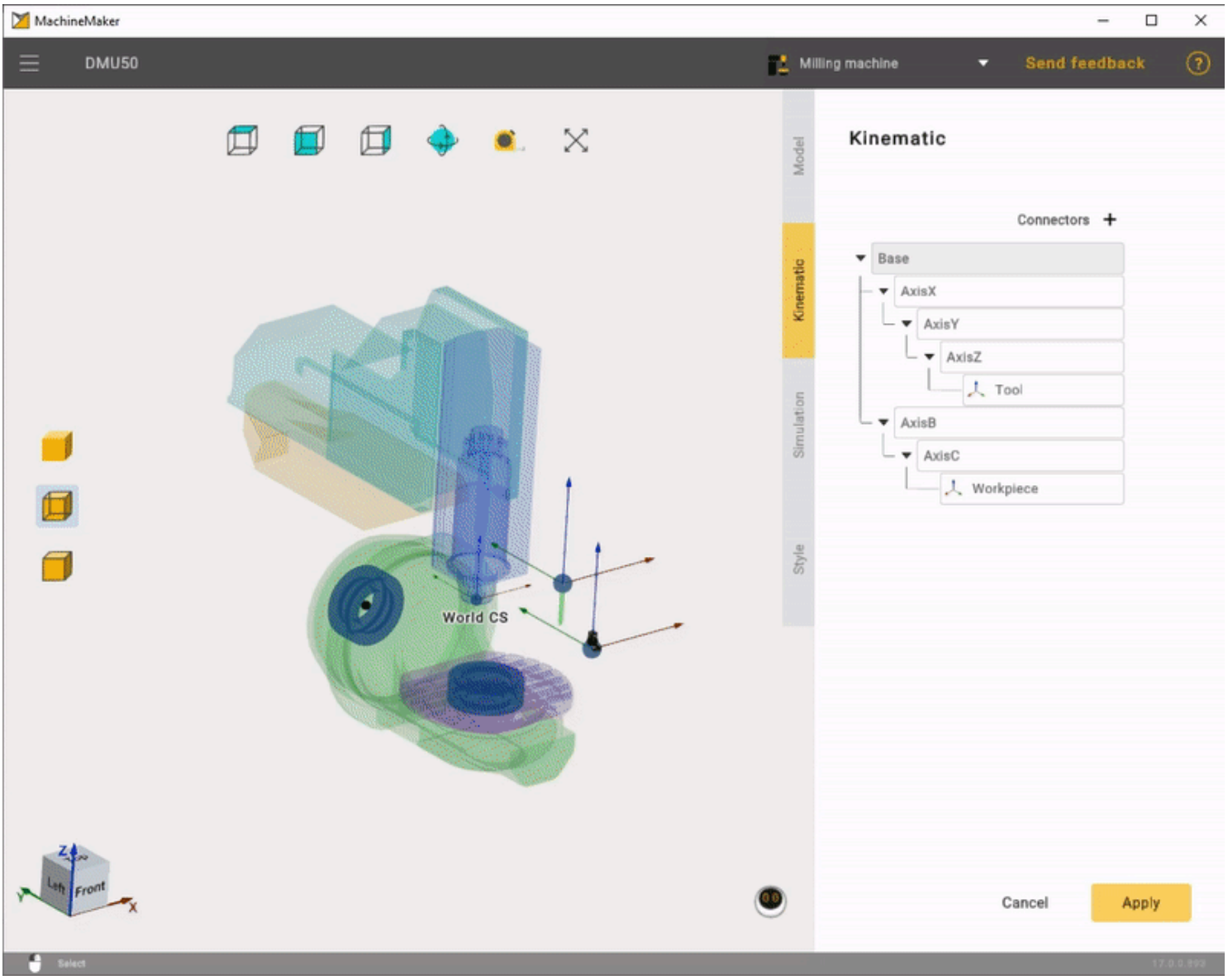
Next define Has Brake, Increment and Scale parameters. Change Control parameter if axis is Indexed or Manual. It is possible to Invert Direction of axis.



For rotary axes it is necessary to specify point of rotation. Hold the Left Mouse Button, drag the bearing and drop it to the snap point. Use Transformation Panel to set position and rotation manually.

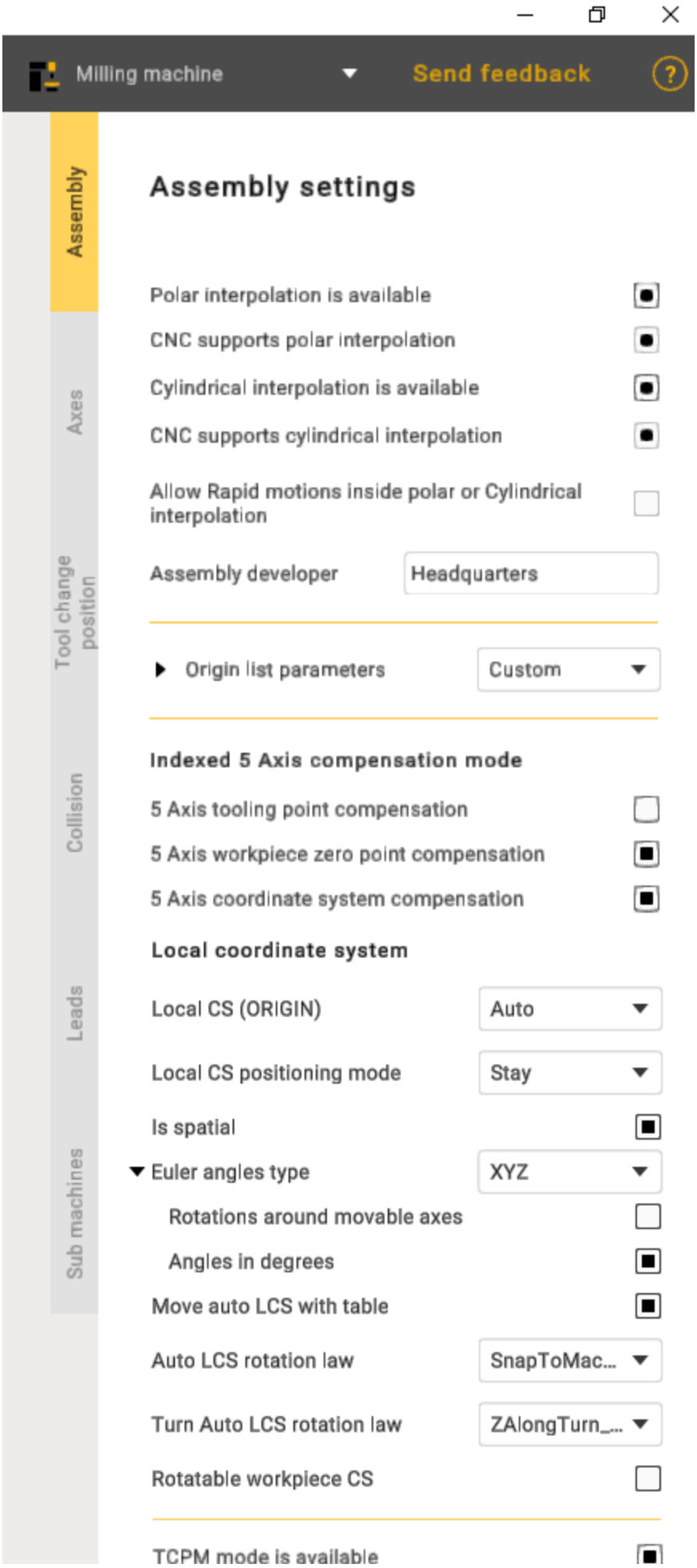


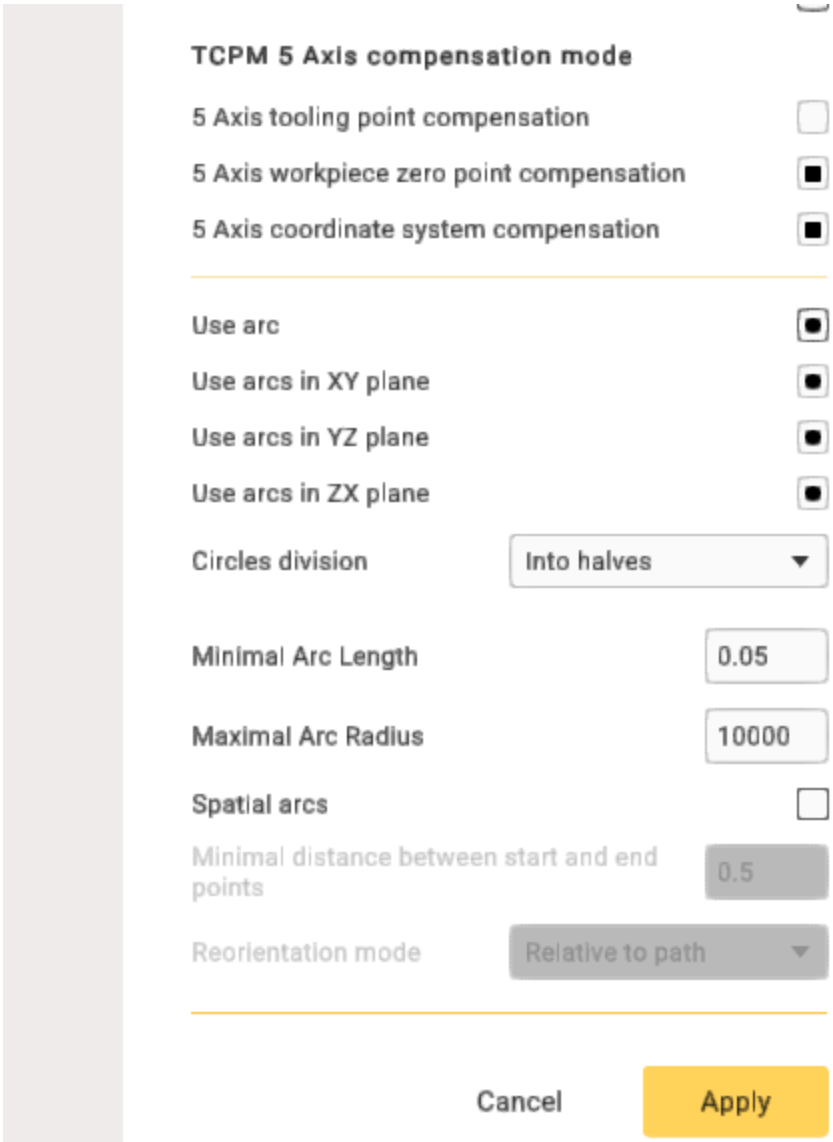
Finally it is necessary to set Tool Type and specify positions of Tool and Workpiece. Place Tool and Workpiece to the correct position at the Kinematic tree. Then hold the Left Mouse Button, drag the bearing and drop it to the snap point. Use Transformation Panel to set position and rotation manually.


MachineMaker
DMU50
Milling machine
Send feedback
Kinematic
Model
Kinematic
Simulation
Style
Connectors
Base
AxisX
AxisY
AxisZ
Tool
AxisB
AxisC
Workpiece
World CS
Left
Front
Cancel
Apply
Select

Assembly options

Click  button to open Assembly settings panel. Check CAM system documentation and SmartHints for parameters information.


Milling machine
Send feedback
Assembly
Axes
Tool change position
Collision
Leads
Sub machines
Assembly settings
Polar interpolation is available
CNC supports polar interpolation
Cylindrical interpolation is available
CNC supports cylindrical interpolation
Allow Rapid motions inside polar or Cylindrical interpolation
Assembly developer
Headquarters
Origin list parameters
Custom
Indexed 5 Axis compensation mode
5 Axis tooling point compensation
5 Axis workpiece zero point compensation
5 Axis coordinate system compensation
Local coordinate system
Local CS (ORIGIN)
Auto
Local CS positioning mode
Stay
Is spatial
Euler angles type
XYZ
Rotations around movable axes
Angles in degrees
Move auto LCS with table
Auto LCS rotation law
SnapToMac...
Turn Auto LCS rotation law
ZAlongTurn_...
Rotatable workpiece CS
TCPM mode is available



- Polar interpolation changes a linear axis to the rotary one in the simple 3-axes milling process.
- If the machine variable Machine –> Control parameters –> Rotary transformations –> CNC support polar interpolation is set then CNC interpolation tick is available. If this parameter is on then the G-code generated with the commands to switch on/off the polar interpolation. Else the G-code is generated in the [X,C,Z] coordinates.
- The cylindrical interpolation gives the possibility to mill the side surface of cylinder by programming the unrolled curves. The unrolled curves are programmed in the [X,Y,Z] coordinates, but the cylinder milling is performed in [X,C,Z] coordinates. So the cylindrical interpolation makes the transformation [X,Y,Z] => [X,C,Z].
- If the machine variable Machine –> Control parameters –> Rotary transformations –> CNC support cylindrical interpolation is set then CNC interpolation tick is available. If this parameter is on then the G-code generated with the commands to switch on/off the cylindrical interpolation. Else the G-code is generated in the [X,C,Z] coordinates.
- Allow rapid motions inside polar or Cylindrical interpolation. This capability is crucial for improving efficiency in machining operations, as rapid motions reduce the time required to traverse from one point to another, enhancing overall machining productivity.
- Assembly developer: Company name.

- Indexed 5-Axis compensation mode represents a configuration in which compensation is systematically applied to a machining process involving five axes.
- The 5-Axis tooling point compensation feature implies the CNC controller's capability to dynamically adjust the tool's position or orientation throughout machining, accommodating variations in the tool itself. This ensures precise adherence of the machined part to the intended design.
- 5-Axis workpiece zero point compensation guarantees the correct alignment of machining operations with the workpiece's coordinate system, enhancing precision and accuracy in the manufacturing process.
- The 5-Axis coordinate system compensation ensures that the CNC machine accurately interprets and executes toolpaths, considering the specific orientation and location of the workpiece in the machining space. This feature is pivotal for achieving precision and accuracy, especially when dealing with intricate geometries, and allows for versatile machining operations.
- TCPM mode availability refers to the availability of a concept in CNC machining where the tool's center point is efficiently managed, ensuring precise and accurate machining.
- TCPM in the 5-Axis compensation mode, refers to a feature in CNC machining where adjustments are made to account for variations in the tool's center point. In a 5-axis setup, which allows movement in five different directions, this compensation mode ensures precise and accurate machining by dynamically managing the tool's center point.
- The 5-Axis tooling point compensation within the context of TCPM refers to a feature in CNC machining where adjustments are made to the tool's position or orientation dynamically.
- The 5-Axis workpiece zero point compensation, in conjunction with TCPM, is a feature in CNC machining that involves dynamic adjustments to align machining operations accurately with the zero point or origin of the workpiece coordinate system. In a 5-axis machining system, capable of movement along five directions, this compensation mechanism ensures precision and accuracy during the manufacturing process.
- The 5-Axis coordinate system compensation, when integrated with TCPM in CNC machining, is a functionality designed to ensure precise toolpath execution by dynamically adjusting for the specific orientation and location of the workpiece within the machining space.
- Use arc function provides users with the capability to specify or enable the use of arc commands in the CNC program. It involves defining parameters such as the arc's start and end points, radius, and direction.
- Circles division: Used to divide arcs into halves or quarters.
- Minimal Arc Length: Prevents the output of arcs shorter than a specified length; a segment will be displayed instead.
- Maximal Arc Radius: Prevents the output of arcs with a radius larger than specified; segments will be displayed.
- Spatial arcs: Arbitrary spatial arcs. A function necessary for robots to work.
- Minimal distance between btart and end points: A restriction that allows the display of segments with a small distance between points.
- Spatial arcs. A function necessary for robots to work.

- Reorientation mode: The method of calculating the midpoint. The functionality may vary depending on the manufacturer.

Local coordinate system(Local CS):

- Auto. Function for indexed 5-axis machining. It is needed so the CAM system can automatically calculate the Local CS;
- Off. Disables this function;
- Unavailable. Makes this function unavailable for your machine.

Local CS positioning mode. This function defines how the rotation of the local coordinate system is output to the NC-code.

Is spatial. A modifier that complements the Local CS positioning mode function. It defines how commands are output to the NC-code of your CAM system.

Euler angles type. A parameter that defines the type of Euler angles.

- Rotations around movable axes;
- Angles in degrees.

These two parameters determine how the spatial angles will be output in the (ORIGIN) command in the NC code.

Move auto LCS with table. This function determines whether the origin point of the coordinate system should rotate together with the workpiece in the CAM system.

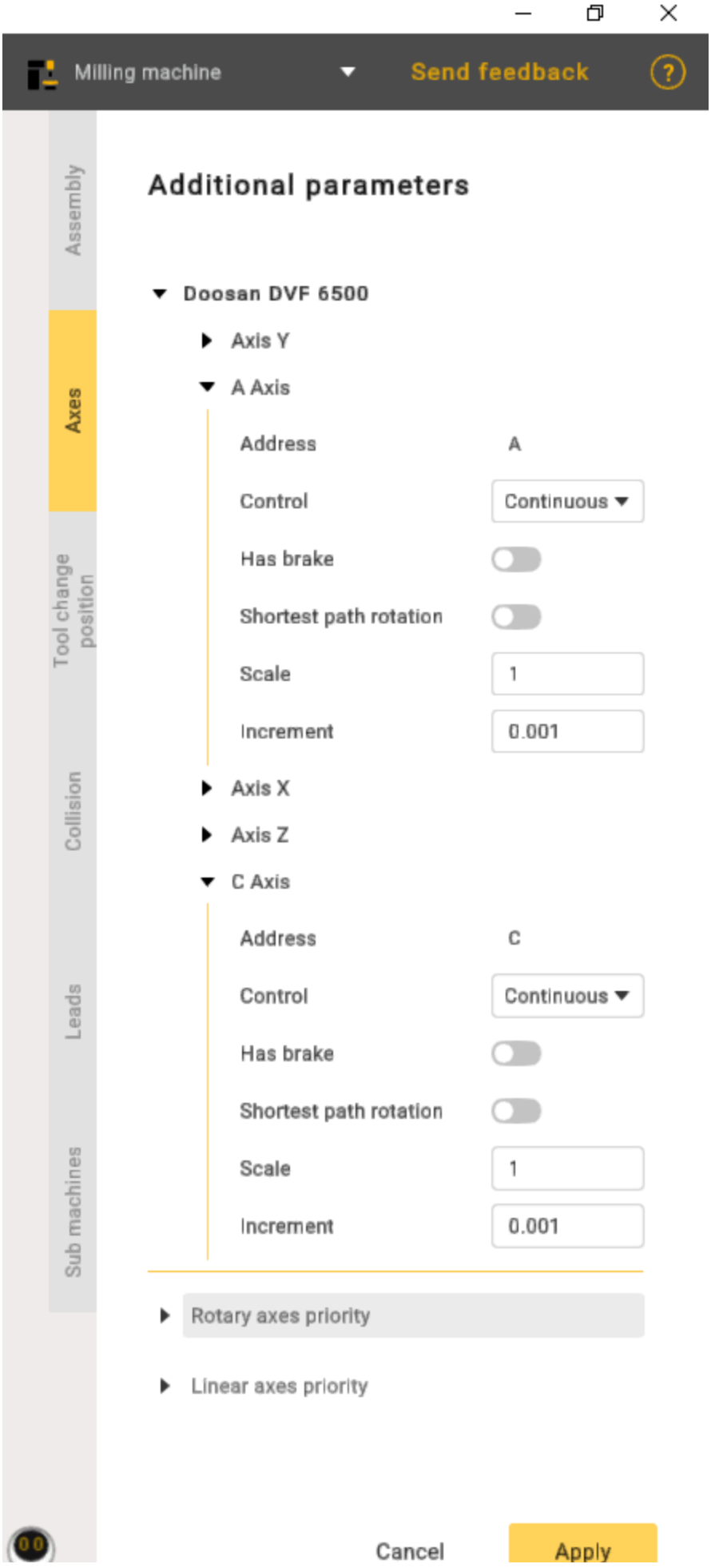
Auto LCS rotation law. Additional parameter for Local CS (ORIGIN).

- Snap to Tool CS. Allows you to snap, for example, the X-axis of the rotated coordinate system to the coordinate system associated with the tool;
- Snap to Machine CS. Attaches the CS to the machine’s Base Coordinate System that you specifie;
- Snap to Workpiece CS. In this mode, the coordinate system will be linked to the geometric coordinate system of your workpiece.
- Exclude spatial angle A,B,C. These values determine which axis the rotation should be performed around. If you select "Exclude spatial angle A", it means that rotation will occur around axes B and C, while rotation around axis A will always be 0.

Rotatable workpiece CS. A parameter that applies specifically to the workpiece. This parameter indicates whether the coordinate system rotates when setting up the workpiece.

Additional options

Click  button to open Machine parameters panel. Then go to the Axes tab. It is possible to specify


Milling machine
Send feedback
Assembly
Axes
Tool change position
Collision
Leads
Sub machines
Additional parameters
Doosan DVF 6500
Axis Y
A Axis
Address
A
Control
Continuous
Has brake
Shortest path rotation
Scale
1
Increment
0.001
Axis X
Axis Z
C Axis
Address
C
Control
Continuous
Has brake
Shortest path rotation
Scale
1
Increment
0.001
Rotary axes priority
Linear axes priority
Cancel
Apply

- Address - axis designation.
- Control:

1. Countinuous.
2. Indexed - indicates that rotation will be carried out incrementally.
3. Manual - implies that the operation is entirely manual.

- Shortest path rotation - refers to the rotation around an axis or point using the most direct path between the initial and final positions in three-dimensional space.
- Scale is a setting with four positions. Each position corresponds to a specific angular increment. Position 1 equals 90 degrees, Position 2 equals 180 degrees, and so on.

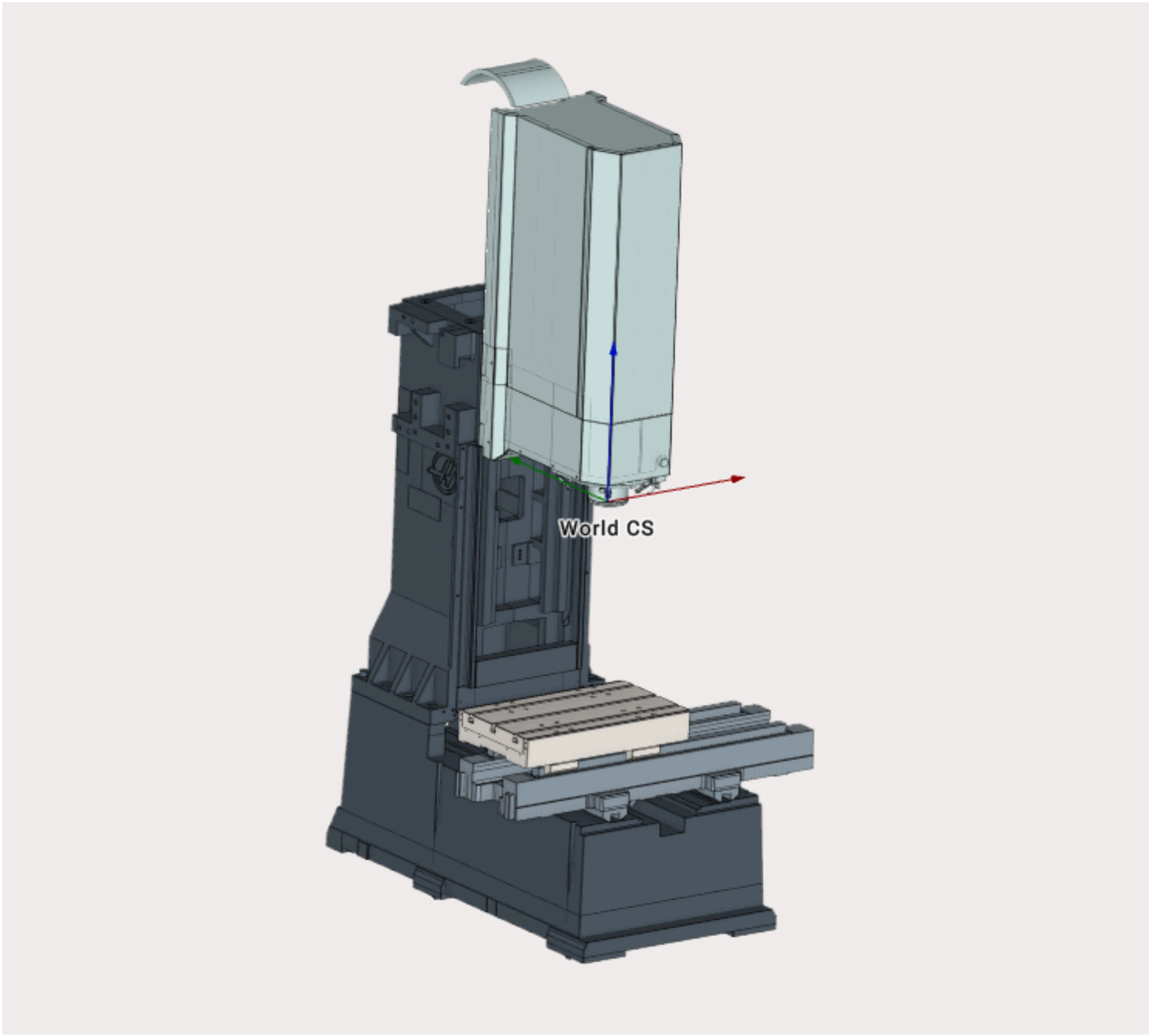
Examples: Machines

In this chapter, you will find examples and tutorials on how to add and configure:

- 3-Axis Milling Machine
- 5-Axis Milling Machine

3-Axes Milling Machine

Download Project here: Milling Machine.zip

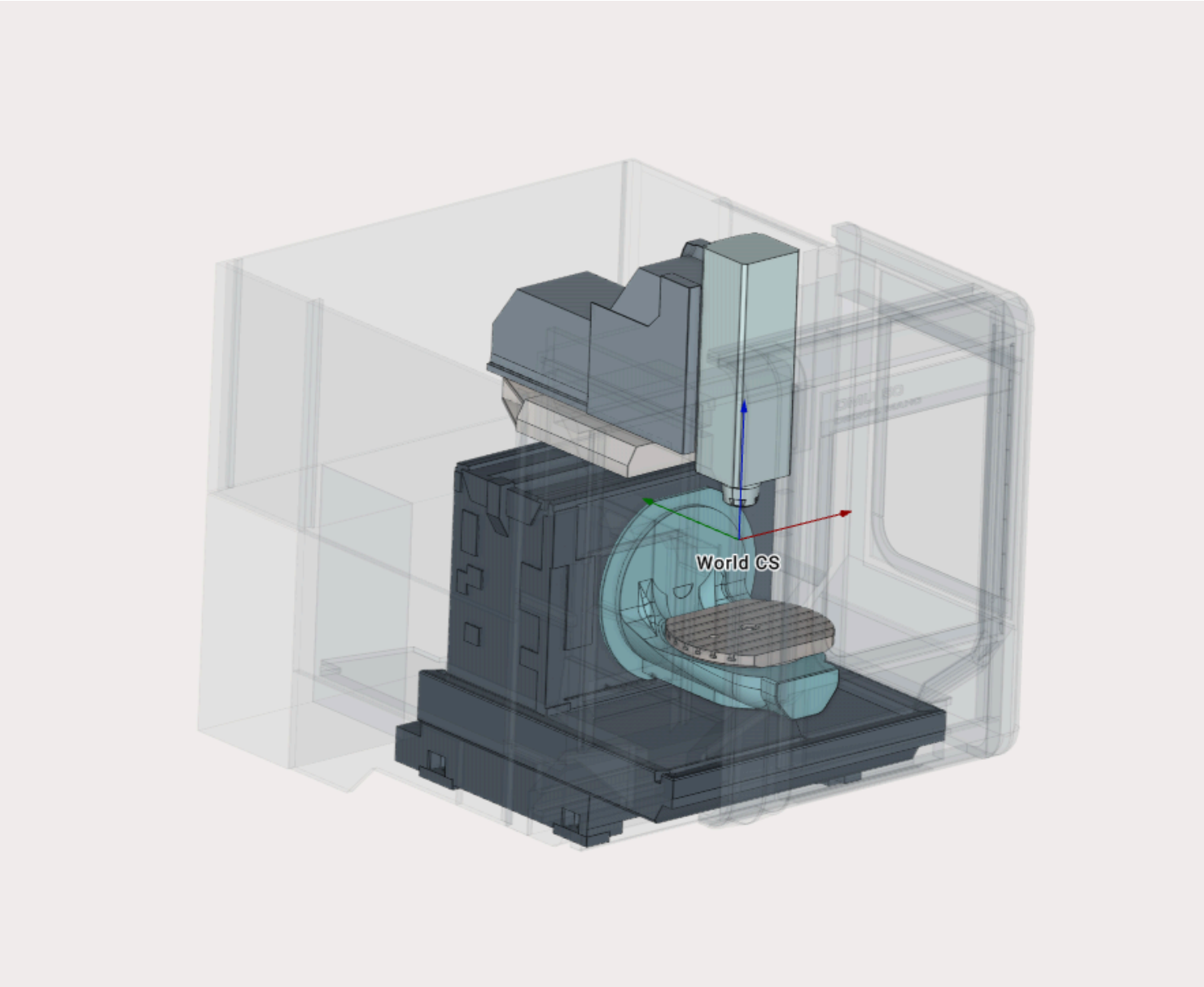


You can see the tutorial video at the link

Download other examples here: Milling_machine_3ax.zip and here Milling_machine

5-Axes Milling Machine

Download Project here: 5AxesMillingMachine.zip



You can see the tutorial video at the link

Robots

This section describes how to create and configure robot cells in MachineMaker. Select the Robot cell context using Application Mode Selector (see Introduction to MachineMaker).

The steps common to all mechanisms are described in Interface and Getting Started: creating a project, adding a mechanism, preparing and importing 3D objects, grouping elements into nodes, coloring, simulation, assemblies and the mechanisms library.

Building a kinematic scheme

- Building a kinematic scheme
- Industrial Robots
- Cobot
- Heavy-Duty Robots
- Flexible Heavy-Duty Robot
- Tables and Positioners
- Rails and Portals
- Composite End effectors

Robot cell assemblies

- Assembly Simulation and Validation
- Table calibration
- Receiving assemblies from CAM system
- Assembly options
- Additional options
- Collision
- Links/Leads
- End effectors and TCP calibration

Examples: Robot cell

- Examples: Robot cell
- Simple robot
- Heavy-Duty robot
- Flexible Heavy-Duty Robot
- Cobot
- End Effectors
- External Tools
- Composite End Effector
- Composite EndEffector: Spot Welding
- Tables and User CS

- Rail
- H-bot (Portal)
- SCARA Robot
- Column-type robot

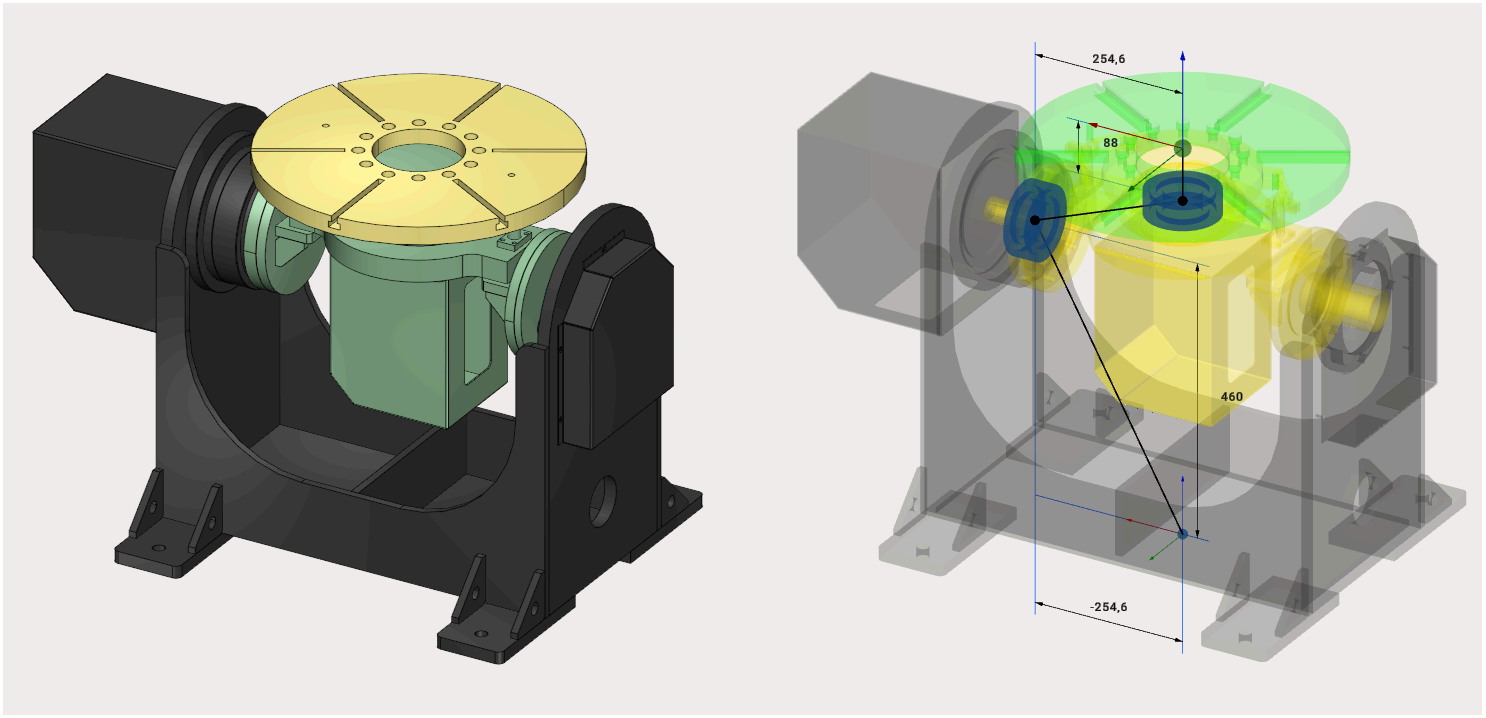
Building a kinematic scheme

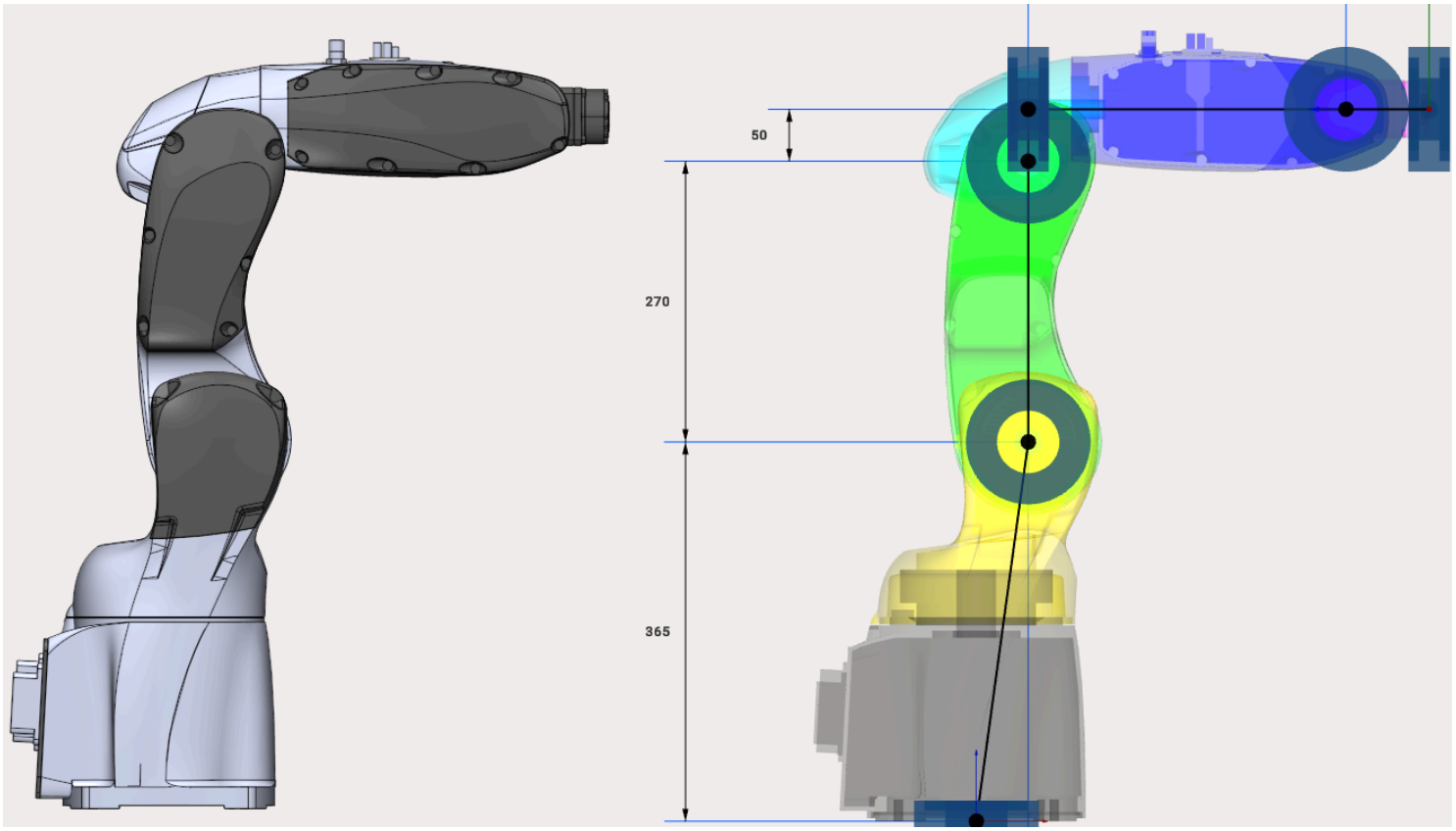
Click Kinematic tab to open kinematic parameters panel.



Kinematics

MachineMaker shows the current mechanism's 3D model and kinematic scheme. It is necessary to build correct kinematic linkage by specifying connector's positions.



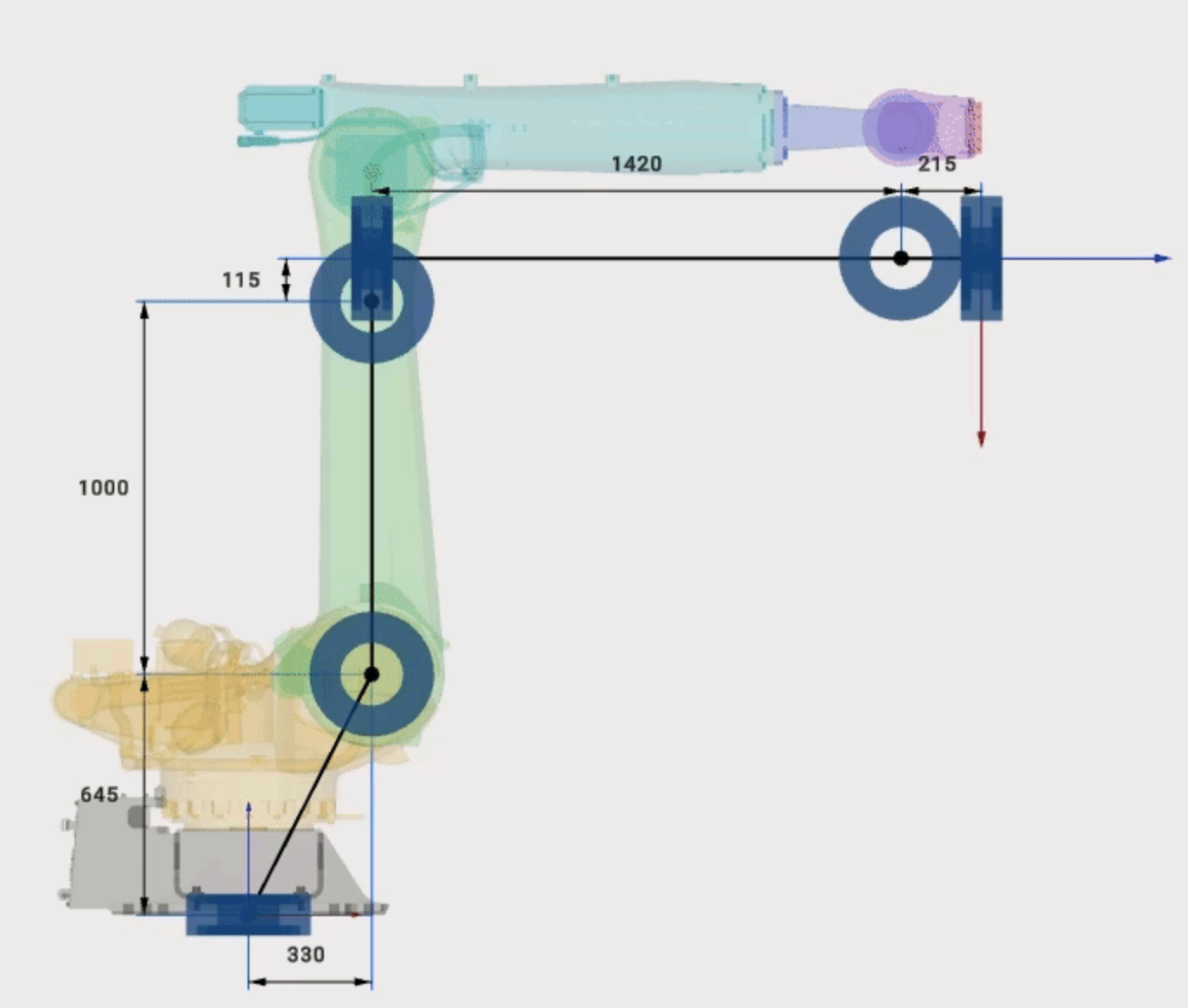


There are three ways to specify connector position:

- Dimensions
- Transformation panel
- Drag&Drop and snap points

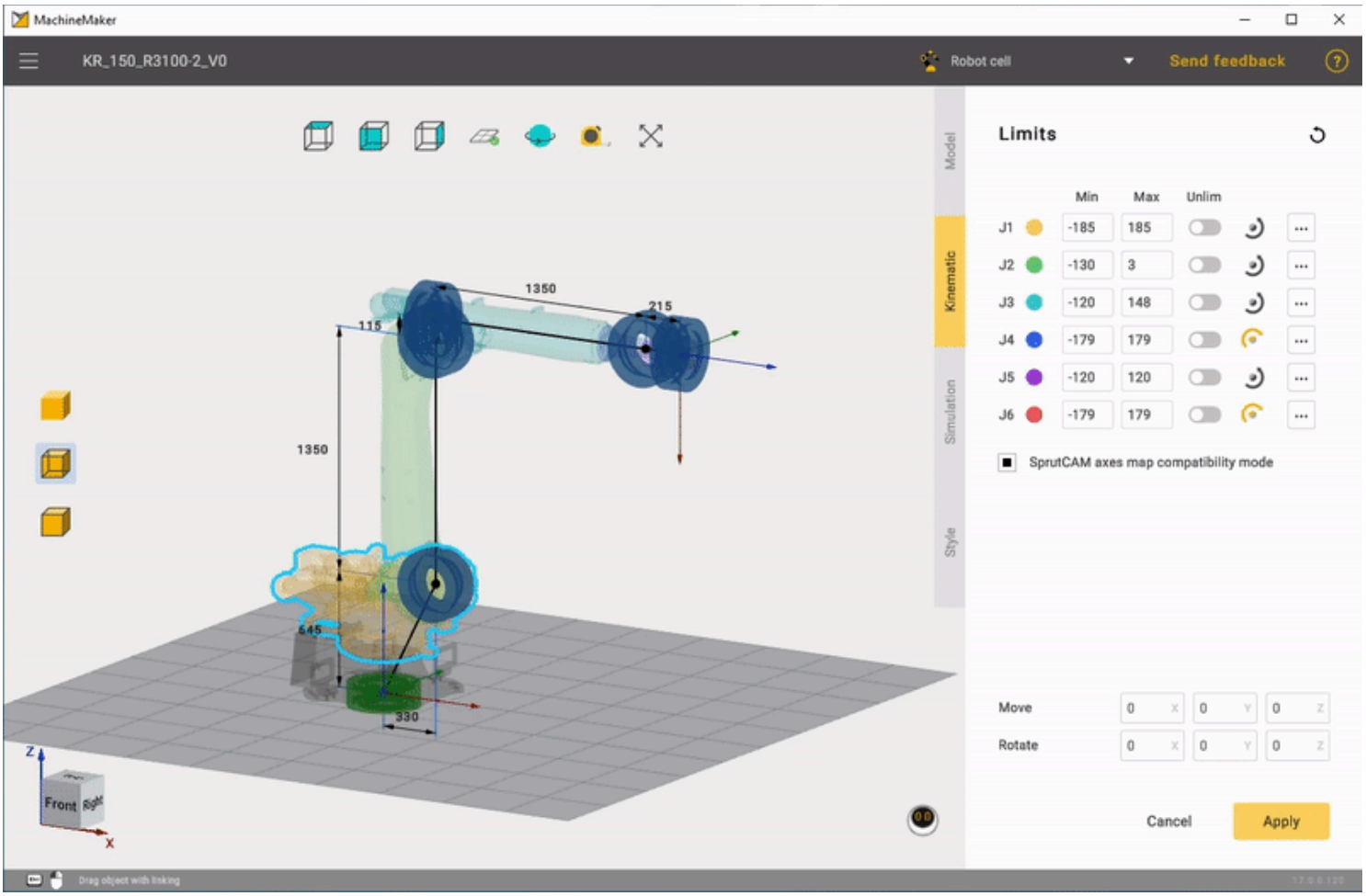
Dimensions

Click to dimension and enter new value.



Transformation panel

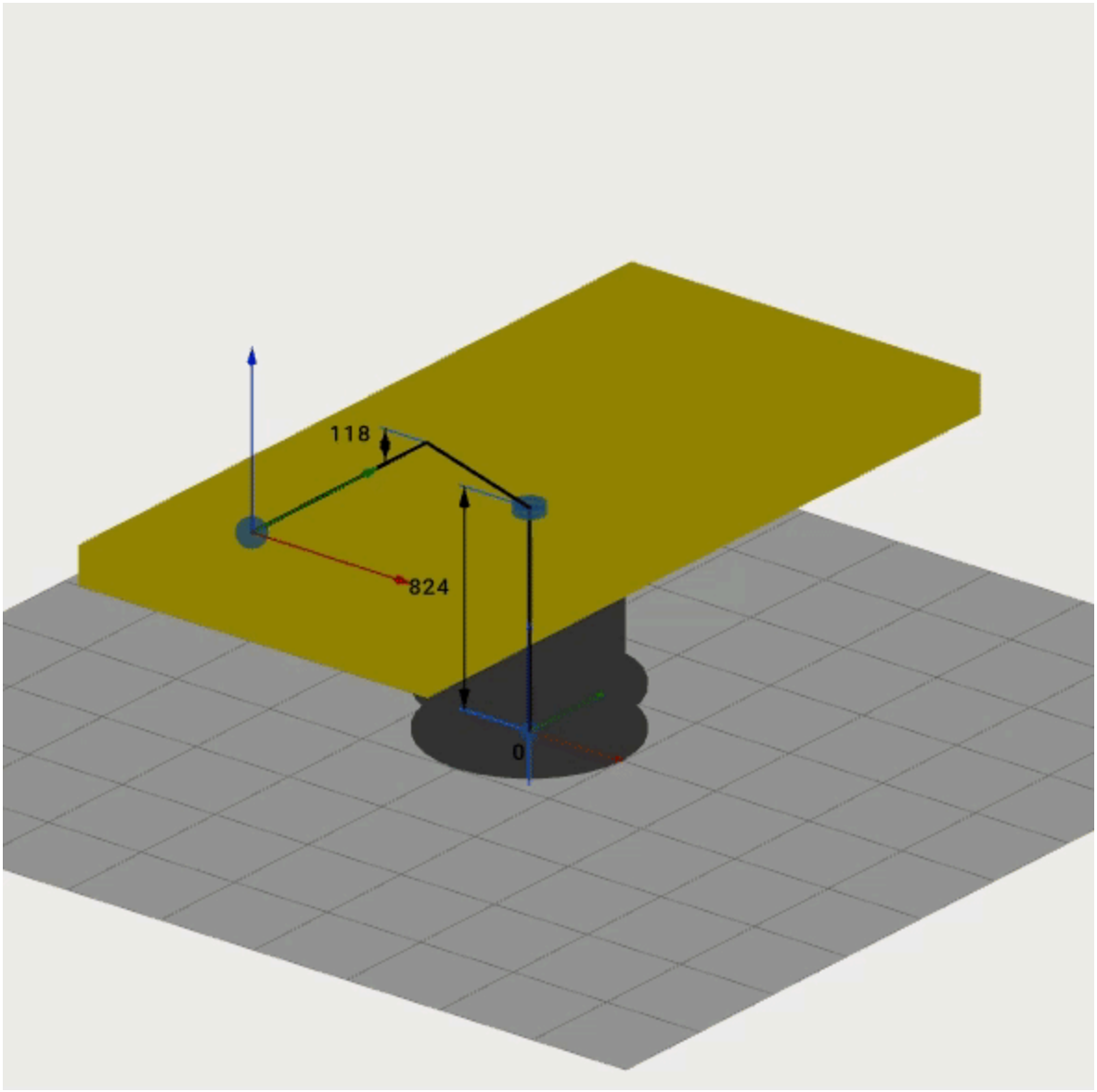
It is also possible to set position of any connector manually. Select connector (blue bearing for rotary joints and blue dot for "assemblies") and enter move and rotate values to the Transformation Panel at the right bottom corner.



Use Mouse Wheel Scroll to change values on any inputbox or combobox. Hold Shift or Ctrl keys while scrolling values to change values faster or slower.

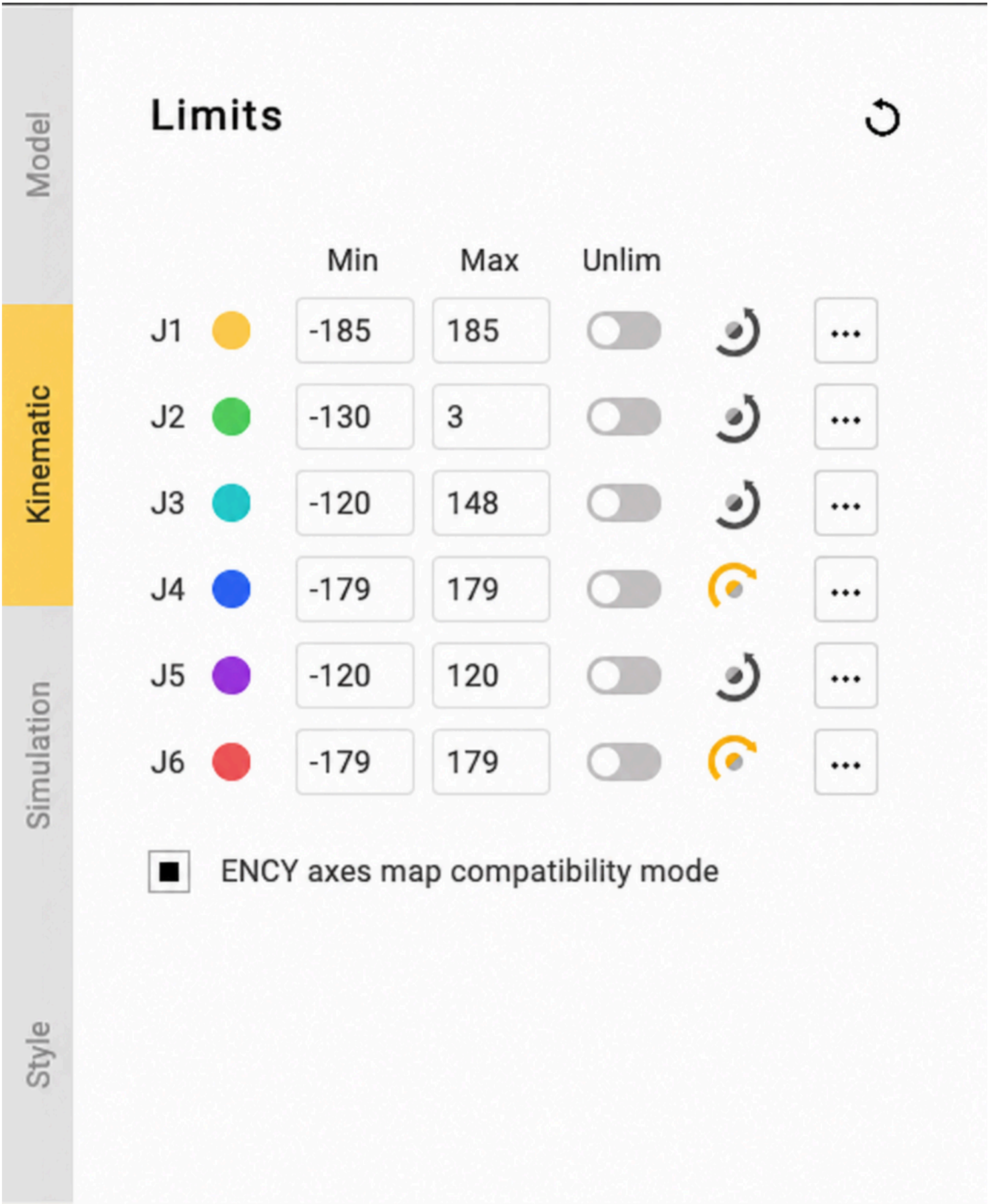
Drag&Drop and snap points

Hold Left Ctrl key to enter Drag&Drop mode. Drag any connector (blue bearing for rotary joints and blue dot for "assemblies"). MachineMaker will show small red snap points nearby. Release mouse button to drop object.

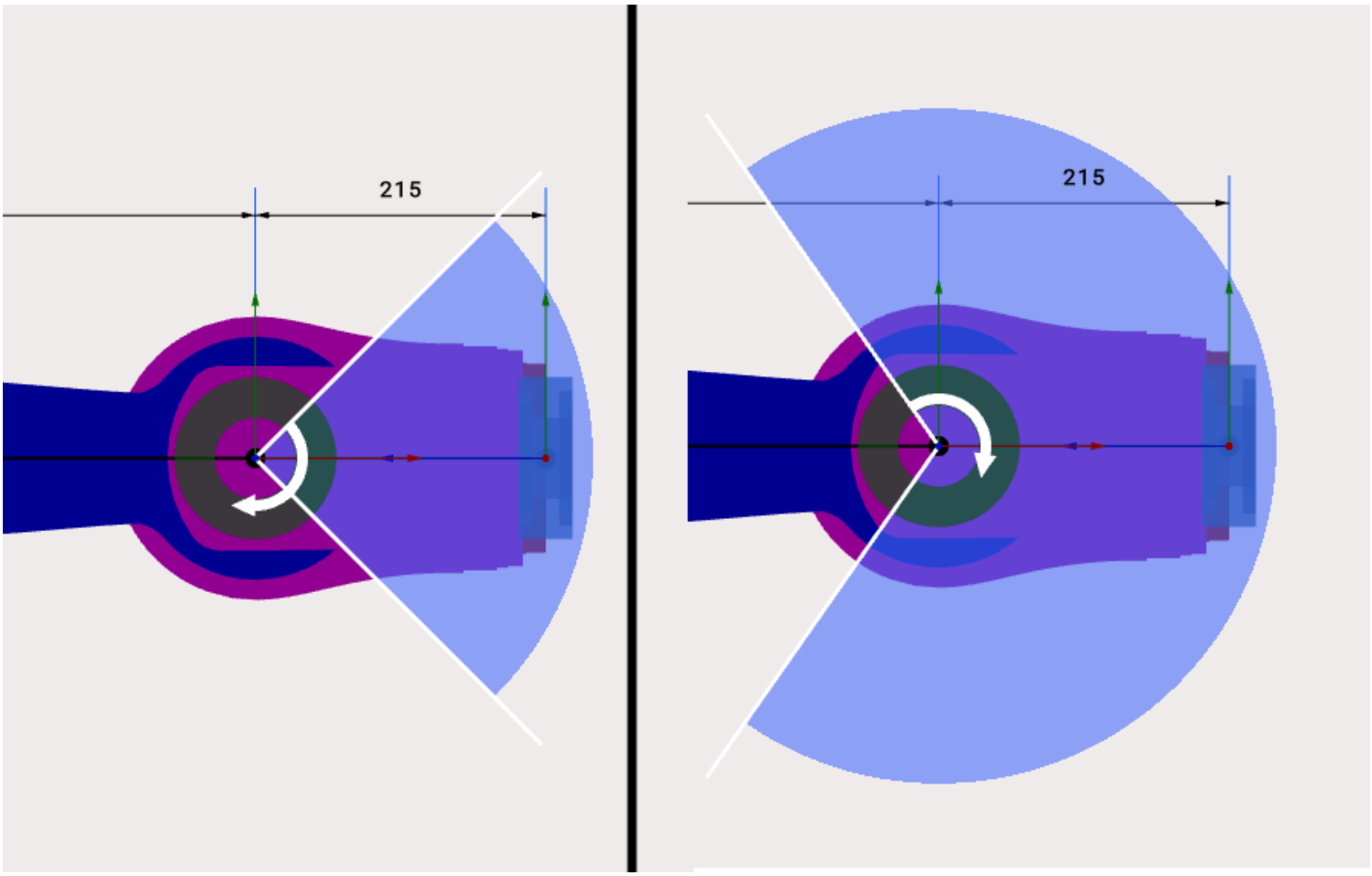


Limits

It is possible to enter limits for each node. You can find this information in DataSheets.



MachineMaker shows joint's minimum and maximum values.



Use  or  buttons to change rotation or movement direction.

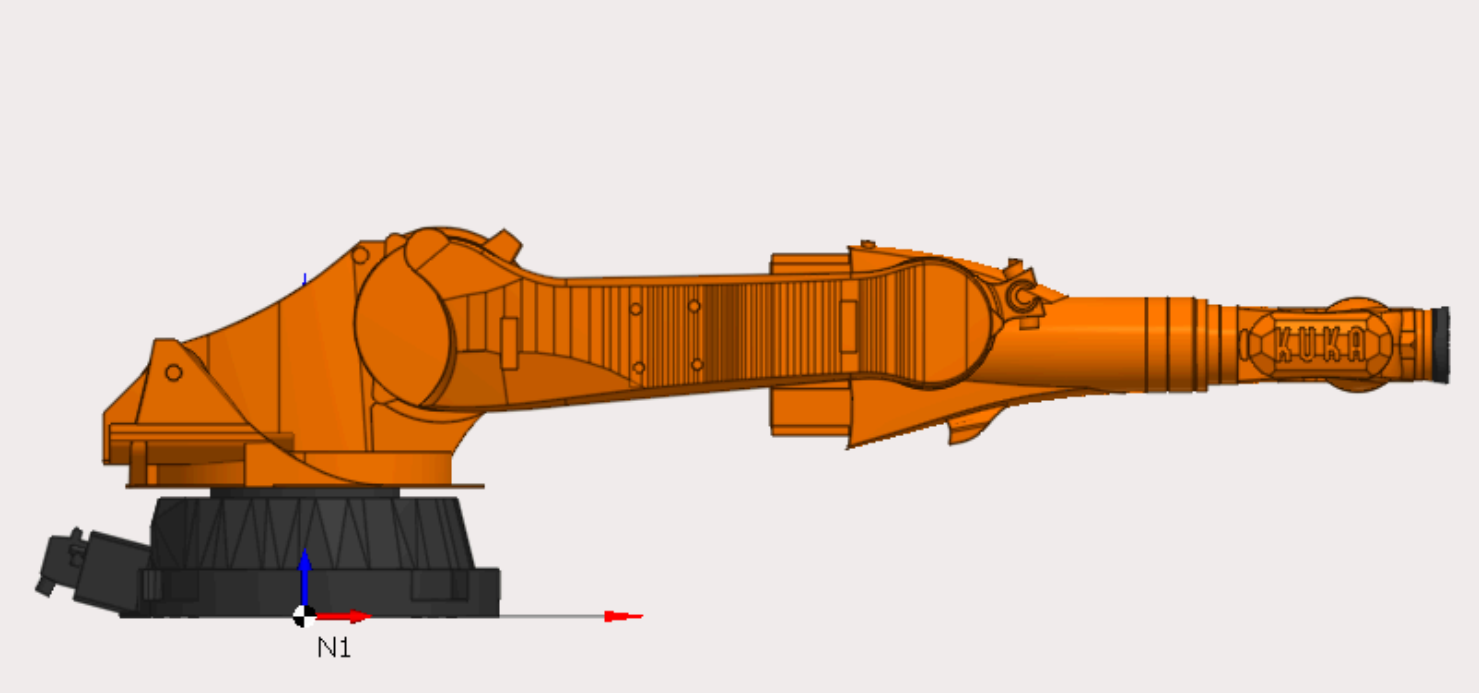
Use Unlim switcher to allow unlimited rotation for positioners.



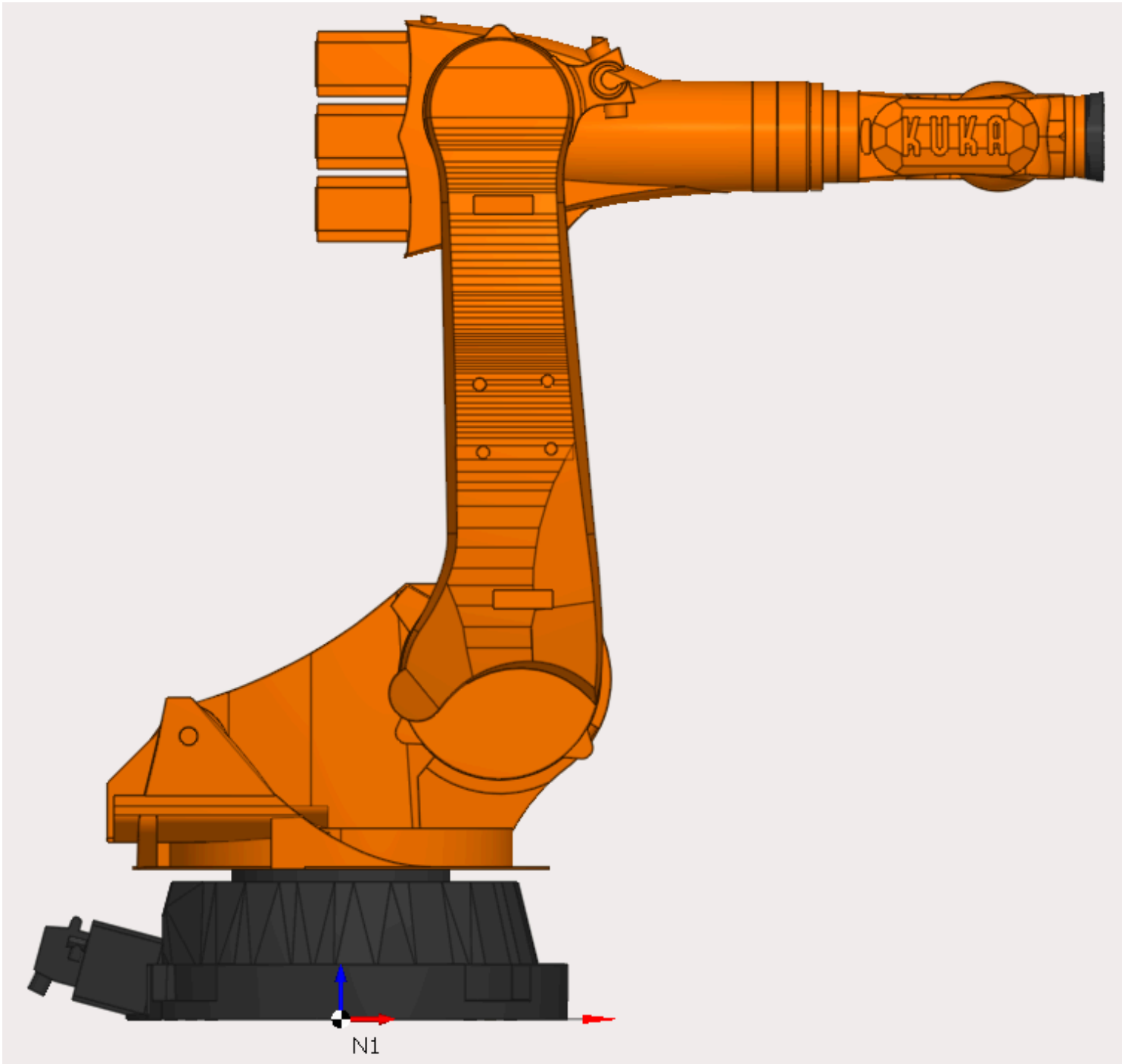
Model Position

Use Model Position to set joint values for current position of imported 3D model. These fields allows you to use CAD files of mechanisms, saved in non-zero positions.

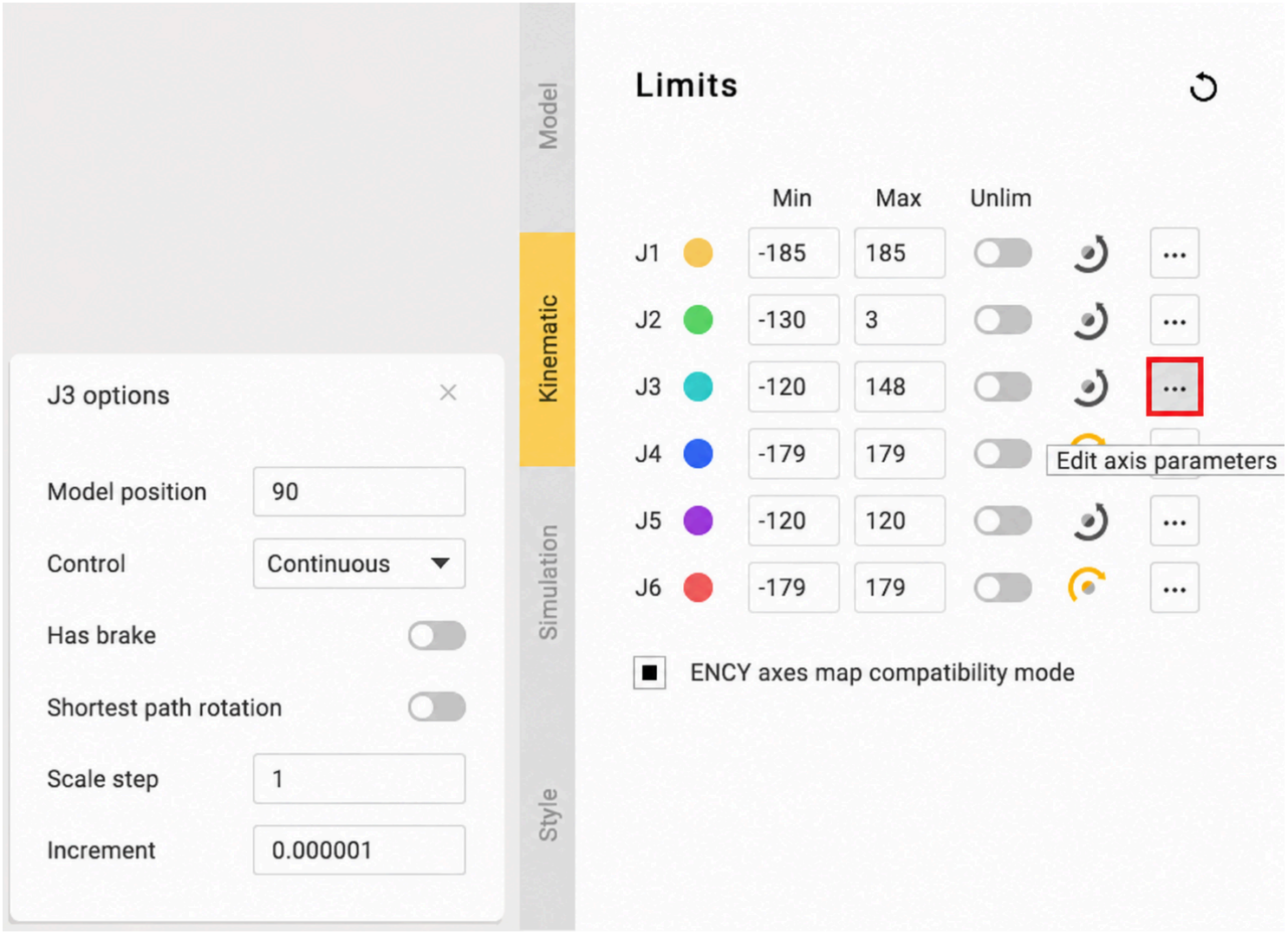
For example here is the zero position of Kuka robots:



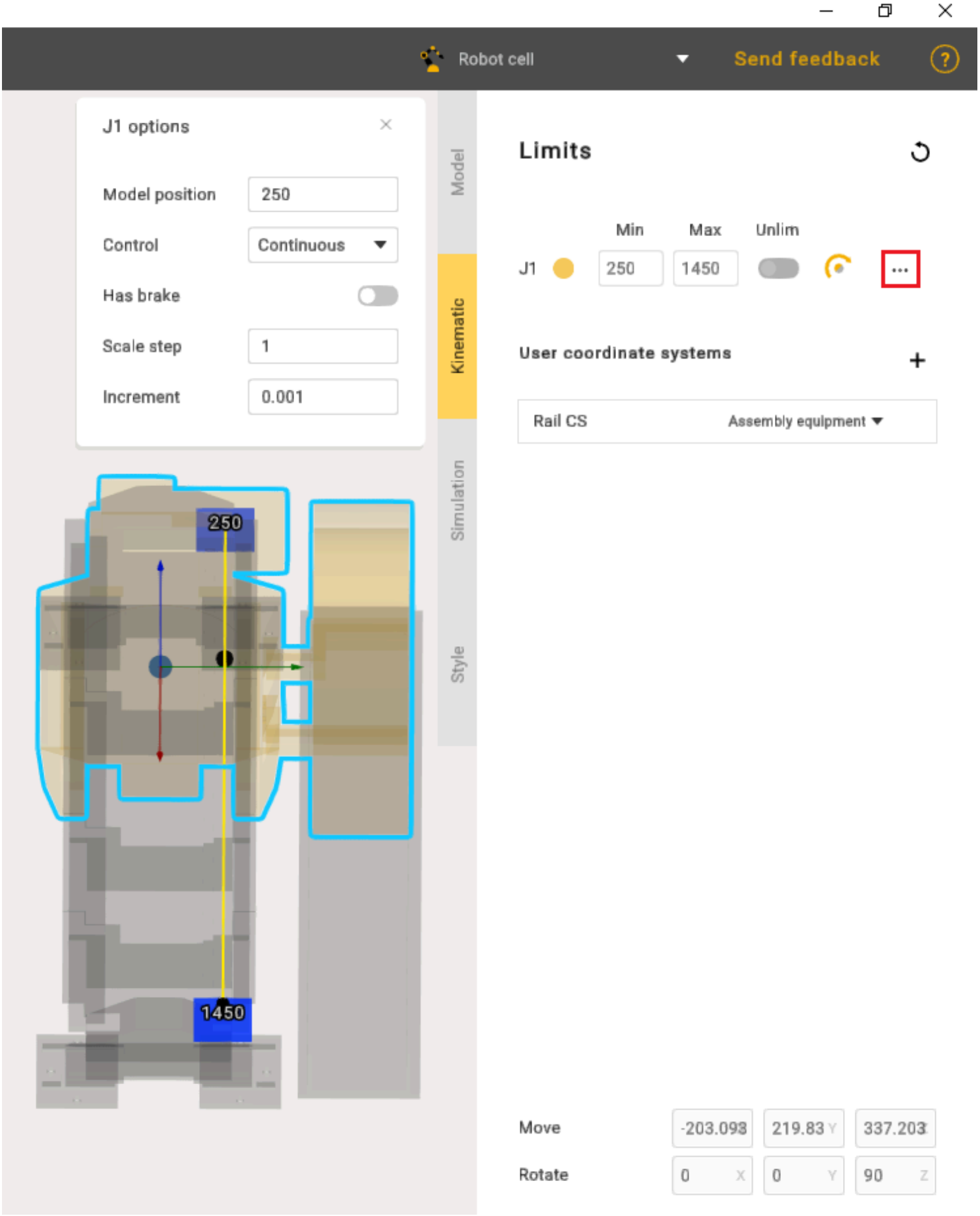
But Kuka download center provides only 3D models for non-zero robot position:



So we can just specify Model Position values and use 3D models provided by Kuka. It is not necessary to change them on CAD system.

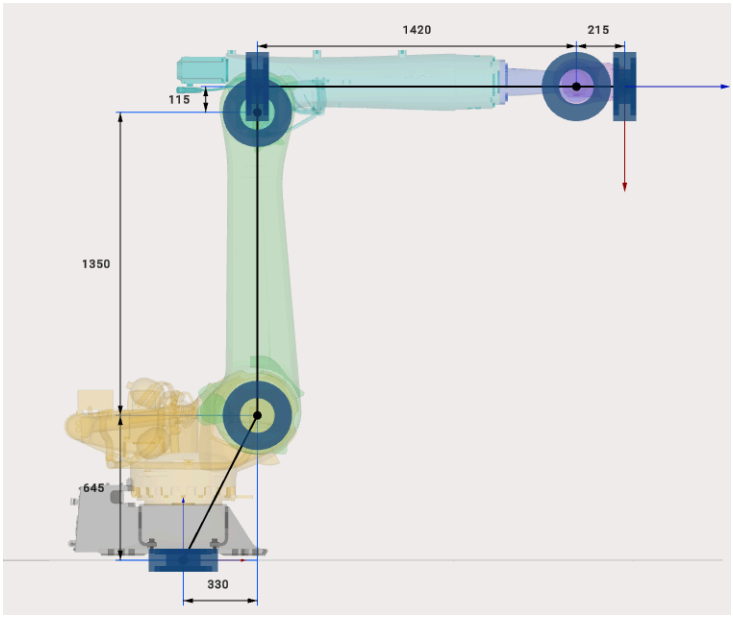


Model Position function is also useful for mechanisms with linear axes. For example, when editing rail limits.

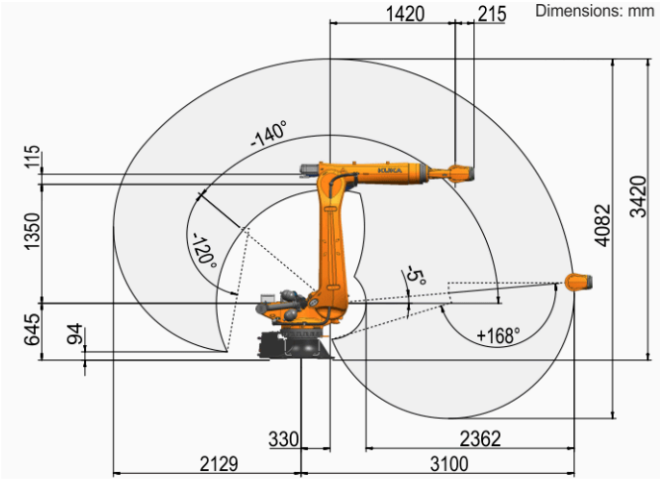

Robot cell
Send feedback
J1 options
Model position
250
Control
Continuous
Has brake
Scale step
1
Increment
0.001
Model
Kinematic
Simulation
Style
250
1450
Limits
Min
Max
Unlim
J1
250
1450
User coordinate systems
Rail CS
Assembly equipment
Move
-203.093
219.83
337.203
Rotate
0
0
90

Industrial Robots

The easiest way to set the kinematics of a 6-axes industrial robot is to use the robot's DataSheet and specify the 6 dimensions in MachineMaker.



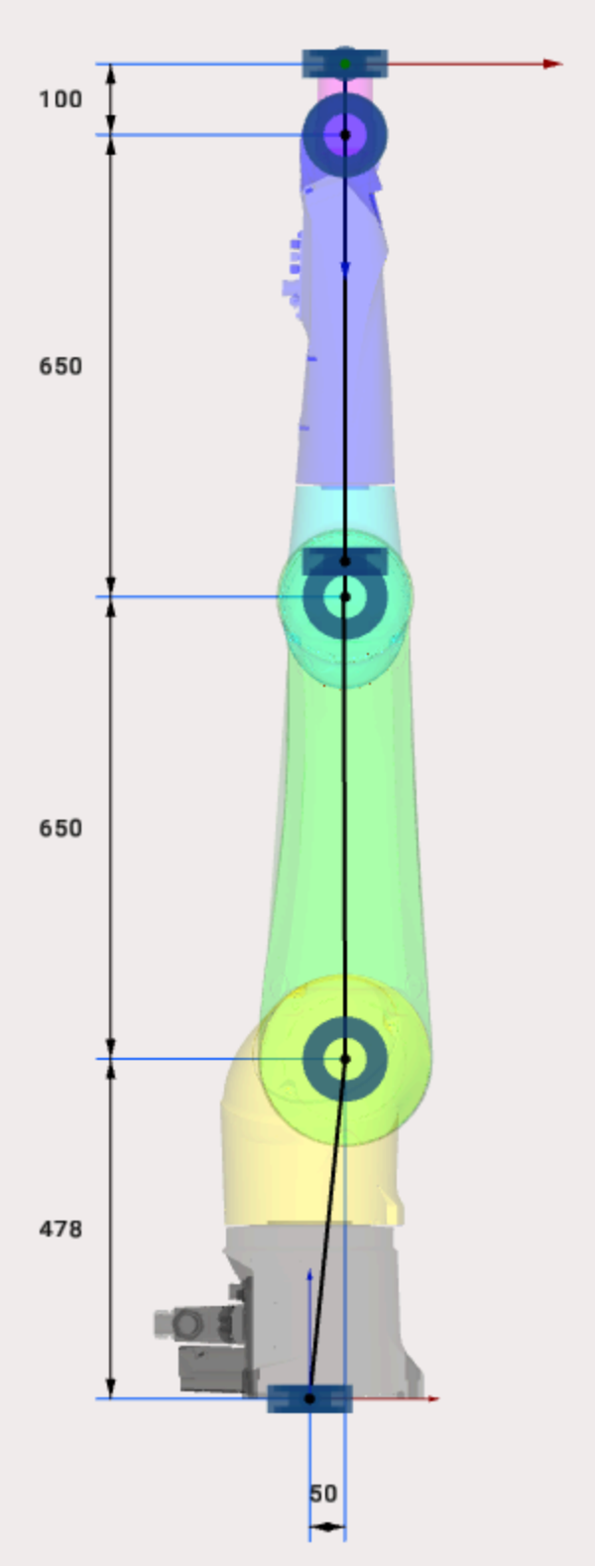
Workspace graphic



Drag&Drop mode is restricted for Robot kinematics to prevent the impairment of the kinematic scheme.

Special cases

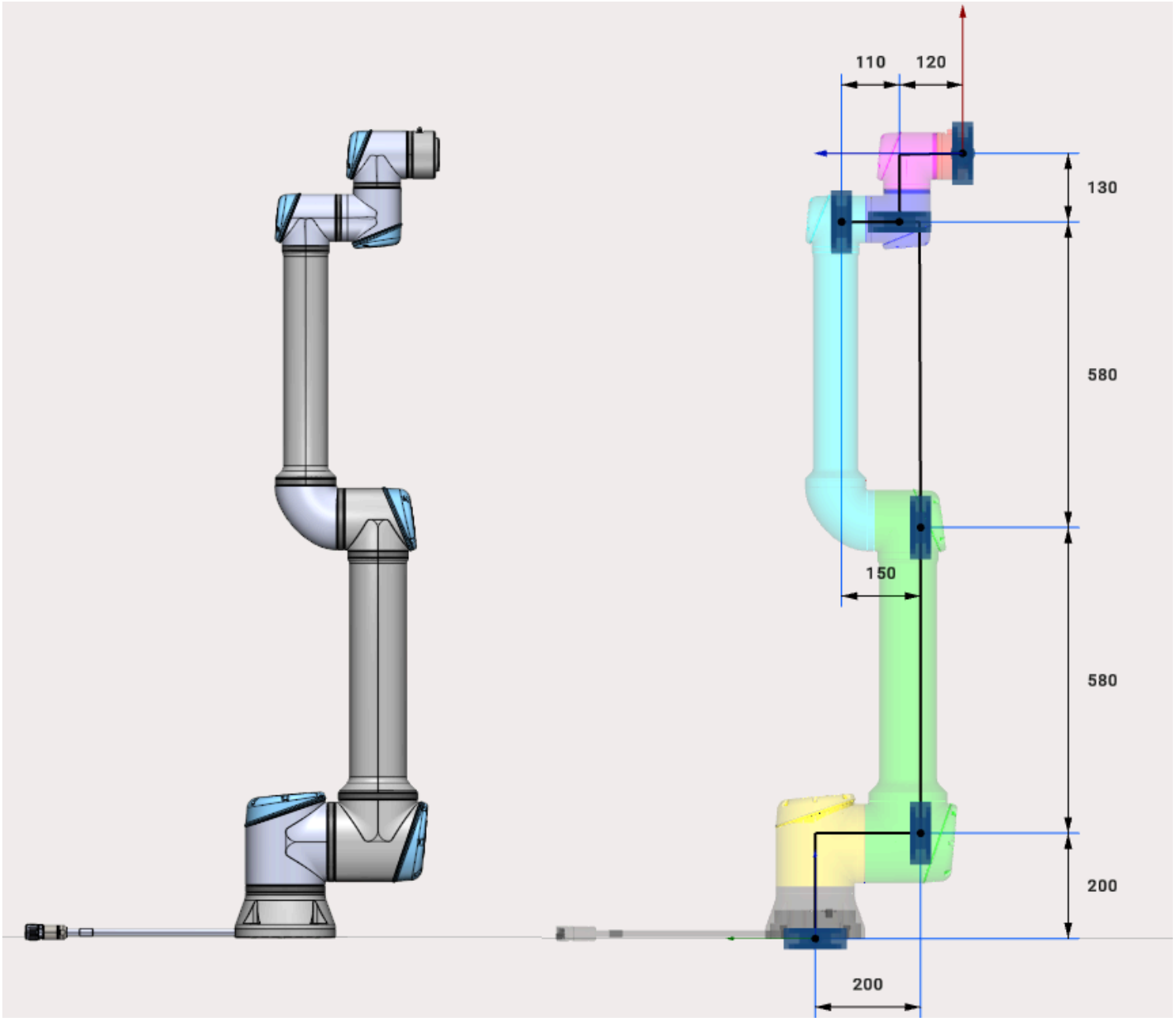
Some robot manufacturers, like Staubli, provide 3D models and DataSheets with robots set at zero positions. MachineMaker automatically assumes the kinematic linkage of the selected type of robot.


100
650
650
478
50

Cobot

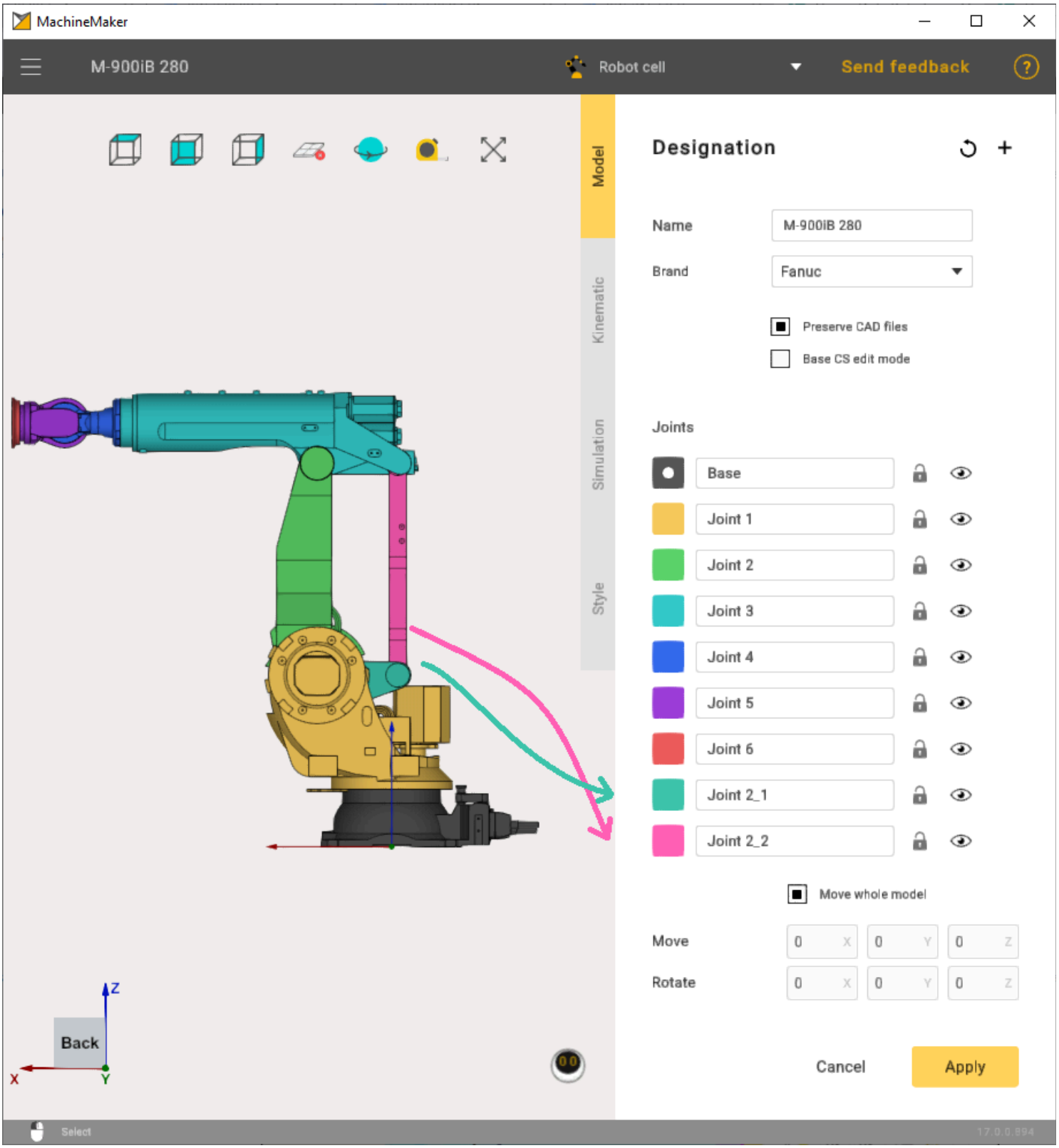
Cobots (Collaborative robots) have a different template of kinematic schemes. As a rule, at zero position this kind of robots is vertically aligned.

Current version of MachineMaker supports 6-axes Universal and AUBO collaborative robots.



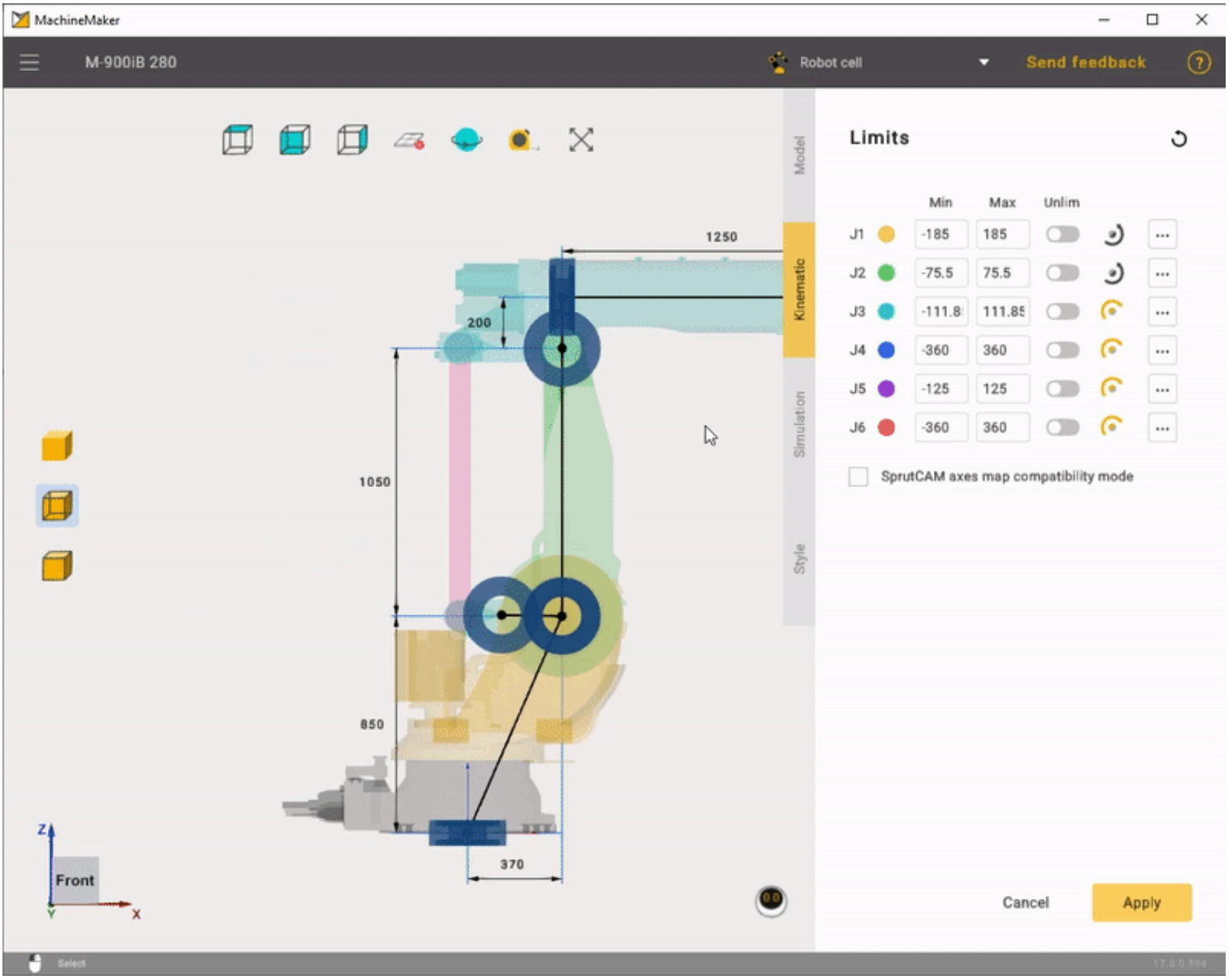
Heavy-Duty Robots

Building heavy-duty robots in MachineMaker is very similar to building industrial robots, but heavy-duty robots have 2 additional joints connected by a connector.



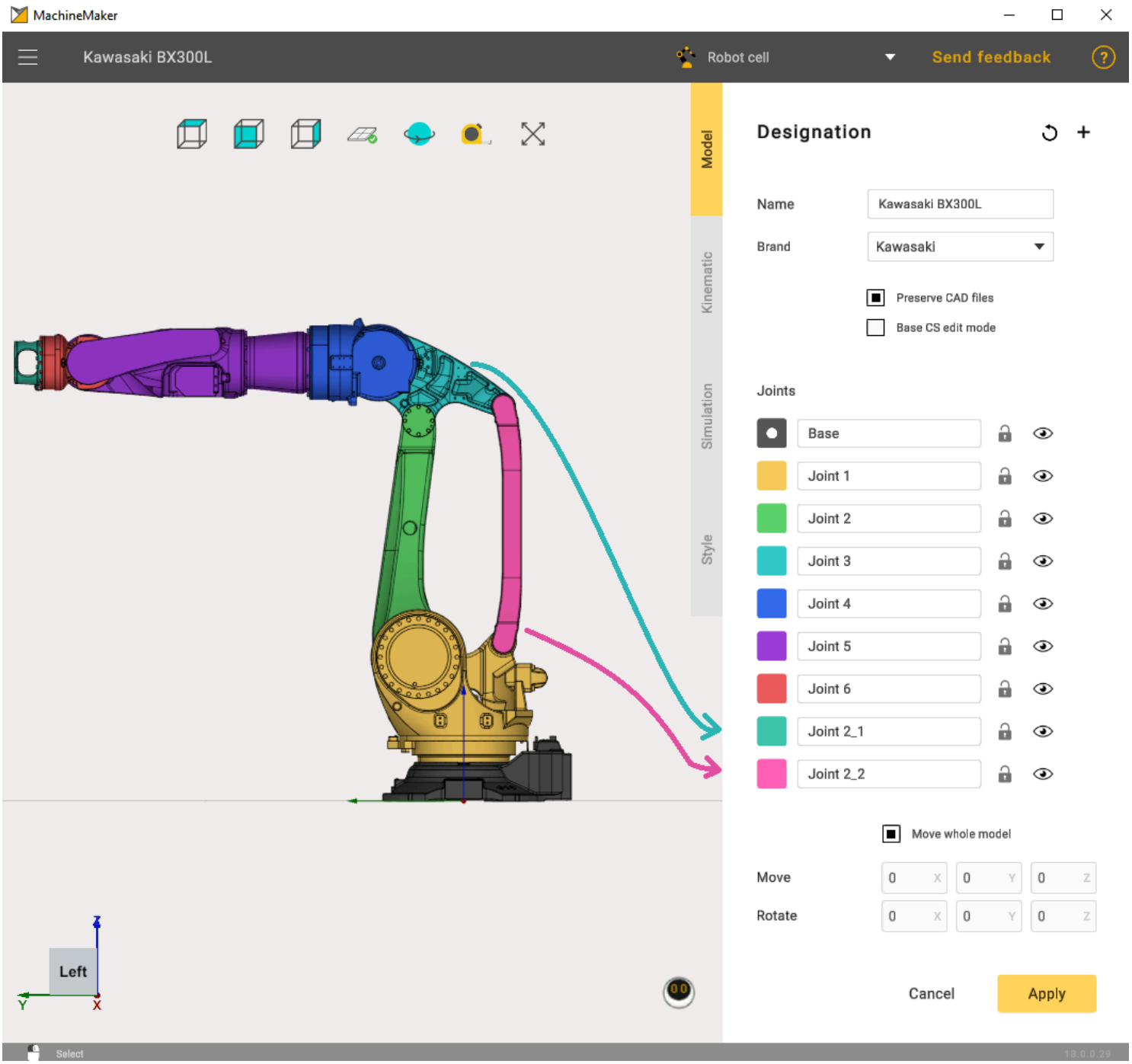
As a rule, robot manufacturers do not provide any information about the position of the additional joints connector. The easiest way to place the connector in the correct position is to hold down the Left Ctrl

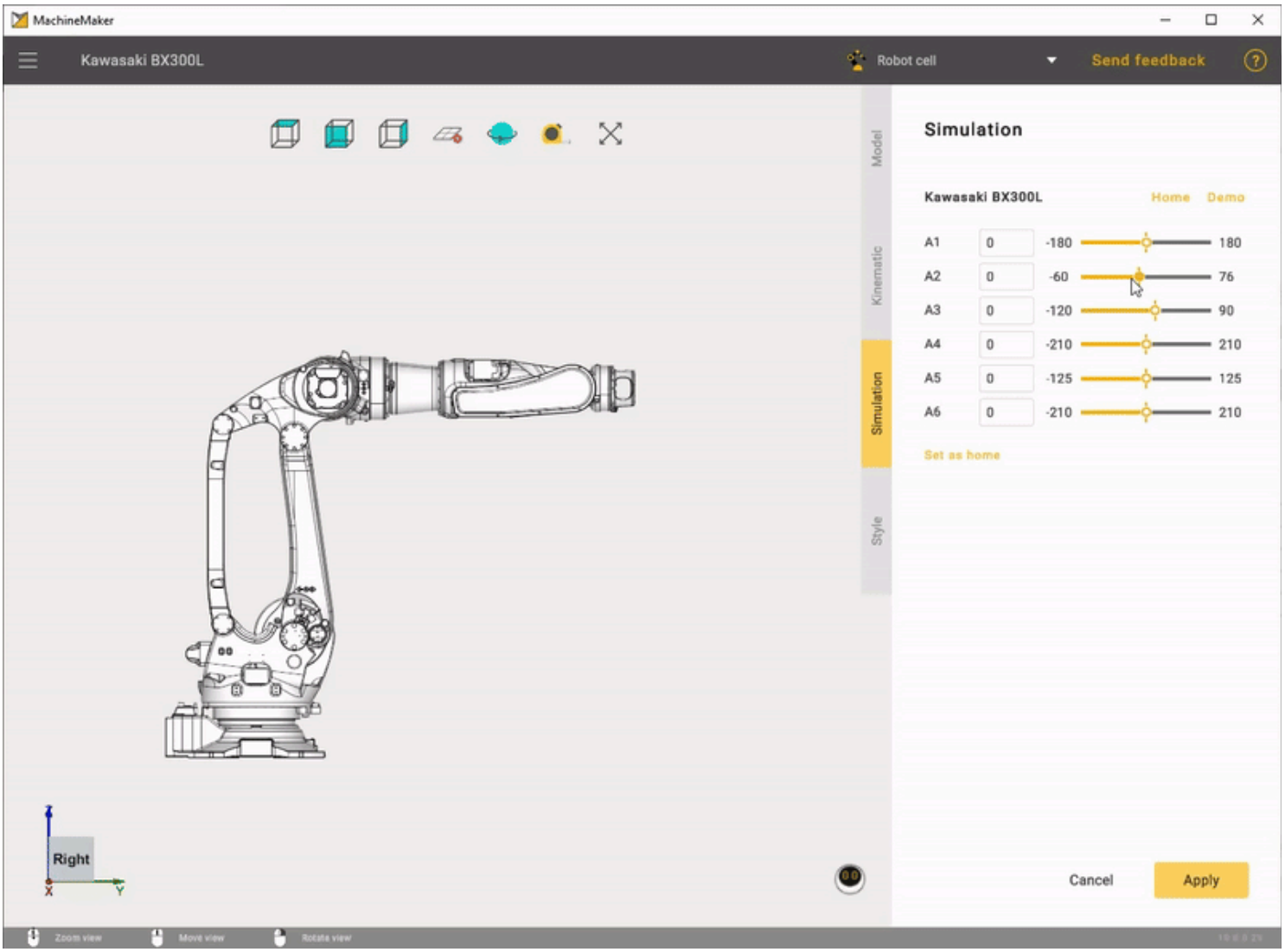
button and drag&drop the connector to a snap point.



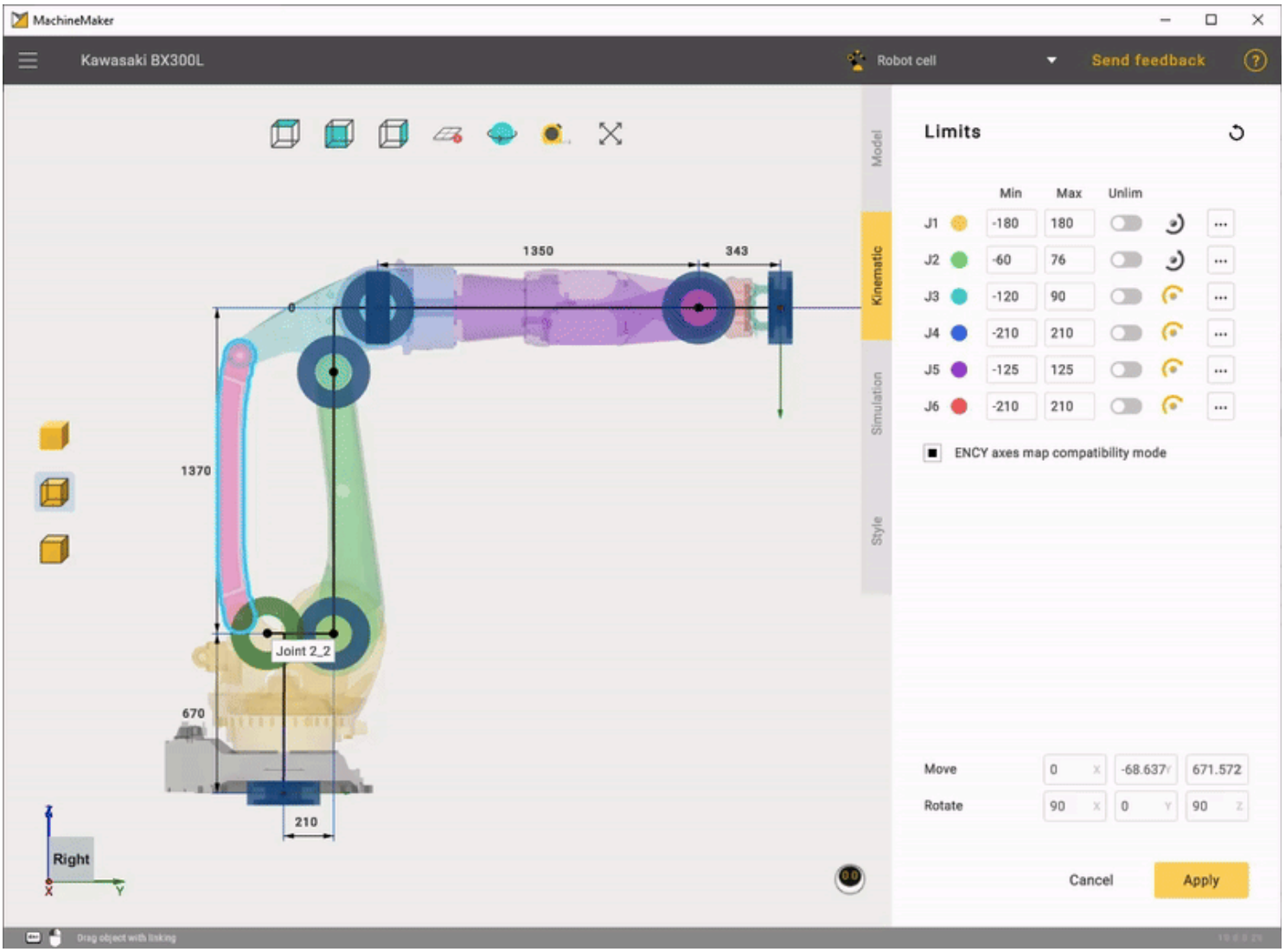
Flexible Heavy-Duty Robot

The Flexible Heavy-Duty Robot setup is similar to the Heavy-Duty robots. They also have 2 additional joints, but in this case they are moving.



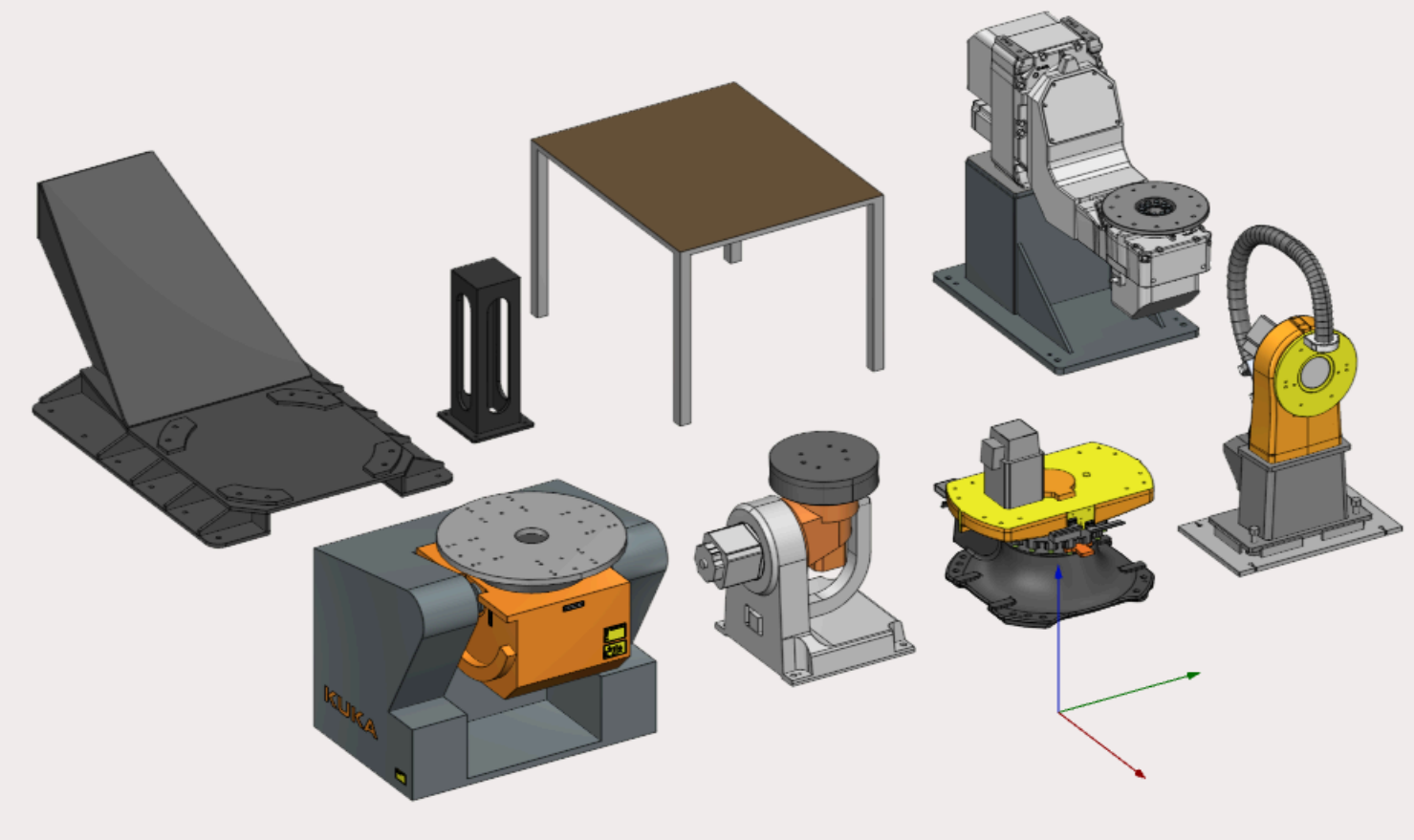


Here, as in the Heavy-Duty Robot setup, the easiest way to set the connector to the correct position is to hold down the left Ctrl button and drag the connector to the anchor point.


MachineMaker
Kawasaki BX300L
Robot cell
Send feedback
Limits
Min
Max
Unlim
J1 -180 180
J2 -60 76
J3 -120 90
J4 -210 210
J5 -125 125
J6 -210 210
ENCY axes map compatibility mode
Model
Kinematic
Simulation
Style
1350
343
1370
670
210
Joint 2_2
Right
Move 0 -68.637 671.572
Rotate 90 0 90
Cancel
Apply

Tables and Positioners

MachineMaker allows you to create static tables, 1-axis positioners and 2-axes positioners.



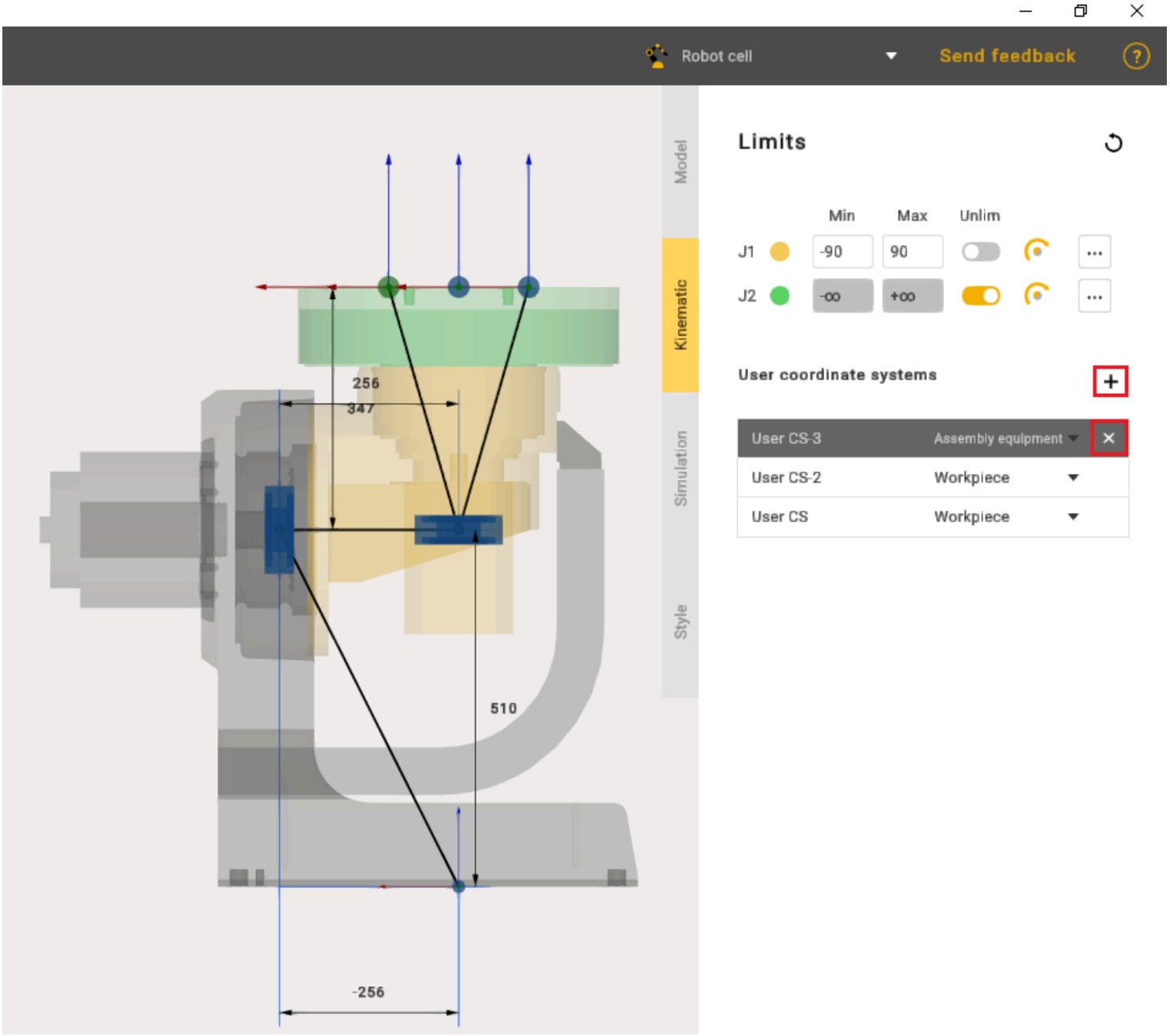
Tables

Table is a fixed (static) object which can hold a workpiece or any another object (including robots or another table).

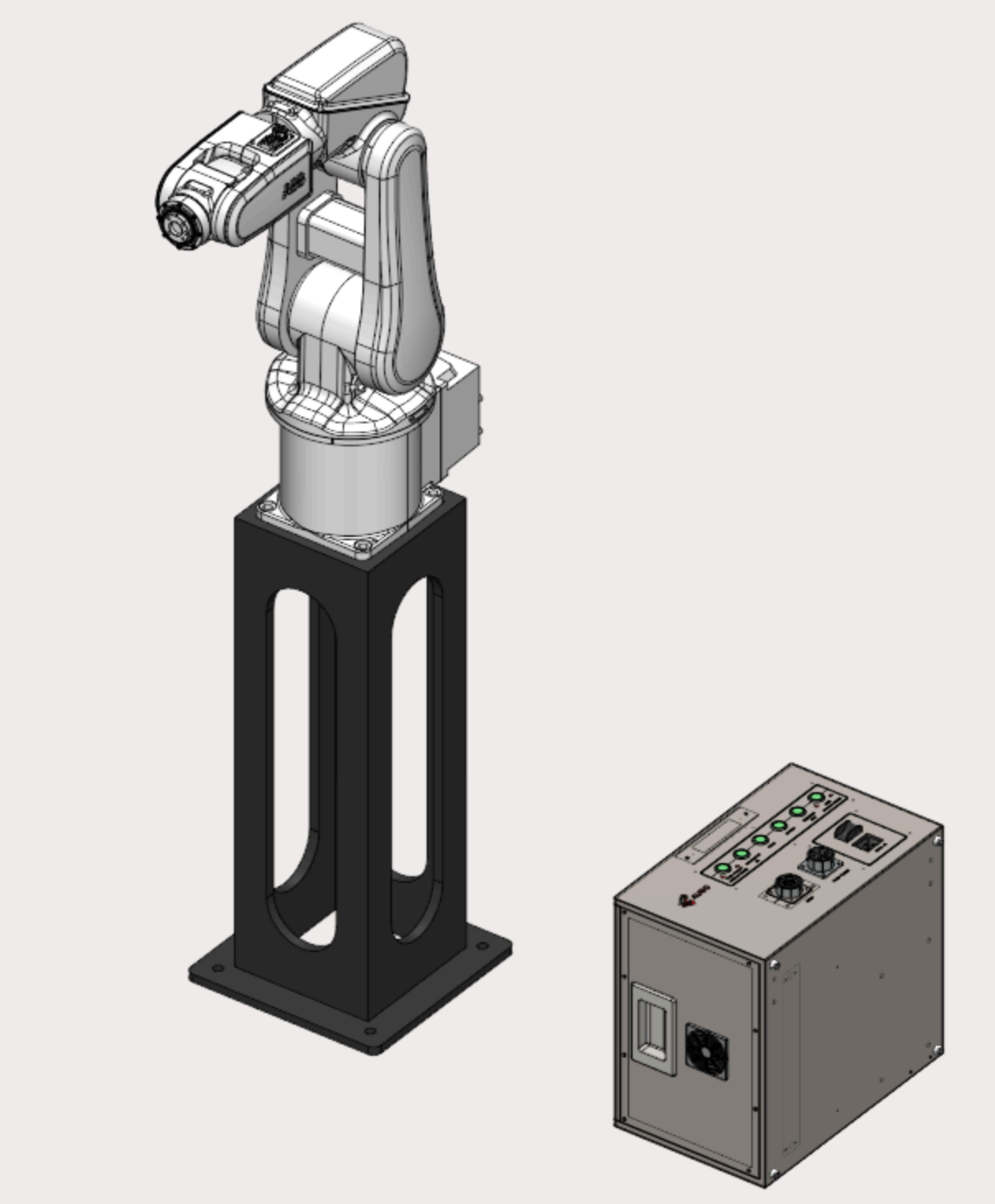
It is possible to add any number of connectors to the table using + button in the User Coordinate Systems panel. Use × button to delete the connector. Use double click to rename the coordinate system.

Hold down Left Control key and use drag&drop to place the connector in the correct position; it is also possible to specify the connector's position by changing dimensions or the date in the Transformation Panel, for details see "Transformation panel". You can also select the type of added connector assembly equipment or workpiece.

MachineMaker will use connectors to connect mechanisms with each other when building Assemblies. All empty connectors will be converted into Workpiece holders for CAM system.

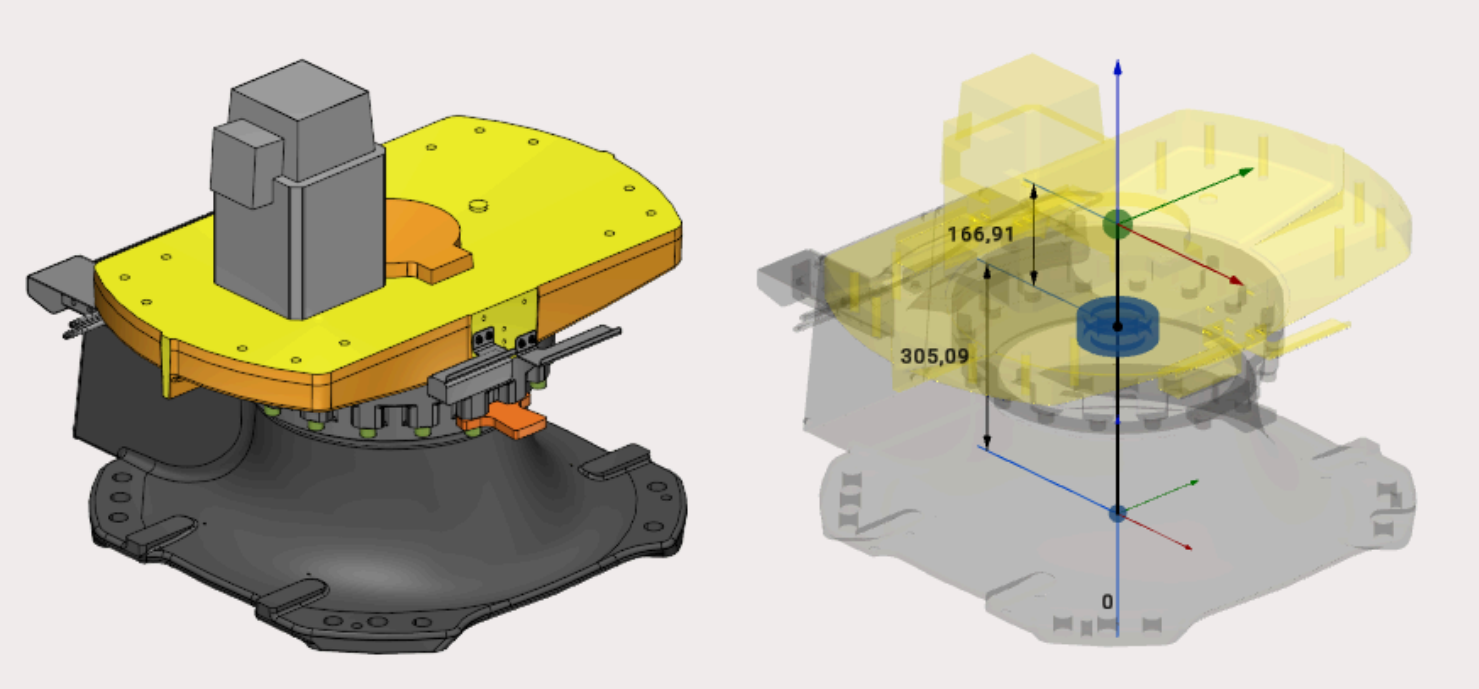


There is a big difference between Fixed Tables and Fixed Objects. A Fixed Object is a standalone static object, it is impossible to place a robot on a Fixed Object. So, Fixed Objects do not have any connectors. Use Fixed Objects option for robot controllers, standalone boxes located in the robot cell, fences and so on. Use Fixed Tables for tables holding robots and workpieces, floors and so on.



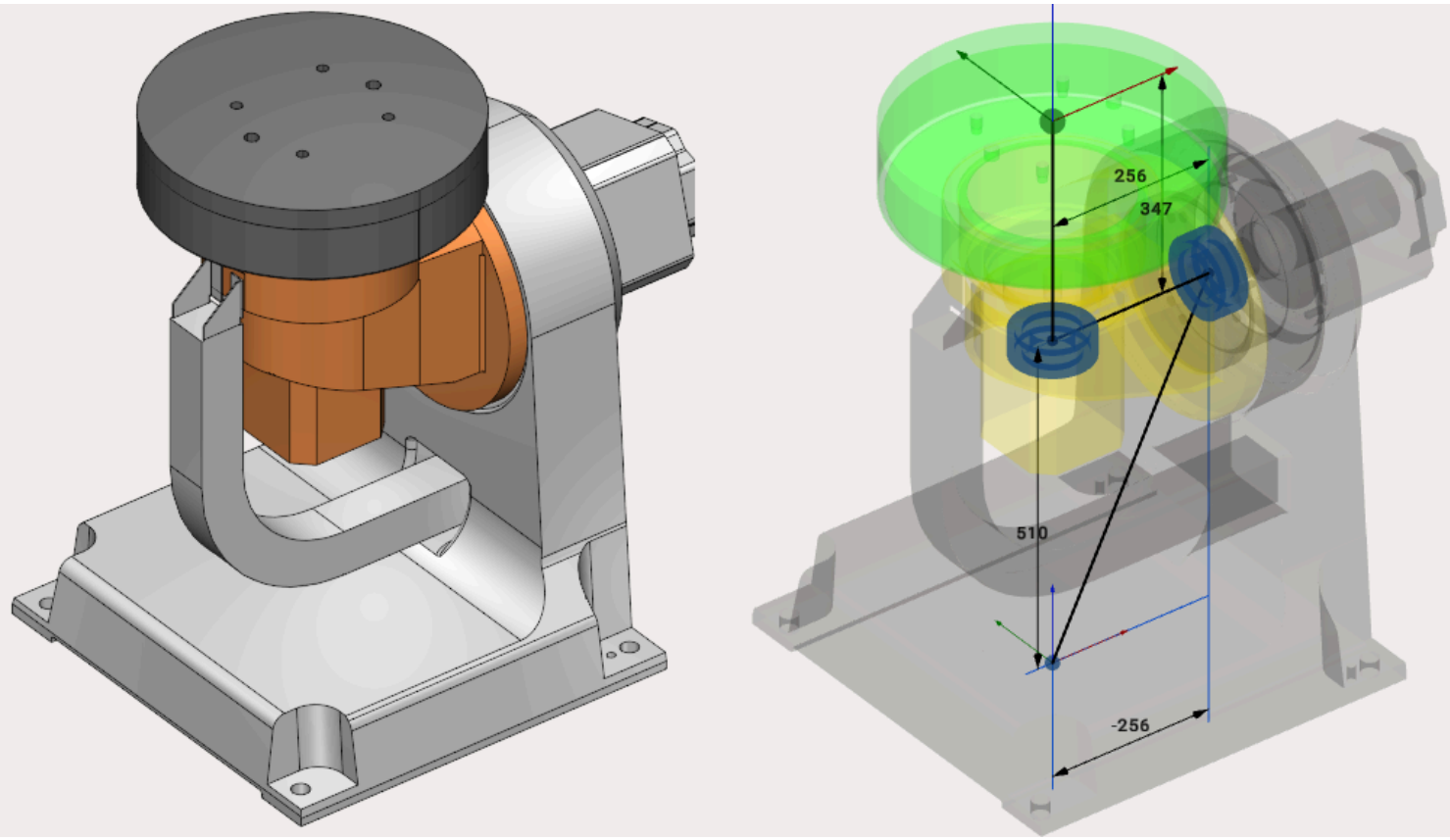
1-axis positioner

1-axis positioner has one rotary joint and an unlimited number of connectors. It is possible to add new connectors using + button in the User Coordinate Systems panel.



2-axes positioner

2-axes positioner has 2 rotary joints and an unlimited number of connectors. It is possible to add new connectors using + button in the User Coordinate Systems panel.

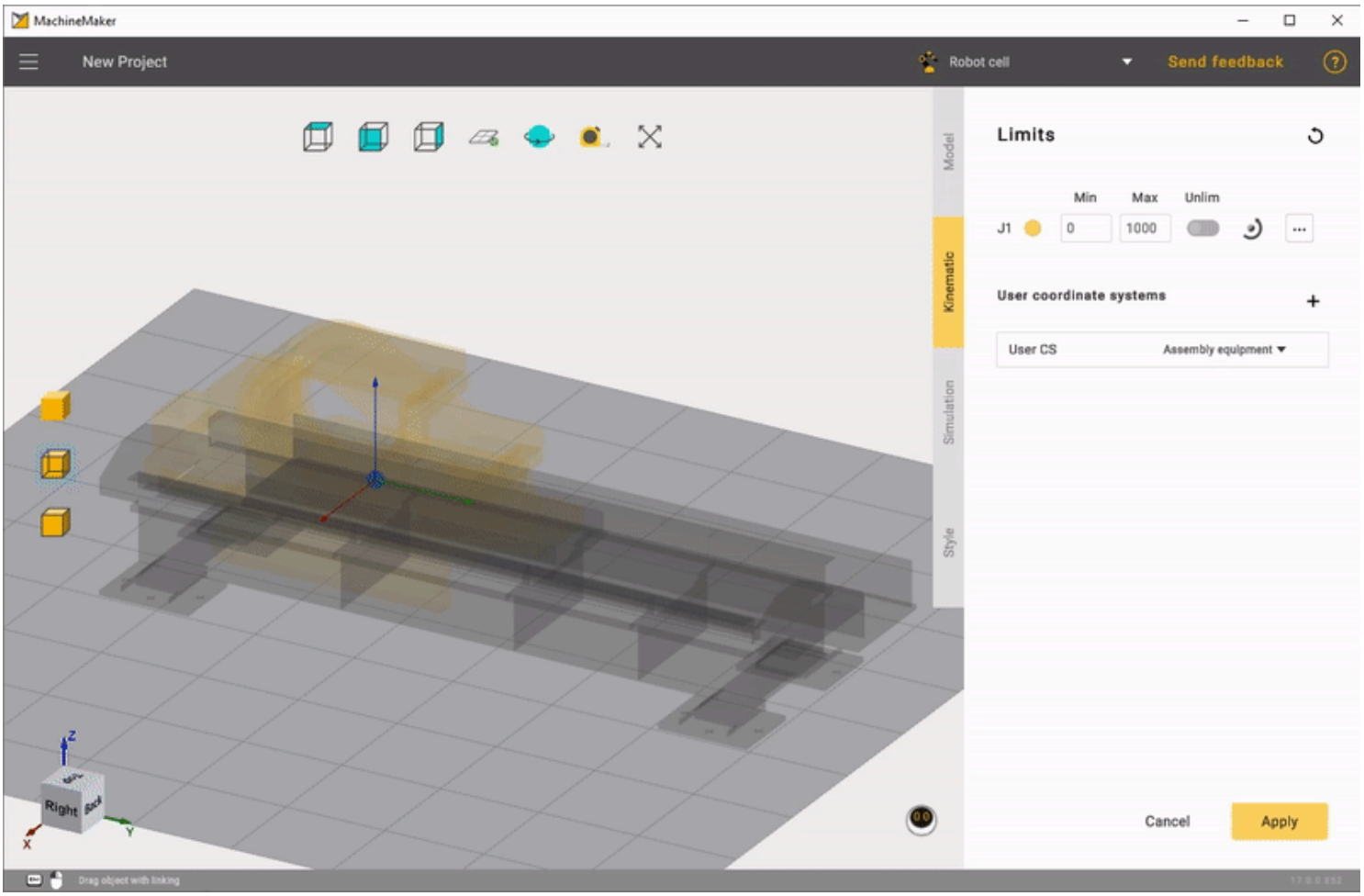


Rails and Portals

MachineMaker allows you to add linear rails, 2-axes portals and 3-axes portals.

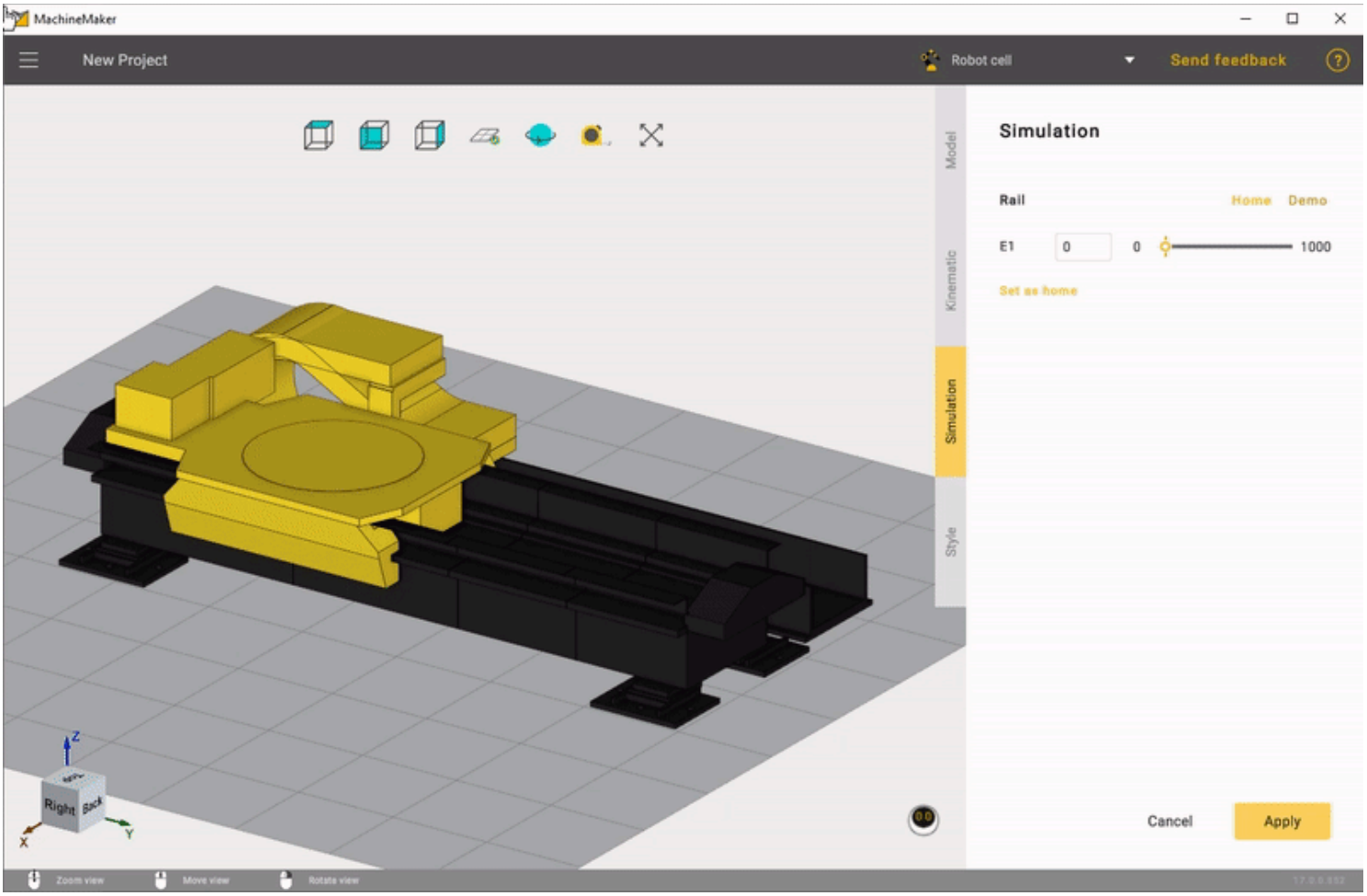
It is possible to add any number of connectors to the table using + button in the User Coordinate Systems panel. Use × button to delete the connector. Use double click to rename the coordinate system.

MachineMaker will use connectors to connect mechanisms with each other when building "Assemblies".



Click on Limits to specify Min and Max values. MachineMaker will show minimal and maximal positions of the 3D model.

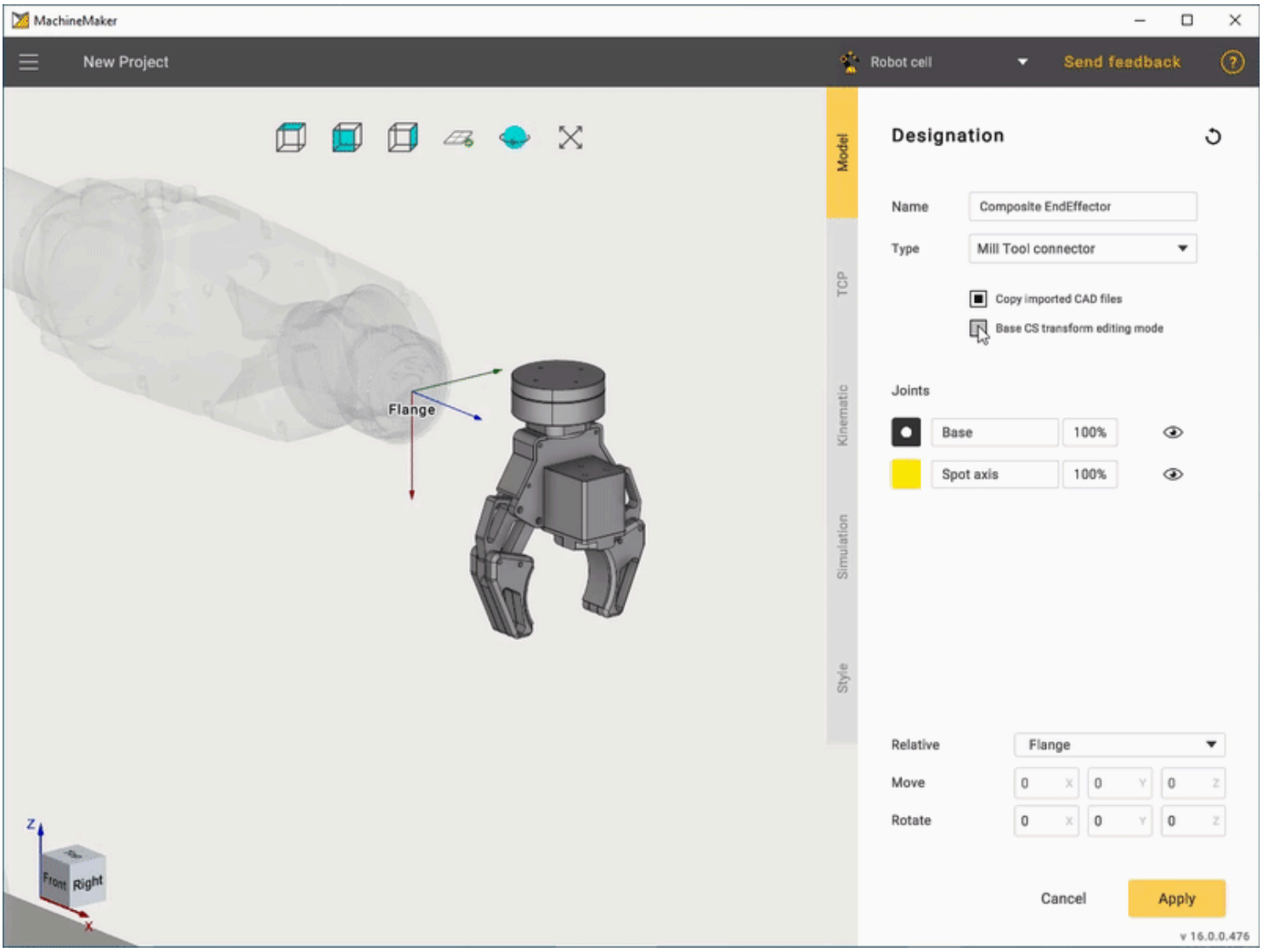
It is possible to change linear axis direction using transformation panel in the right bottom corner.


MachineMaker
New Project
Robot cell
Send feedback
Simulation
Rail
Home
Demo
E1
0
0
1000
Set as home
Model
Kinematic
Simulation
Style
Cancel
Apply
Zoom view
Move view
Rotate view

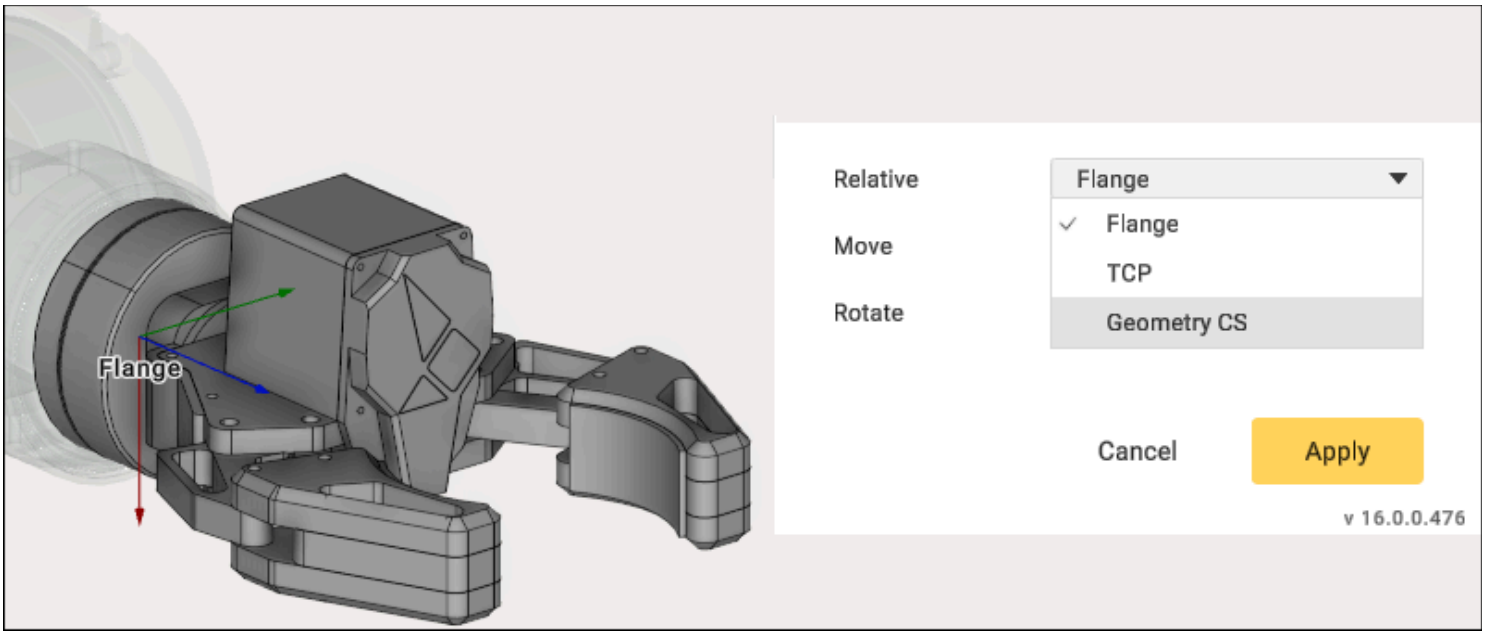
Composite End effectors

Composite end effectors usually contain movable parts such as fingers.

First of all, it is necessary to connect the end effector with the robot flange. The easiest way is to use Base CS transform editing mode.

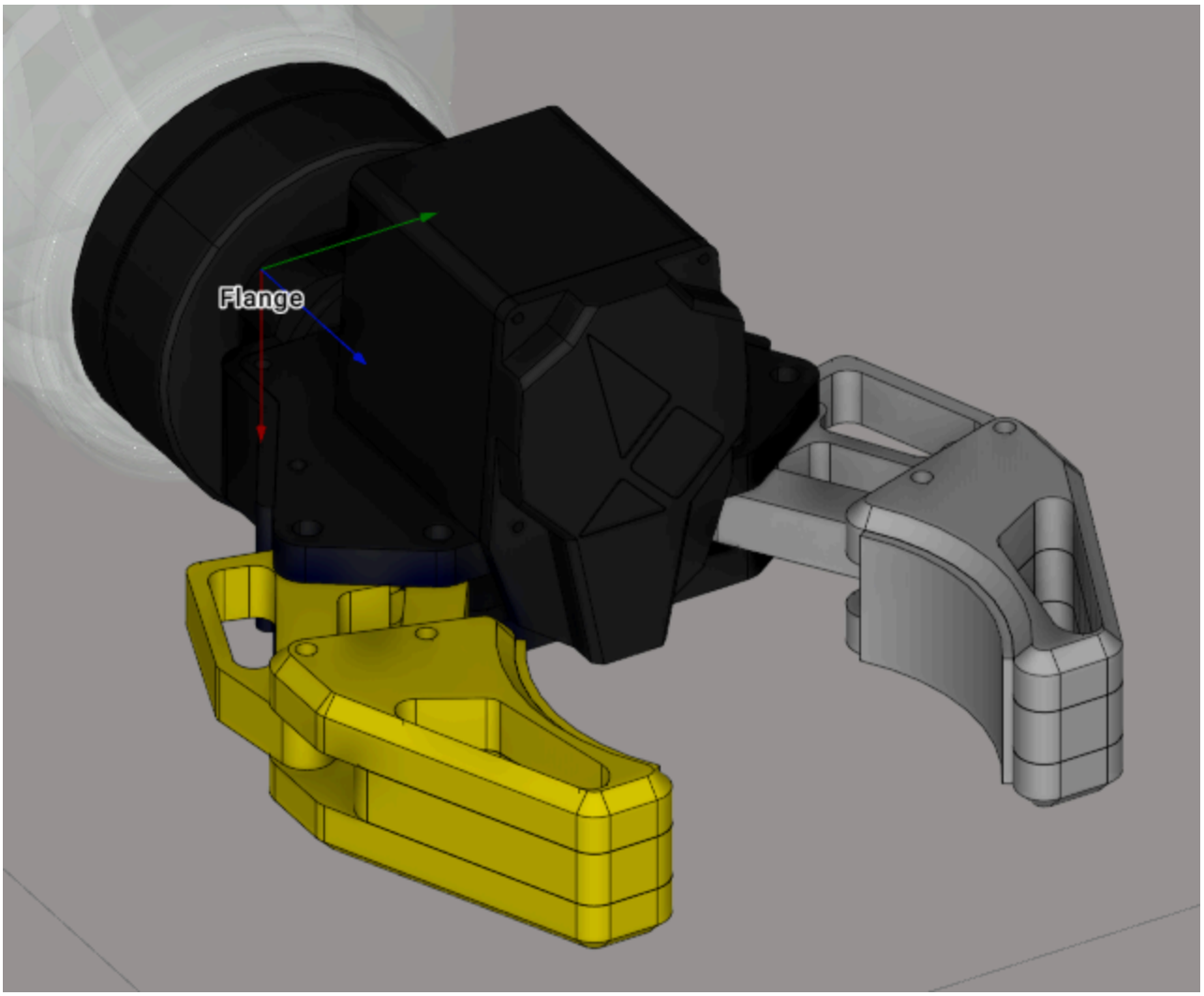


Relative selector allows you to change coordinate system for the Transformation Panel. Use Default for Geometry CS, Base CS for the Robot Flange CS and TCP for the tool center point.

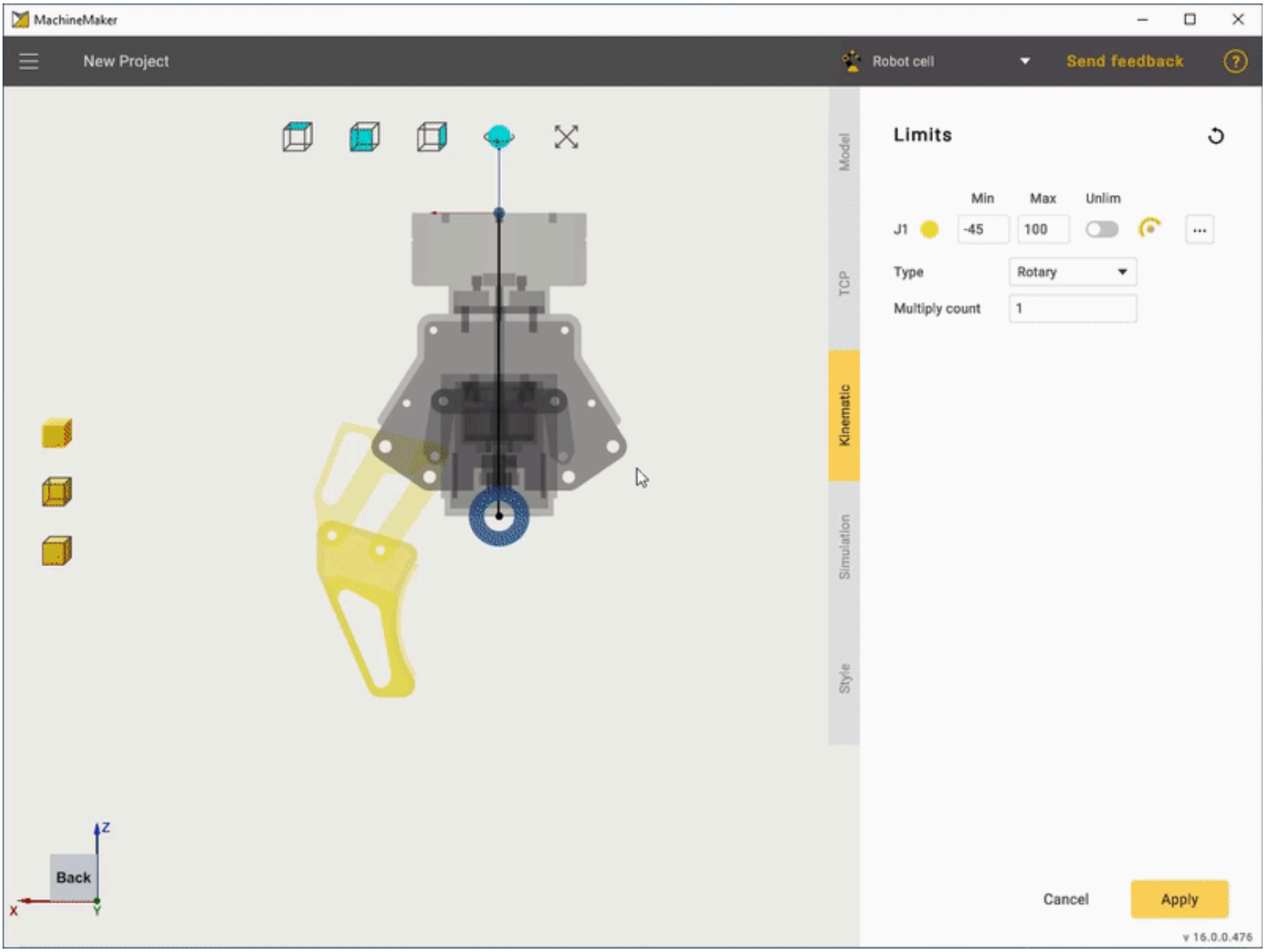


Once this is done, you have to "Grouping elements into nodes".

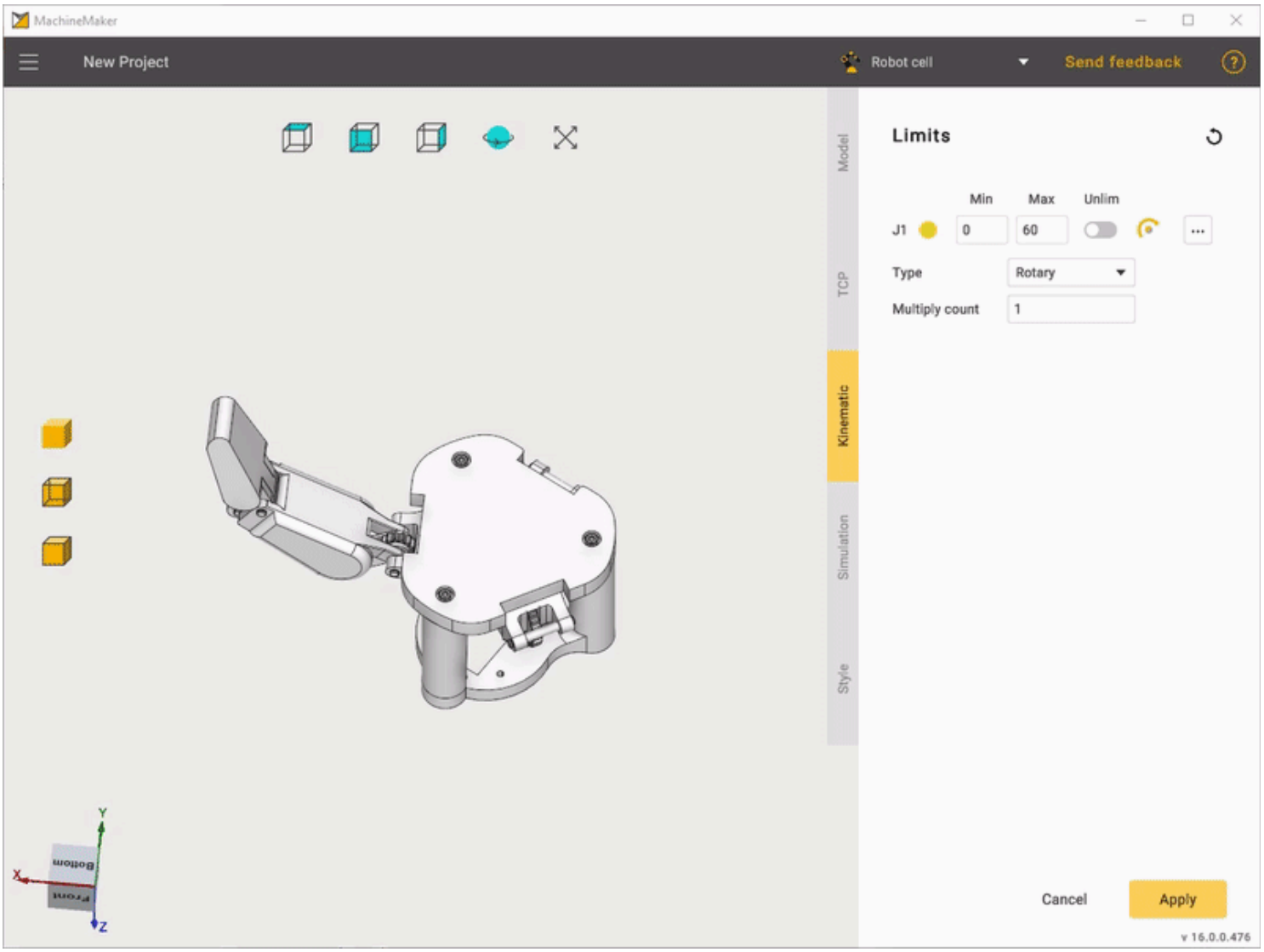
At that stage we need to select only one movable joint. MachineMaker will automatically add all necessary joints later.



Next, go to the Kinematic tab and define the connectors location. First of all it is necessary to select the connector type, it may be Linear or Rotary. Use Drag&Drop and Transformation Panel to set the connector's position and orientation. Set minimal and maximal positions in the Limits panel.

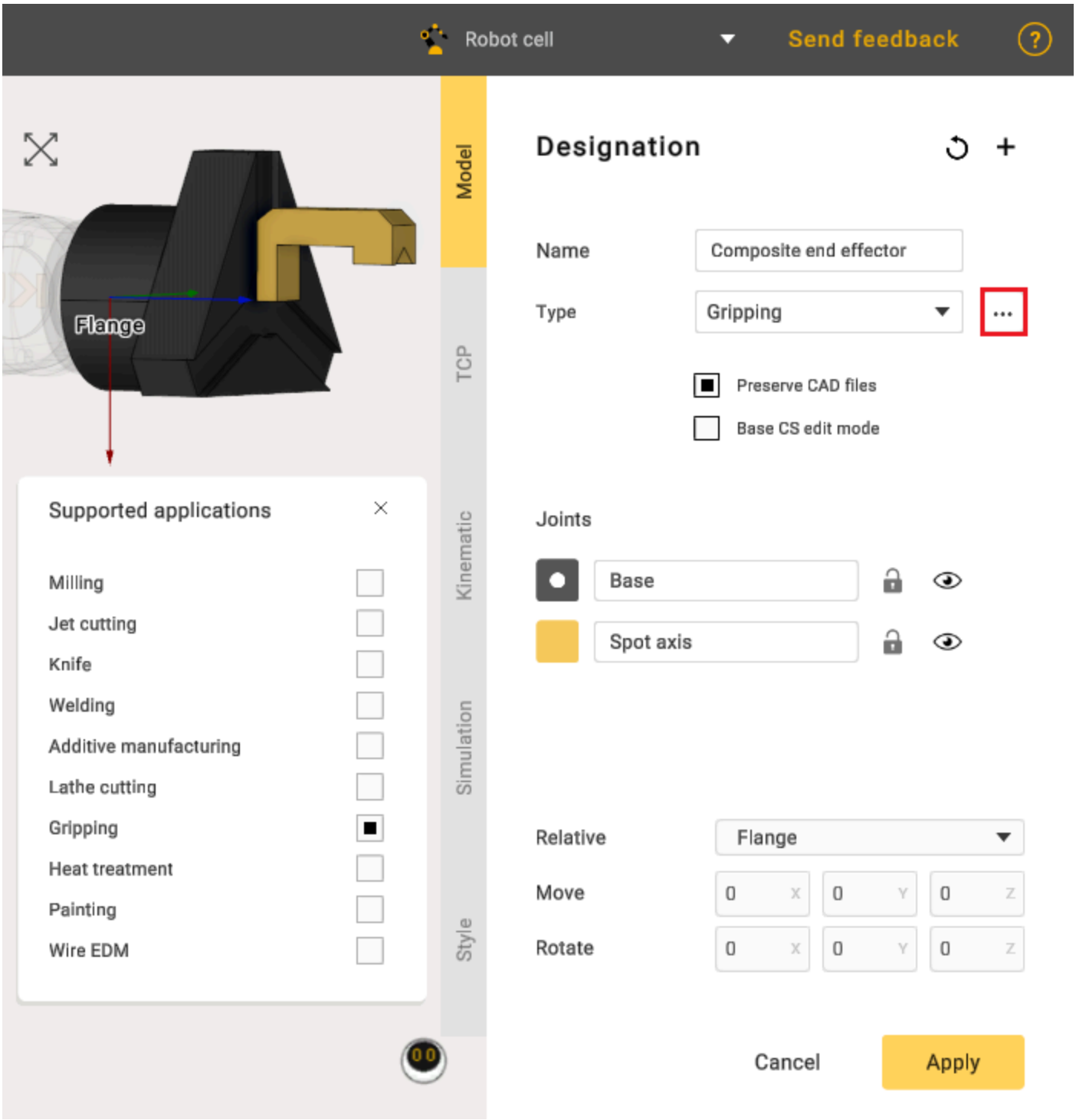


In order to create copies of movable joint use Multiply count edit.

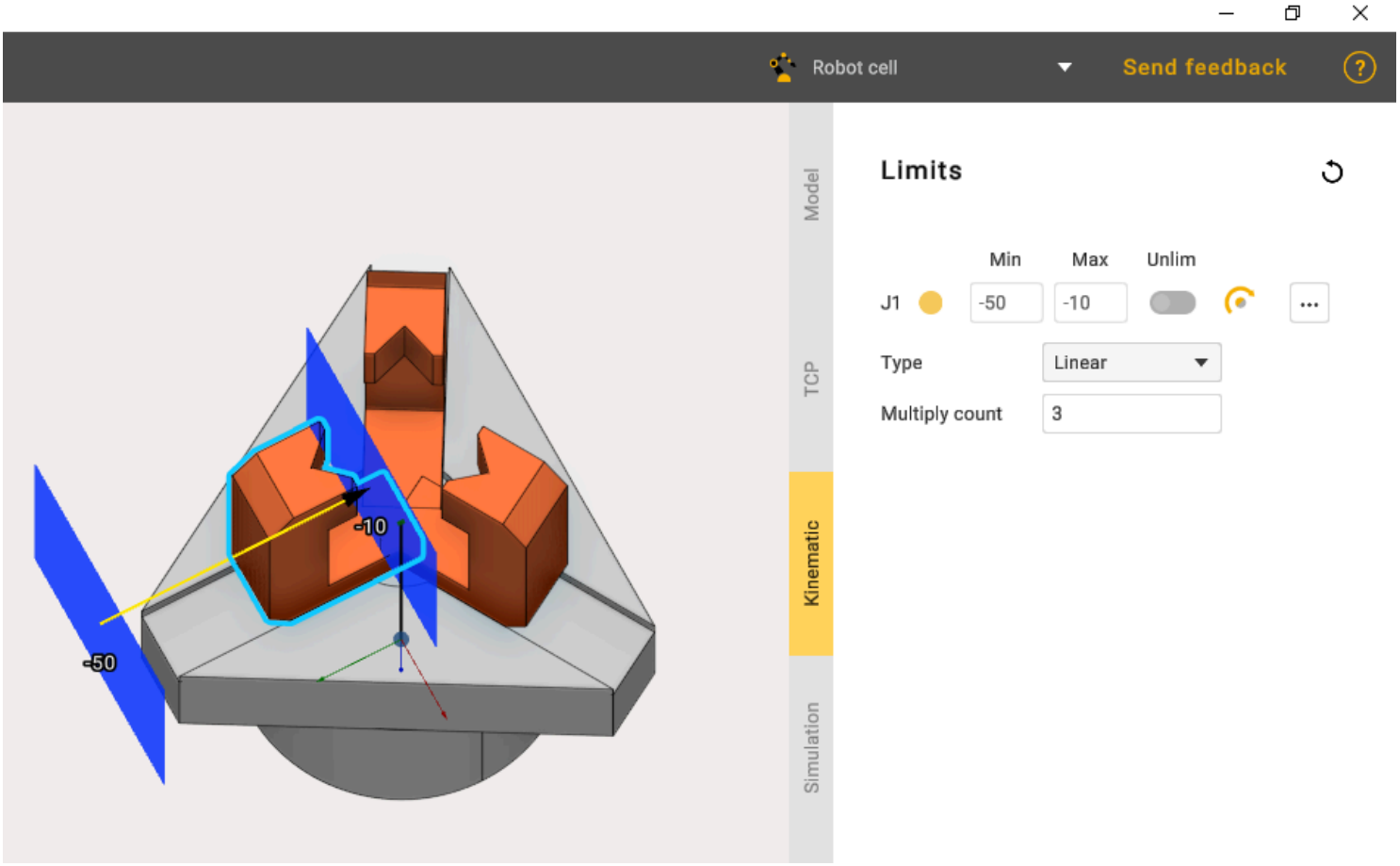


Finally set the TCP and Style similarly to a plain "End Effector"

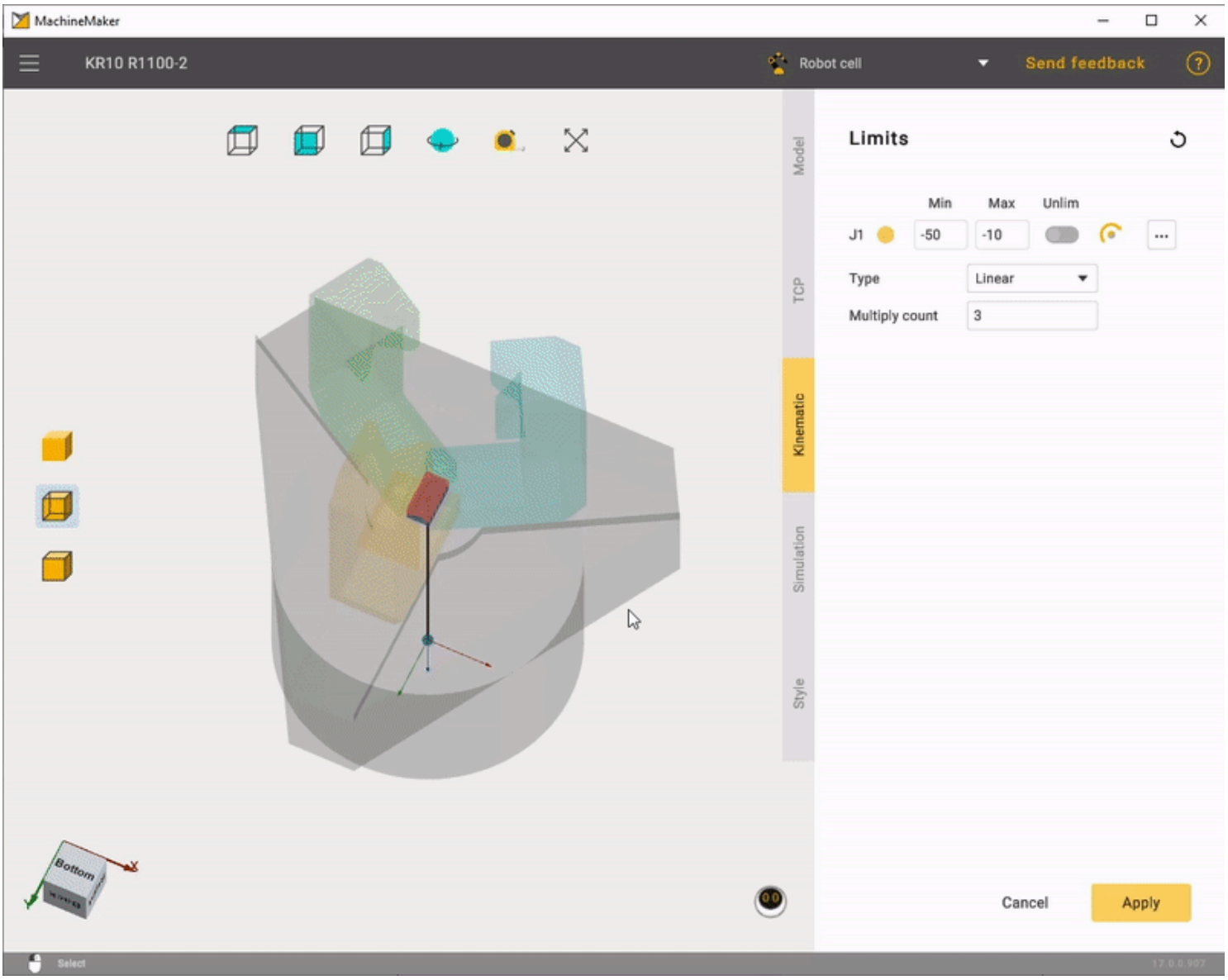
In some cases, a composite end effector can be linear. Ensure that the "Gripping" type is selected.



In kinematics, choose the "Linear" type and set the necessary limits for the jaws. Also use the "Multiply count edit" function to create copies of the jaws.

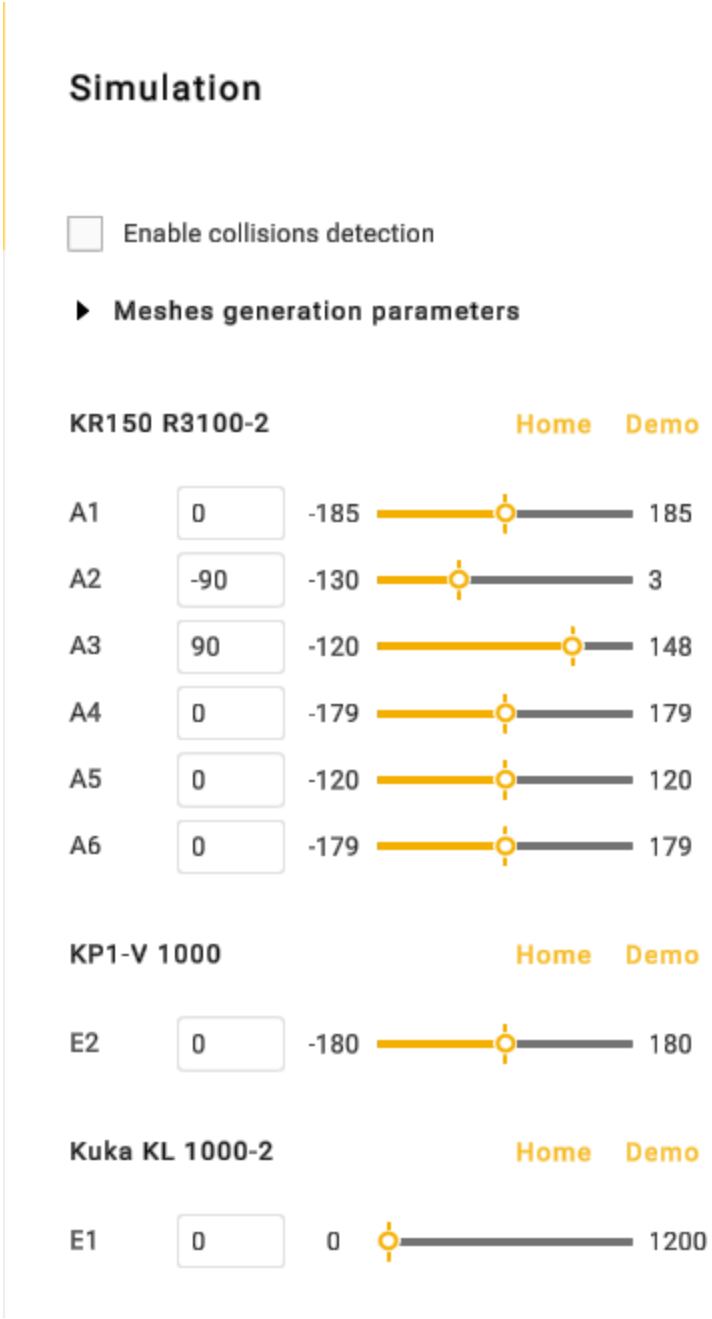


Similarly to "Rotary" the limits of jaws movements are edited.


MachineMaker
KR10 R1100-2
Robot cell
Send feedback
Model
TCP
Kinematic
Simulation
Style
Limits
Min
Max
Unlim
J1
-50
-10
Type
Linear
Multiply count
3
Bottom
Cancel
Apply
Select

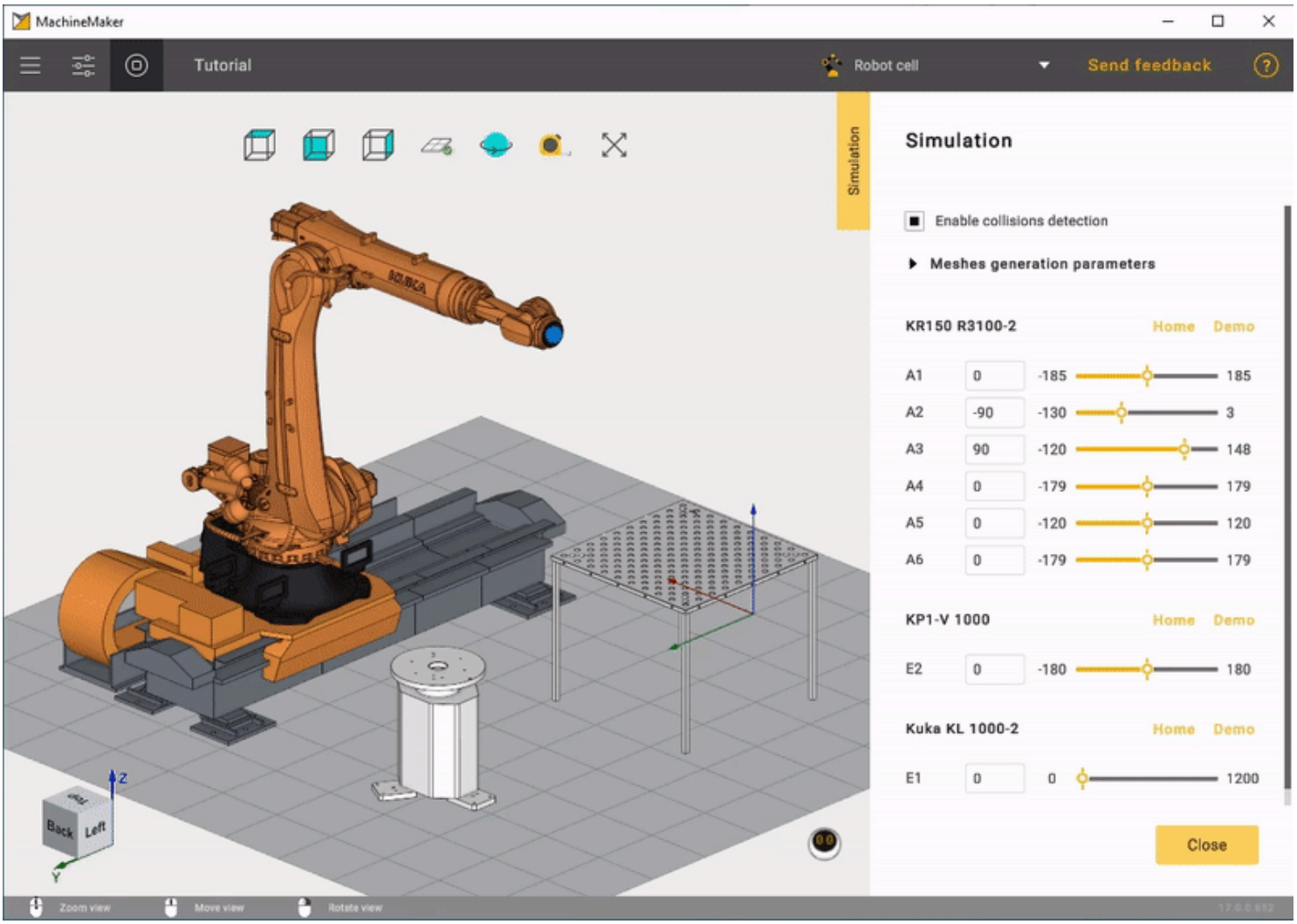
Assembly Simulation and Validation

We recommend validating the complete assembly by simulating mechanisms movements. Click  button to open Assembly simulation panel.



In this tab there is "Enable collisions detection".



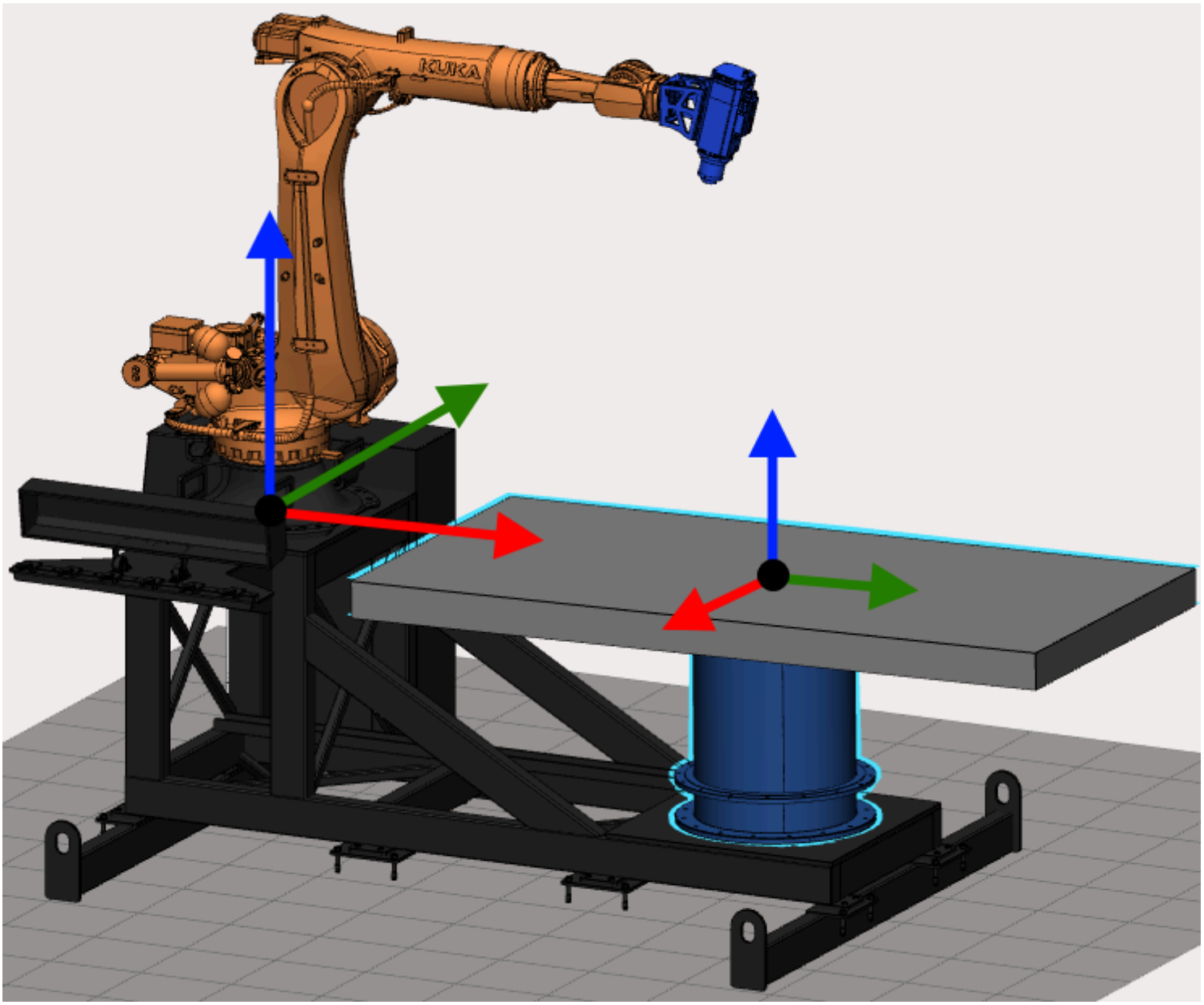


This panel is similar to the the panel described here: [Mechanism movements in simulation], but allows you to simulate all mechanisms in assembly.

Table calibration

Table calibration function is available from the assembly view. Finish editing mechanism by clicking Apply or Cancel buttons to see the entire mechanisms assembly.

Robot has a Base and TCP coordinate systems. It is necessary to specify User Coordinate System position relative to the Robot Base Coordinate System.

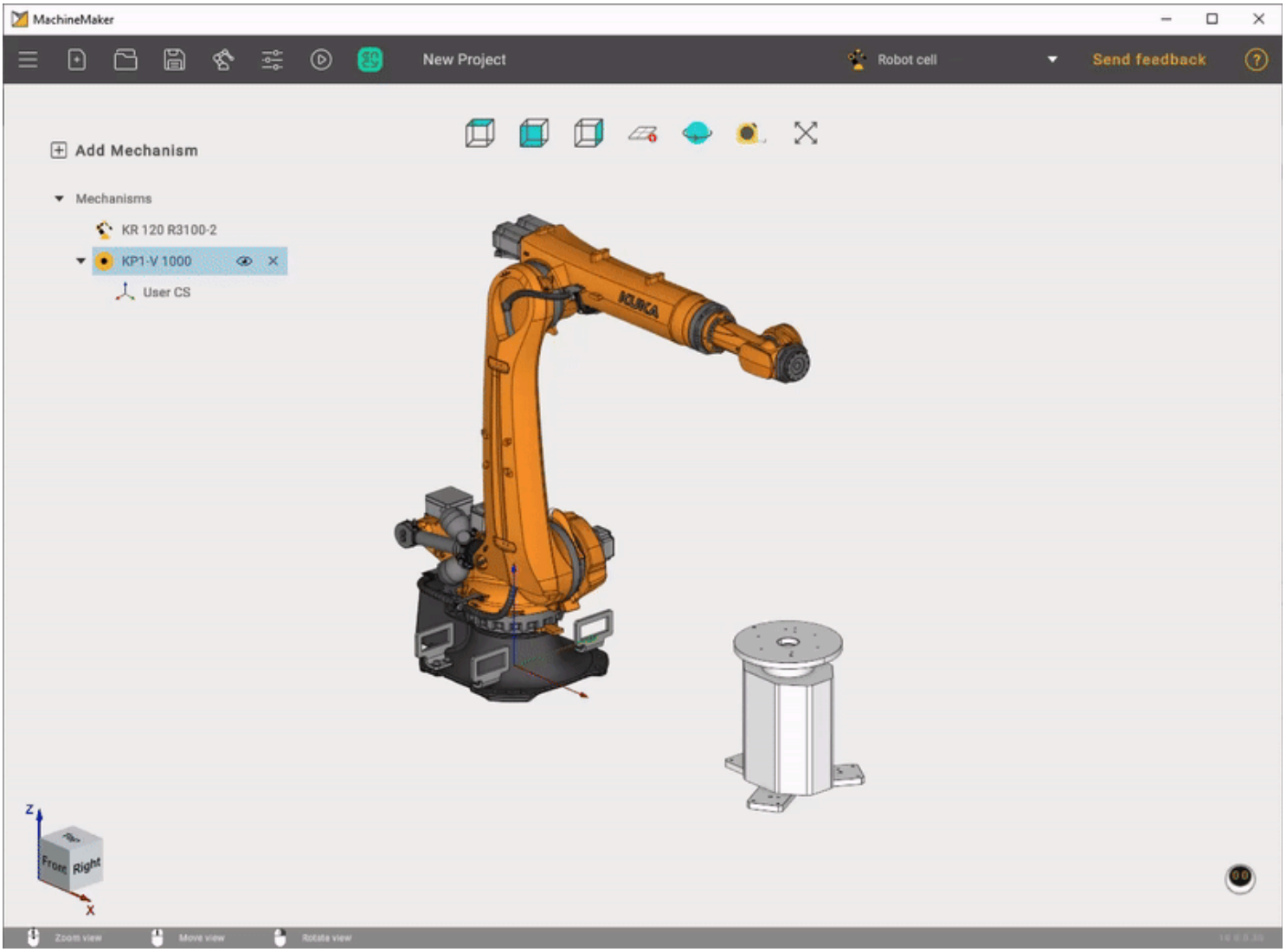


Hold down Left Ctrl key to show all Coordinate Systems.

How to calibrate a table

Select a table using the left mouse button in the Transformation panel on the right. Select the desired User CS as Target and select Robot Base CS in the Relative field. Now you can see User Coordinate

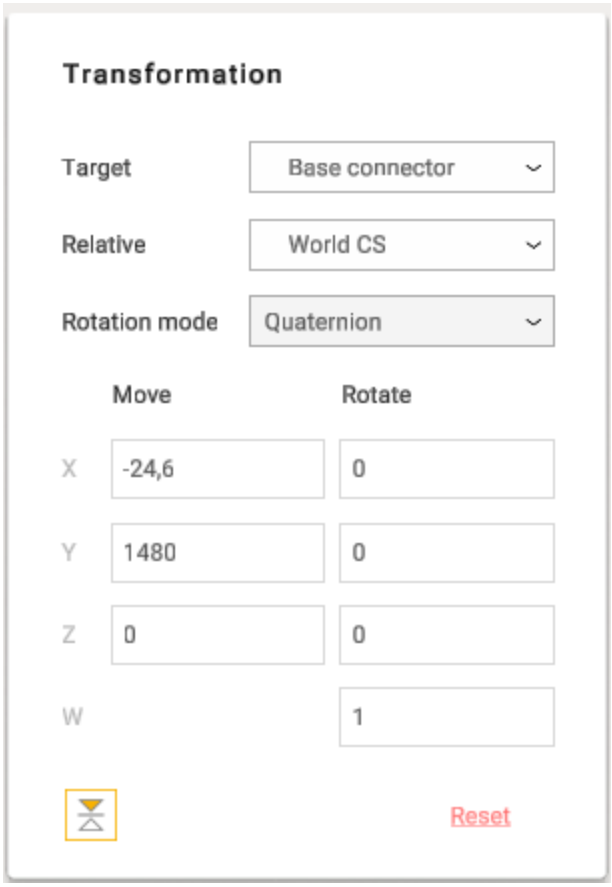
System position relatively to the Robot Base Coordinate System in the Move and Rotate fields. Enter correct values to finish calibration.



Use Robot's User CS calibration function to obtain accurate values

Quaternions, Radians and Euler angles

Some robots (such as ABB) use quaternions instead of euler angles. For this kind of robots MachineMaker can show quaternions fields. You can switch to Euler angles if you prefer to use human-friendly Euler angles.



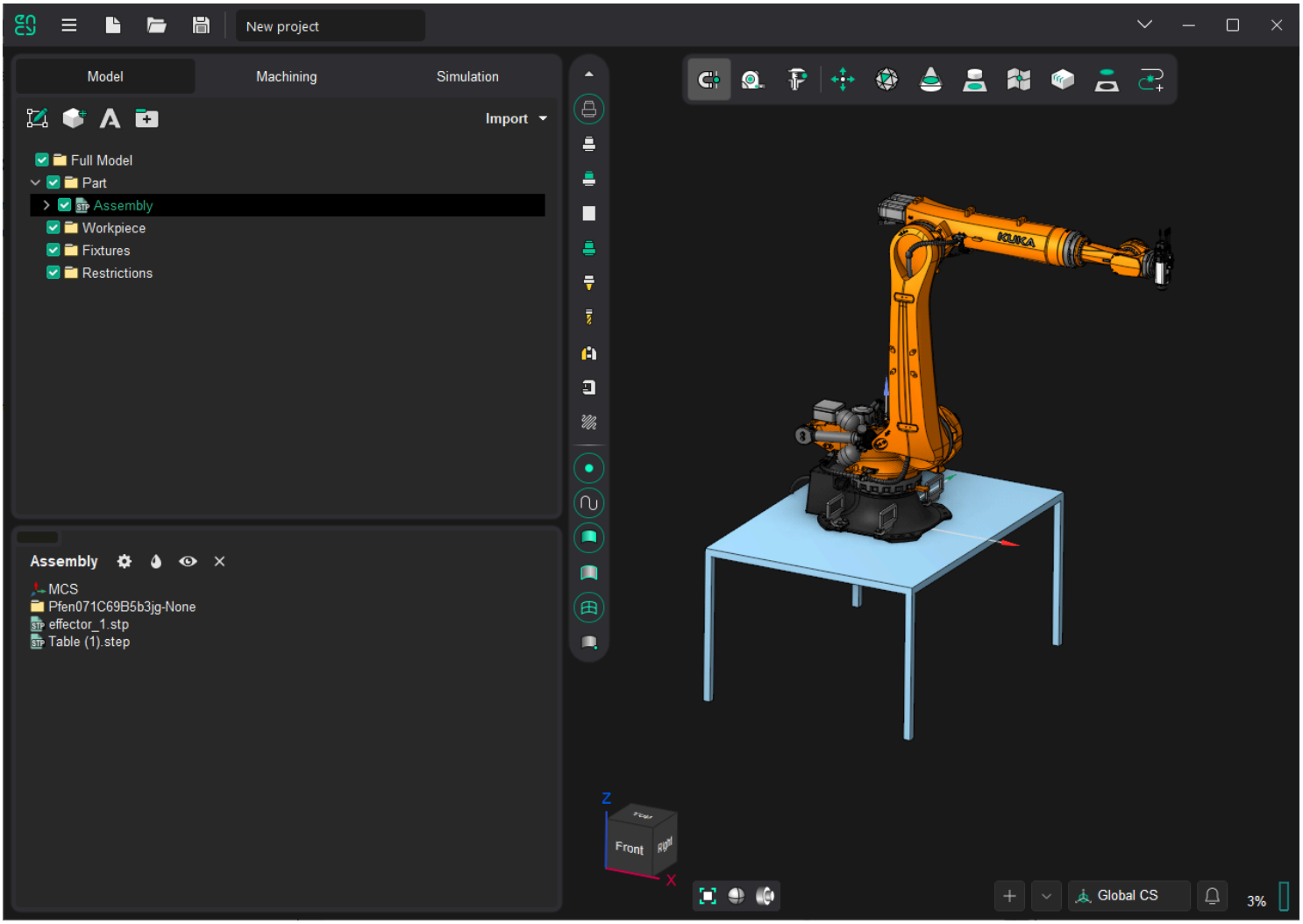
MachineMaker will automatically detect that you are doing table calibration and will switch rotation mode to the correct values system. You can switch it back to the Euler angles without loosing your data.

MachineMaker will suggest using quaternions only for robots which support it (like ABB).

Receiving assemblies from CAM system

The cell can be supplied as a whole 3D model. From which you need to extract the geometry of each mechanism separately and load them into MachineMaker. To simplify this operation, you can use CAM system.

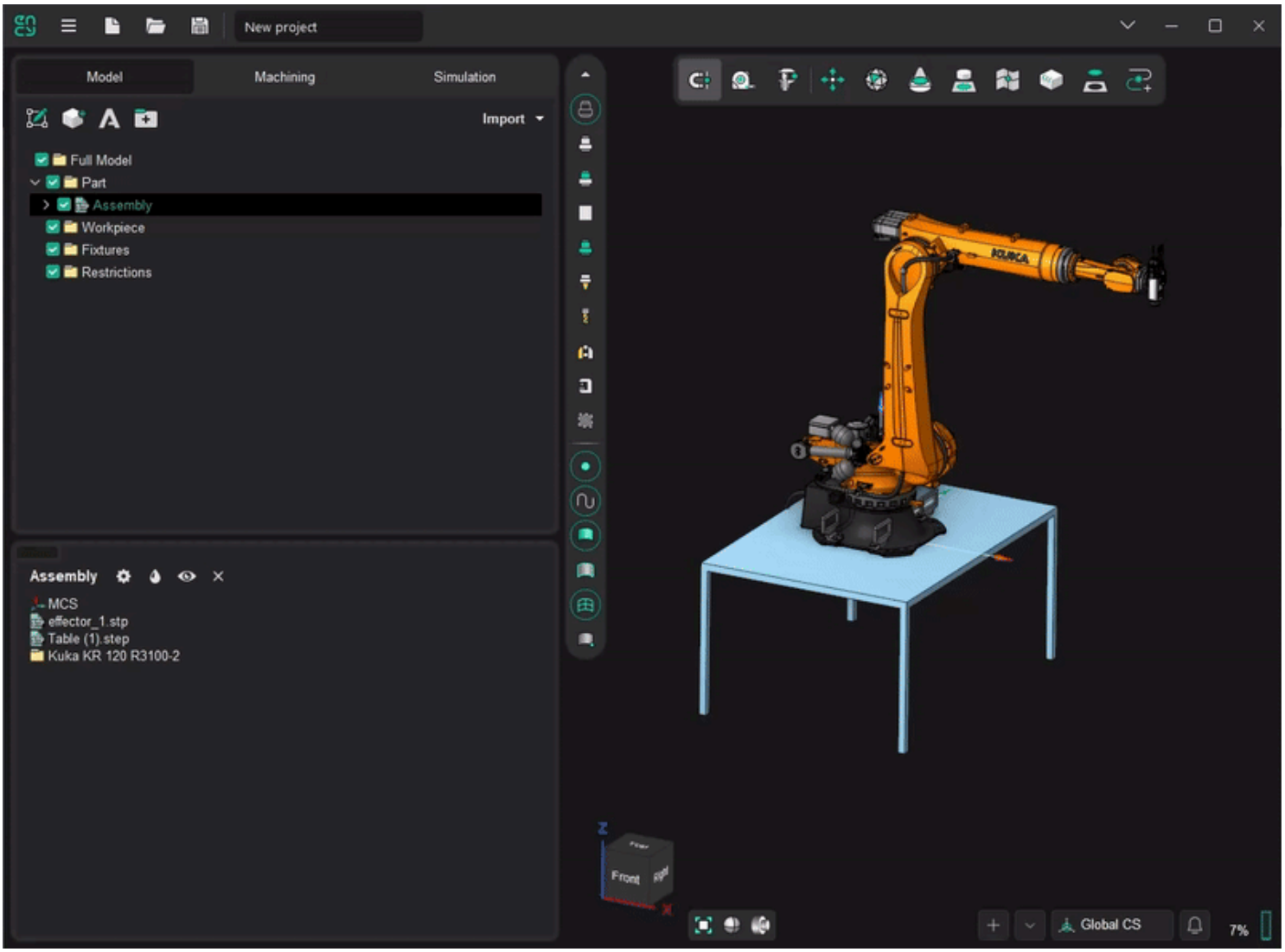
Consider the process of transferring assemblies using the example of building a robot cell according to such a 3D model.



In our case, the cell will consist of 3 mechanisms:

- Table;
- Robot;
- Spindle.

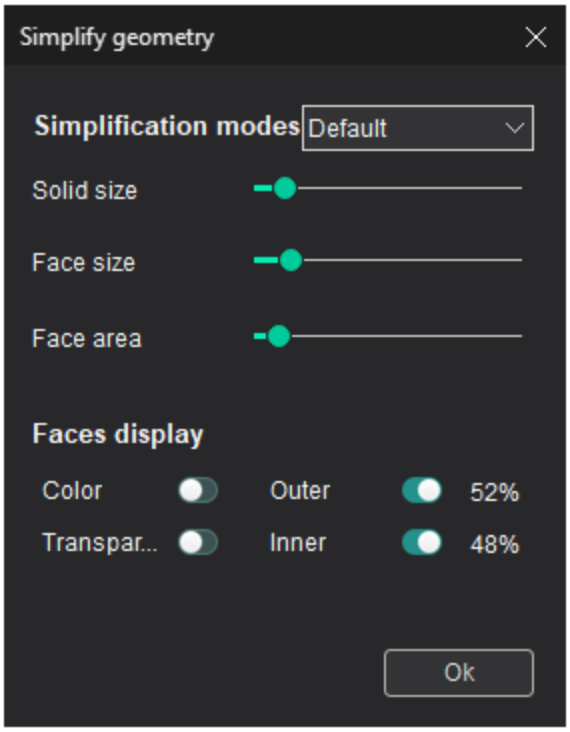
Therefore, first the 3D model must be divided into these parts. Let's create groups under the same name and move the surfaces that belong to these mechanisms there.



Simplify geometry

The geometry of some mechanisms may be overly detailed which affects the file size, loading and rendering speed. To solve this problem you can use the simplification tool. By simplification we mean the removal (with a certain tolerance) of small faces or faces located inside the shell. A similar function works when importing geometry into MachineMaker (the function is described here: 3D Models Simplifier).

The function can be called using the context menu with the "Simplify GeomModel..." command.



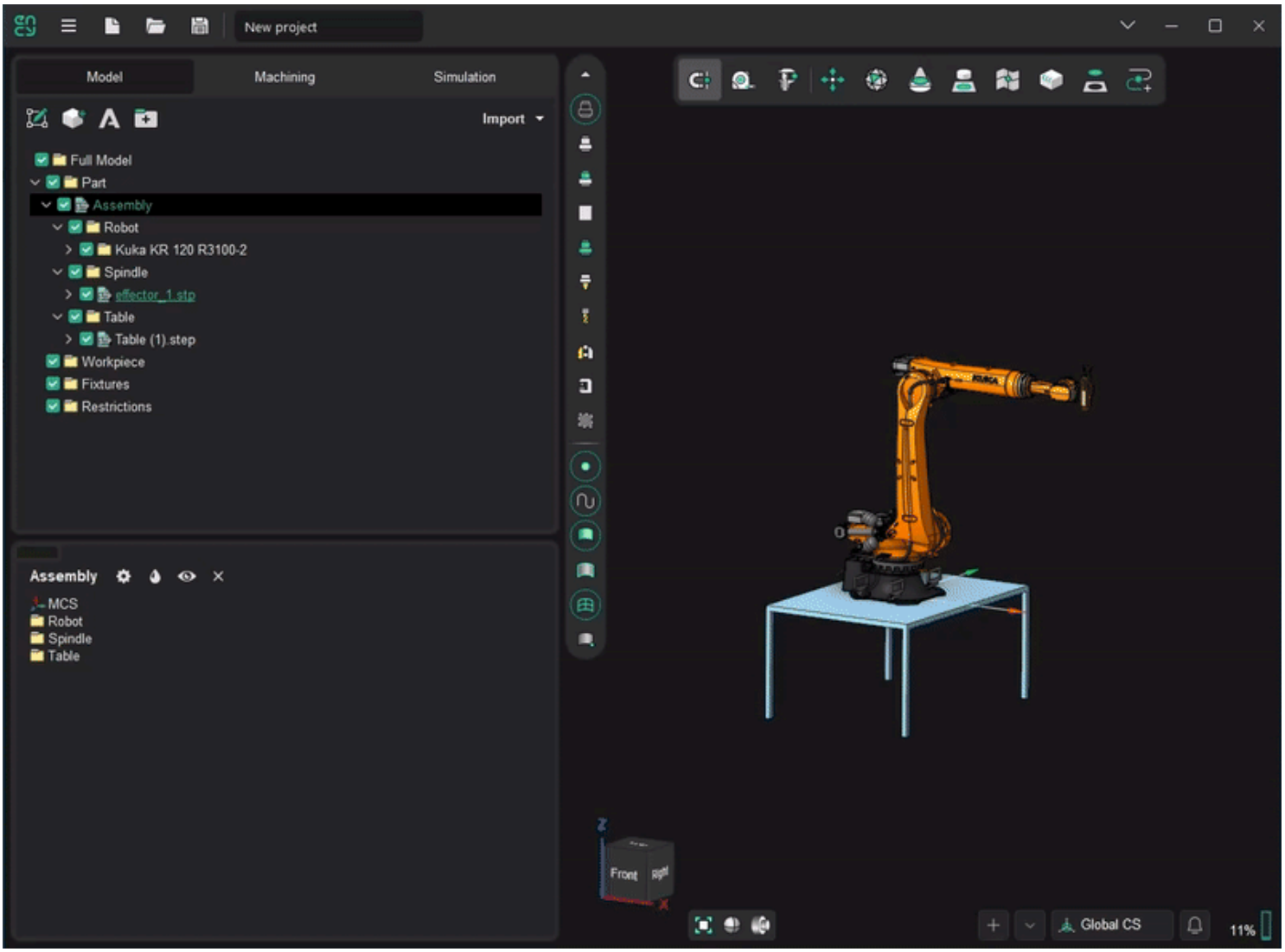
In this window, you can set the simplification parameters by choosing from ready-made options or by setting them manually.

Solid size - specifies the maximum size of solids to be excluded.

Face size - defines the maximum size of faces to be excluded.

Face area - defines the minimum internal face area at which the face will be excluded.

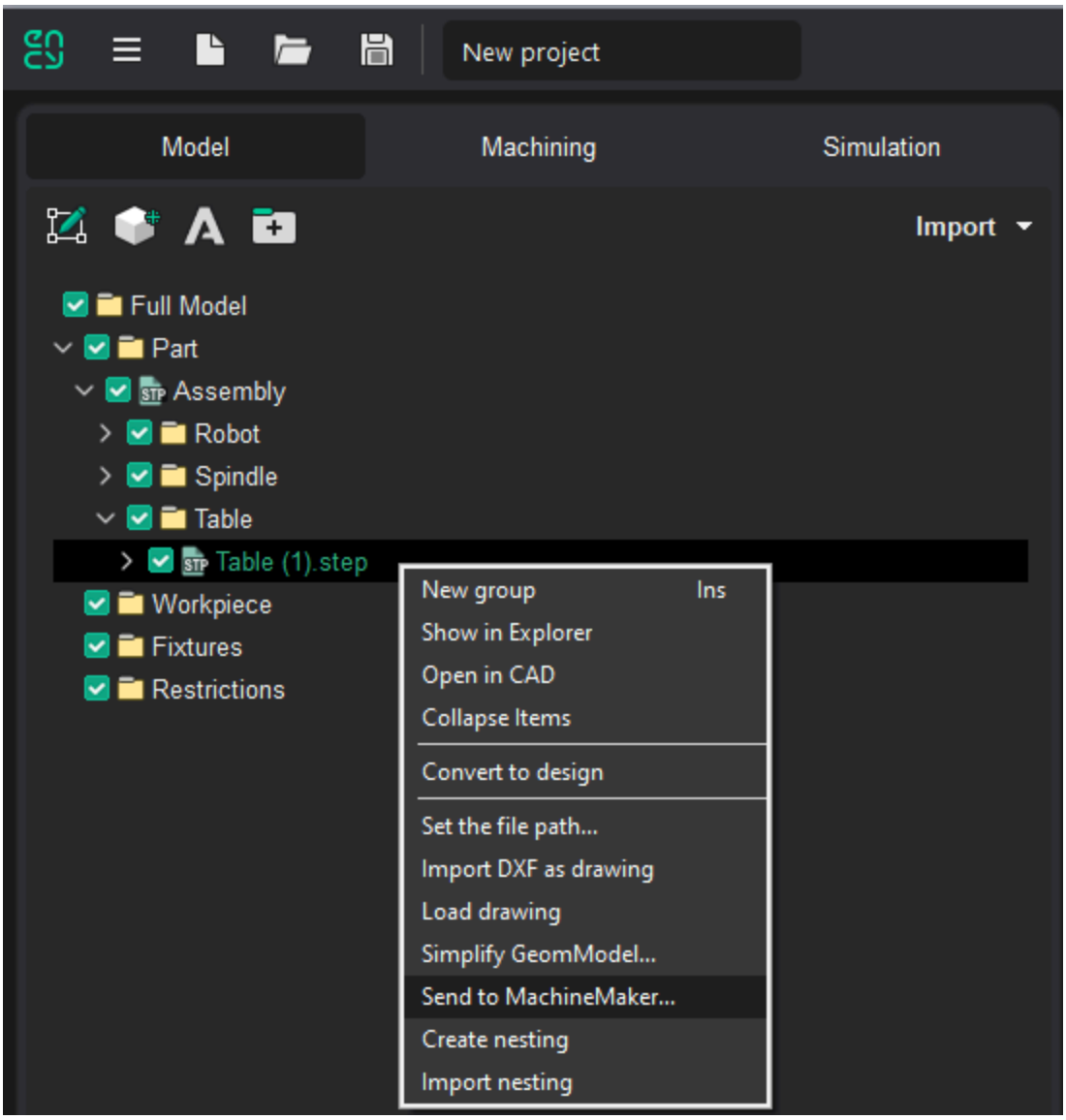
The Faces display parameters are responsible for the display modes of internal and external faces and help to visually control which faces will be excluded from the model.

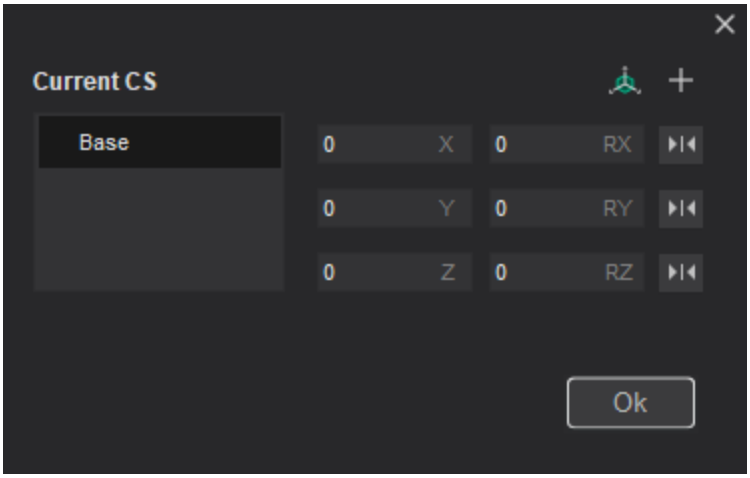


Sending to MachineMaker

At this stage we begin to transfer the mechanisms to MachineMaker and assemble the cell.

To do this, call the context menu on the selected mechanism and click the "Send to MachineMaker..." item.



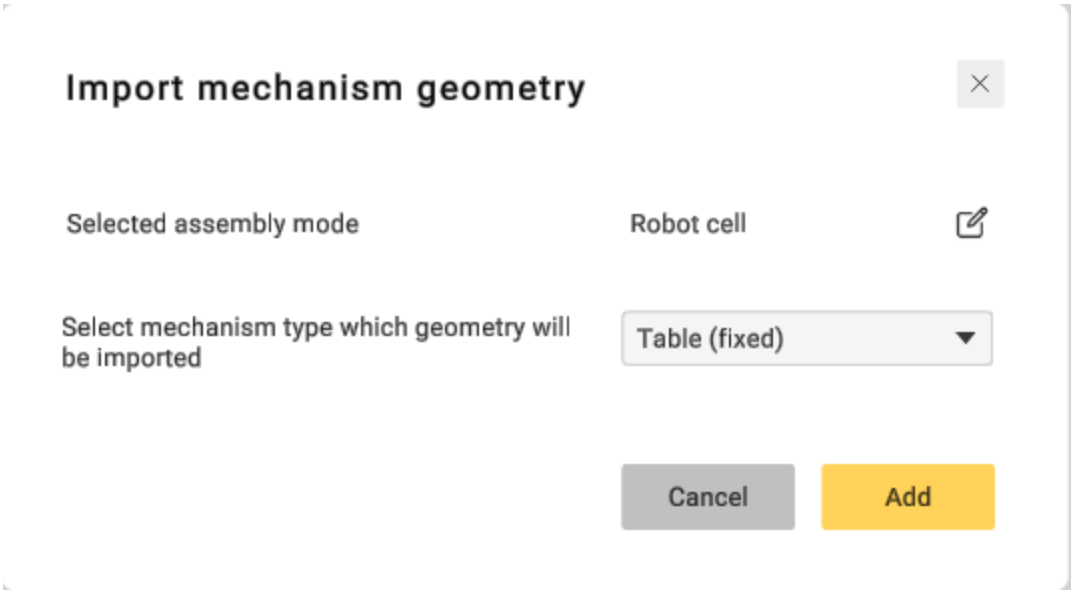


This form will appear. It allows you to set and edit the base coordinate system relatively to which the mechanism will be located and additional coordinate systems used for the positioning of the mechanism connectors.

Add all possible CS  - adds the base coordinate systems of neighboring mechanisms. Hovering the mouse cursor over them will show the silhouettes of the mechanisms associated with them.

Ok - sends the 3D model with the set CS to MachineMaker.

When loading geometry into MachineMaker in the Import mechanism geometry window, select the type of mechanism to be transferred from the drop-down list.

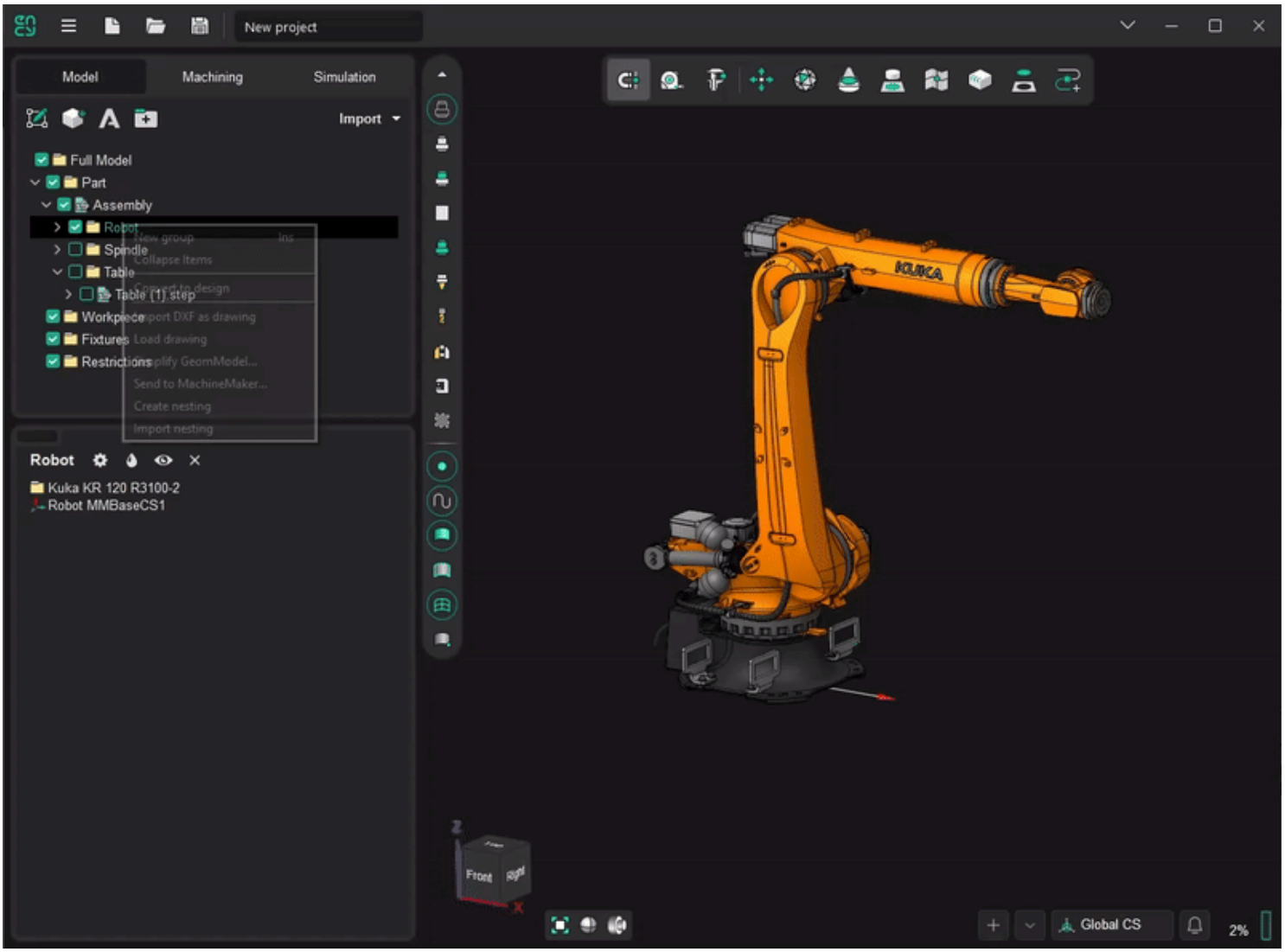


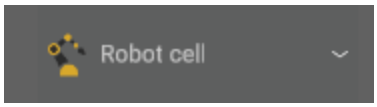
After clicking Add button, the mechanism will be added to the scene and you will be able to get started with cell assembly.

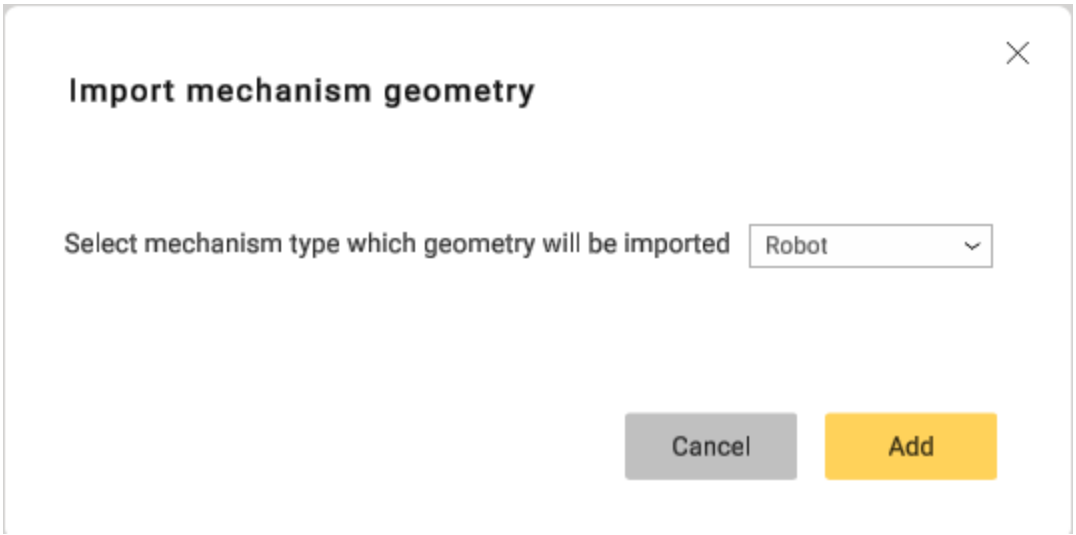
Let's start from the Robot mechanism.

Robot

Let's set the base coordinate system BaseCS - this will be the location of the mechanism on the floor. Next set an additional coordinate system AdditionalCS, the point to which the next mechanism will be attached. In our case, this is Spindle.

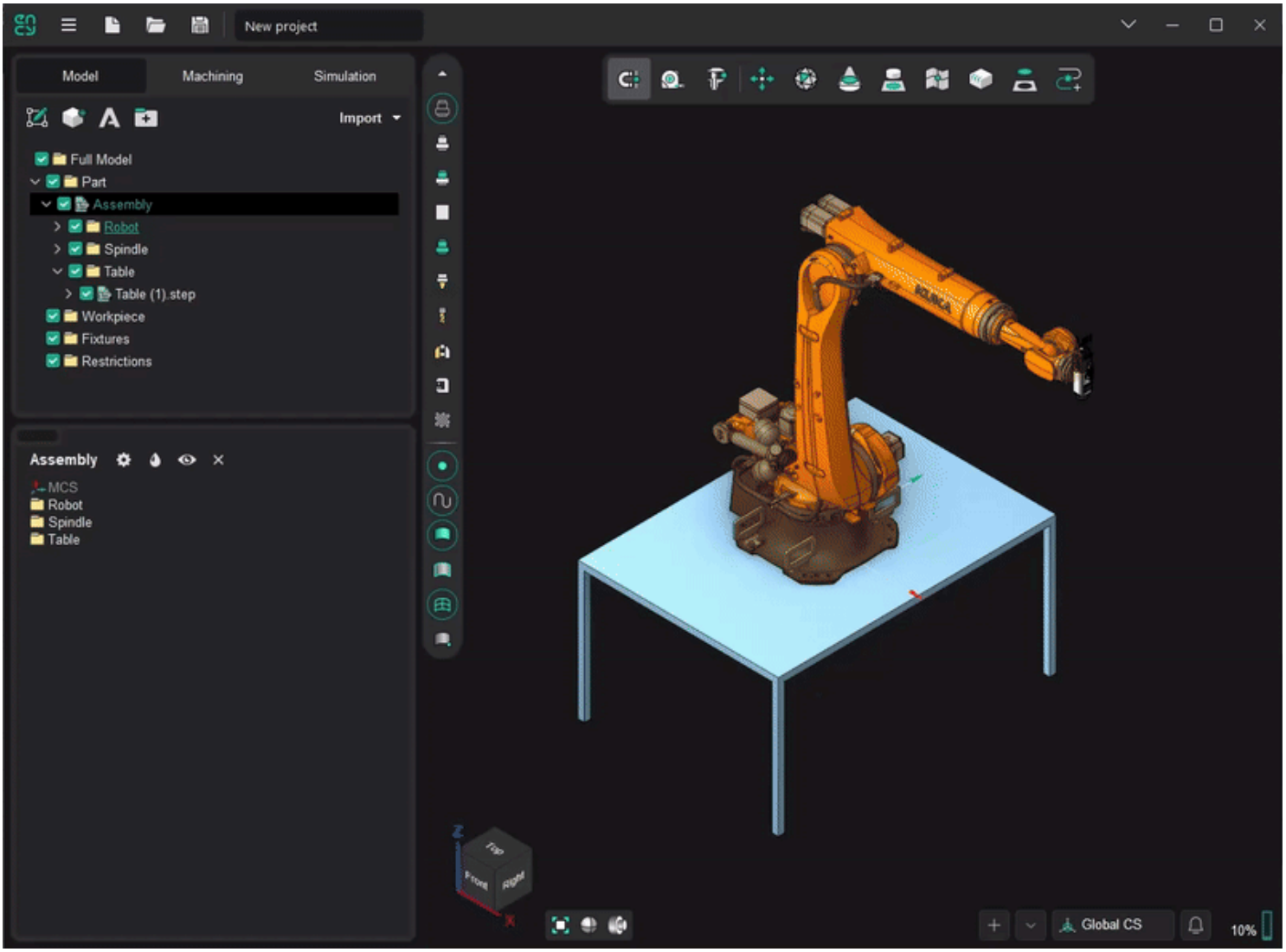


Finally send it to MachineMaker. In the Import mechanism geometry window, select the type of mechanism - Robot. Verify that MachineMaker is in Robot Cell context mode 



Spindle

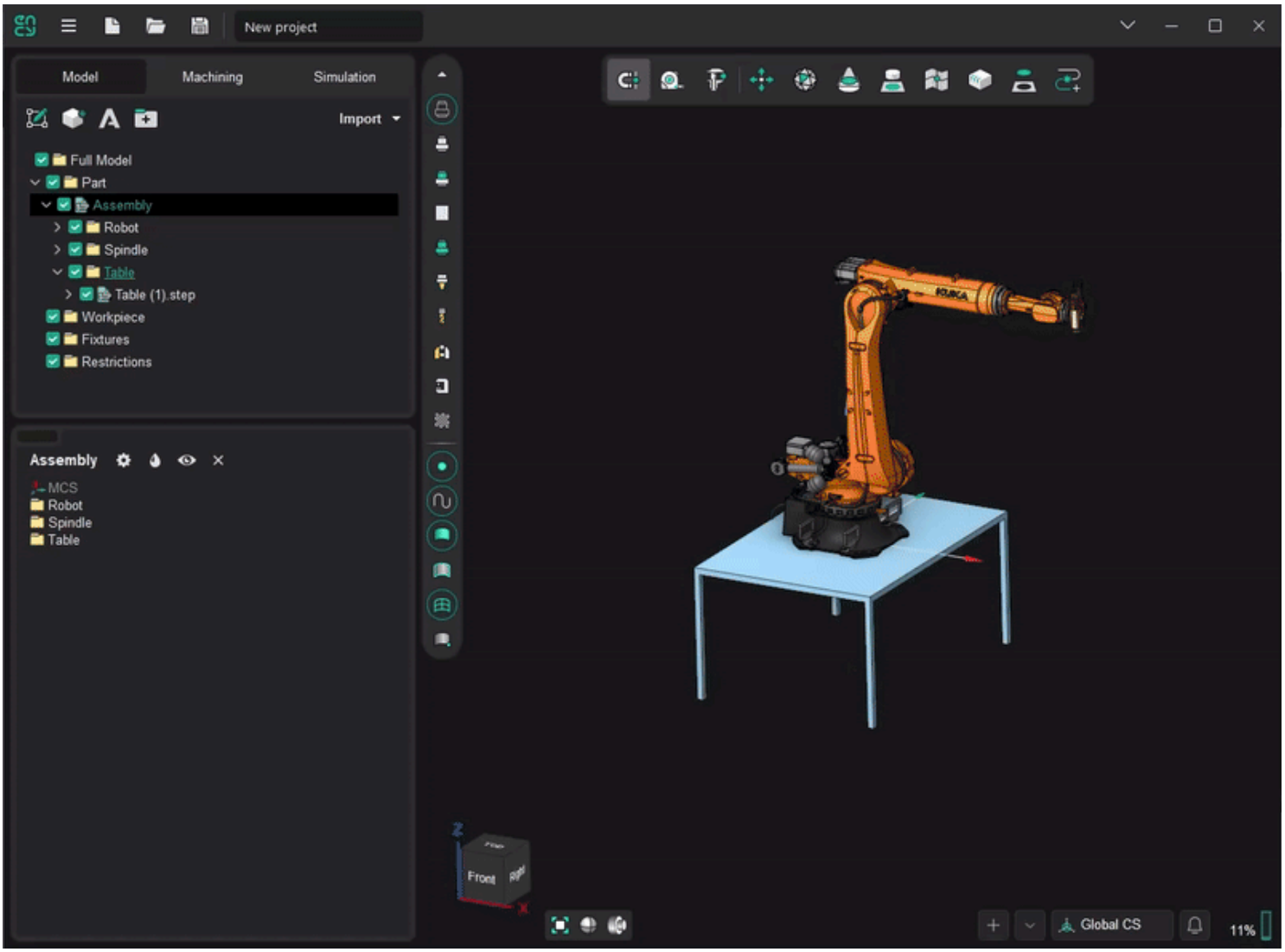
Working with the spindle is very similar to the above. The base coordinate system specifies the point of attachment to the AdditionalCS of the robot and the additional coordinate system specifies the point of attachment of the tool. After sending to MachineMaker, you need to select the type of mechanism to load - End effector. If the coordinate systems are correct, then the spindle will automatically join the sixth axis of the robot. In any case, you can manually correct the connection.



Table

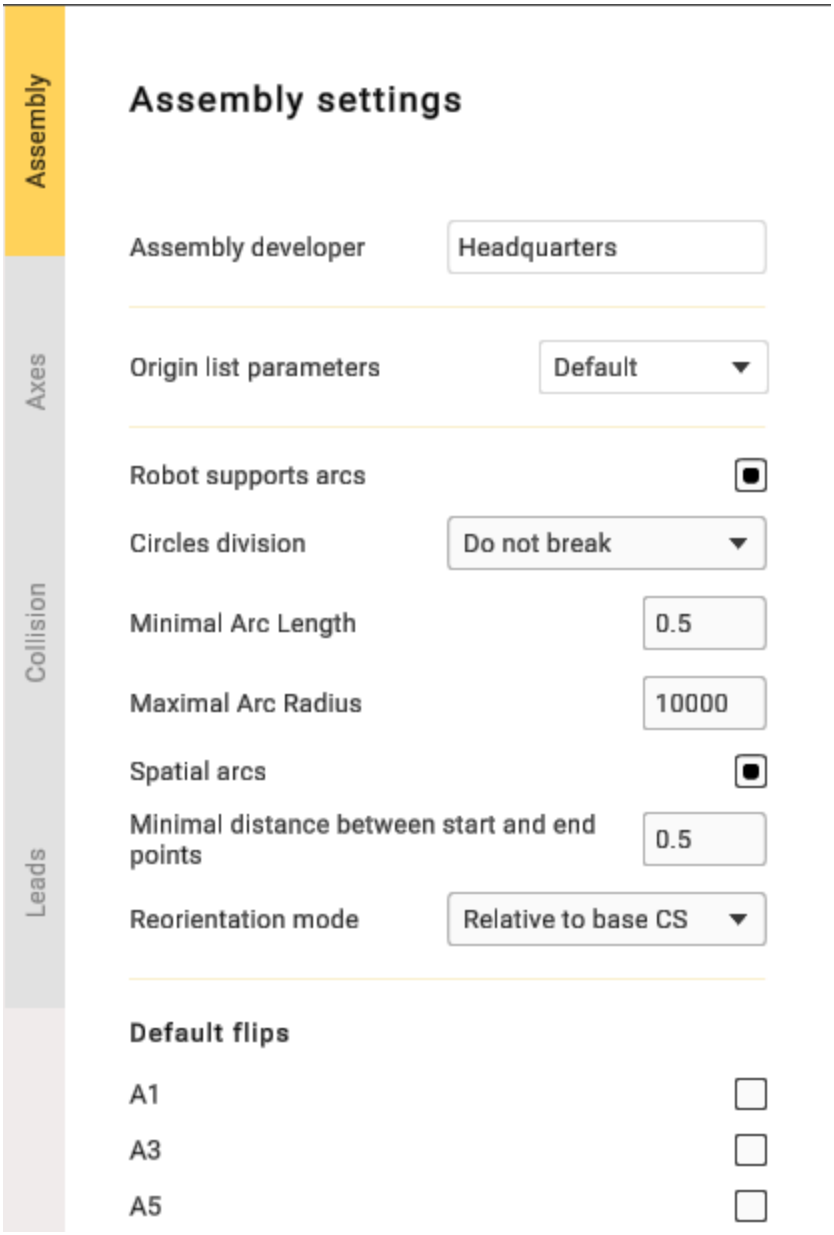
The base coordinate system of the table is responsible for the location on the floor, and the additional coordinate systems is used for the placement of other mechanisms. You can any have any number of additional CSs. In our case, the additional coordinate system will be automatically set in the robot's BaseCS.

Finally select the type of mechanism - Table(fixed) in MachineMaker. Then place the robot on the table.


New project
Model
Machining
Simulation
Import
Full Model
Part
Assembly
Robot
Spindle
Table
Table (1).step
Workpiece
Fixtures
Restrictions
Assembly
MCS
Robot
Spindle
Table
Front
Global CS
11%

Assembly options

Click  button to open Assembly parameters panel.



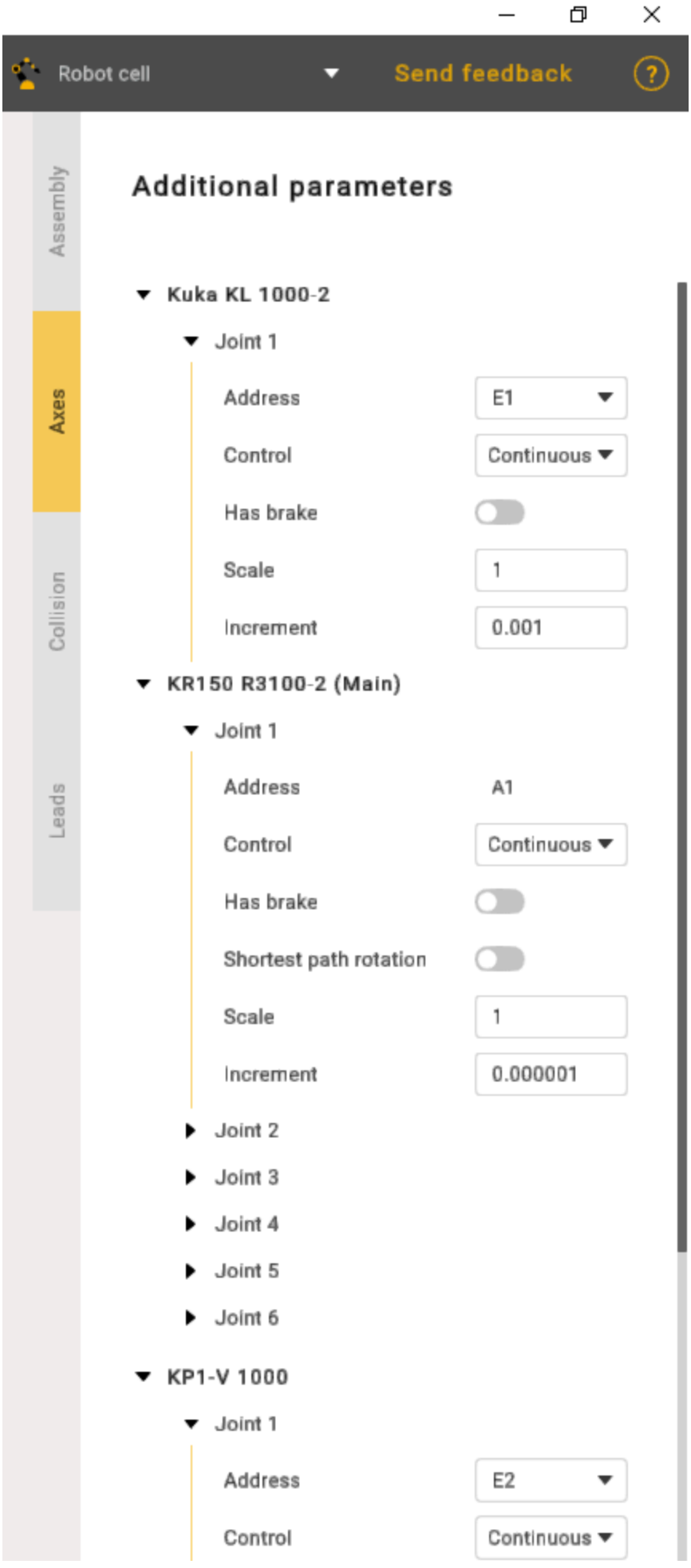
- Snap base to rotary positioner: When enabled, this option attaches the coordinate system to the rotary positioner, moving with it. When disabled, the coordinate system on the positioner remains stationary.
- Snap base to linear axis: Functions similarly to "Snap Base to Rotary Positioner," but is used with linear axes.
- Fix WCS on axis: This option is used to select the axis of the coordinate system. For example, if you have multiple mechanisms and need to choose a specific one.
- Assembly developer: Company name.
- Robot supports arcs: Necessary to output arcs in the control program.

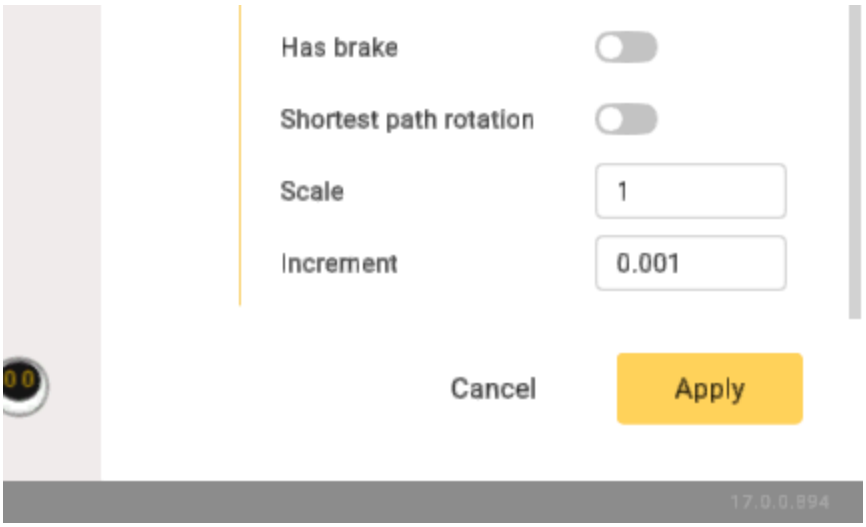
- Circles division: Used to divide arcs into halves or quarters.
- Minimal Arc Length: Prevents the output of arcs shorter than a specified length; a segment will be displayed instead.
- Maximal Arc Radius: Prevents the output of arcs with a radius larger than specified; segments will be displayed.
- Spatial arcs: Arbitrary spatial arcs. A function necessary for robots to work.
- Minimal distance between btart and end points: A restriction that allows the display of segments with a small distance between points.
- Reorientation mode: The method of calculating the midpoint. The functionality may vary depending on the manufacturer.
- Default flips: Needed to set the position of the robot.

Additional options

Robot controller can use external axes and it is necessary to assign correct positions (indices) for these axes in the assembly. Default CAM-system postprocessors use index-based axes identifiers (ExtAxis1Pos for the first axis, ExtAxis2Pos etc). Some custom postprocessors can use axis address instead of indices (E1, E2, E3, J4 etc).

Click  button to open the Assembly parameters panel. Then go to the Axes tab.


Robot cell
Send feedback
Assembly
Axes
Collision
Leads
Additional parameters
Kuka KL 1000-2
Joint 1
Address
E1
Control
Continuous
Has brake
Scale
1
Increment
0.001
KR150 R3100-2 (Main)
Joint 1
Address
A1
Control
Continuous
Has brake
Shortest path rotation
Scale
1
Increment
0.000001
Joint 2
Joint 3
Joint 4
Joint 5
Joint 6
KP1-V 1000
Joint 1
Address
E2
Control
Continuous

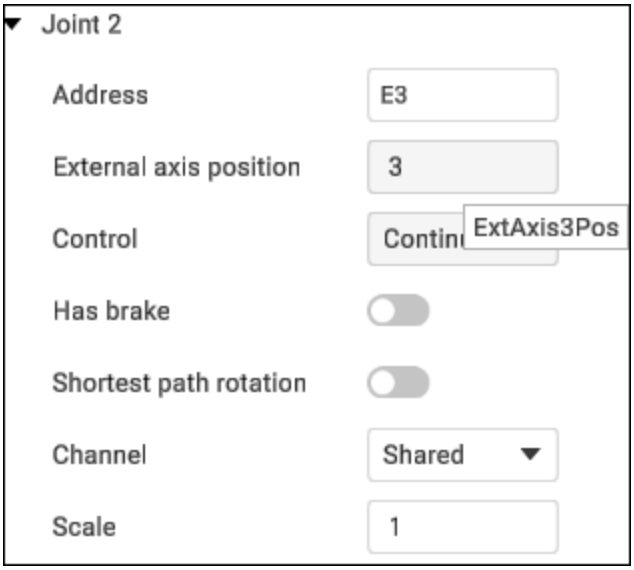


- Address - axis designation.
- Control:

1. Countinuous.
2. Indexed - indicates that rotation will be carried out incrementally.
3. Manual - implies that the operation is entirely manual.

- Shortest path rotation - refers to the rotation around an axis or point using the most direct path between the initial and final positions in three-dimensional space.
- Scale is a setting with four positions. Each position corresponds to a specific angular increment. Position 1 equals 90 degrees, Position 2 equals 180 degrees, and so on.

Define Address and External axis position (index) here. MachineMaker will show axis identifier (like ExtAxis3Pos) in tooltip. You can use it in the postprocessor.



Axis address and axis index must be unique in the assembly context. If you try to set use a value that has been already taken, MachineMaker will propose to replace the existing one.

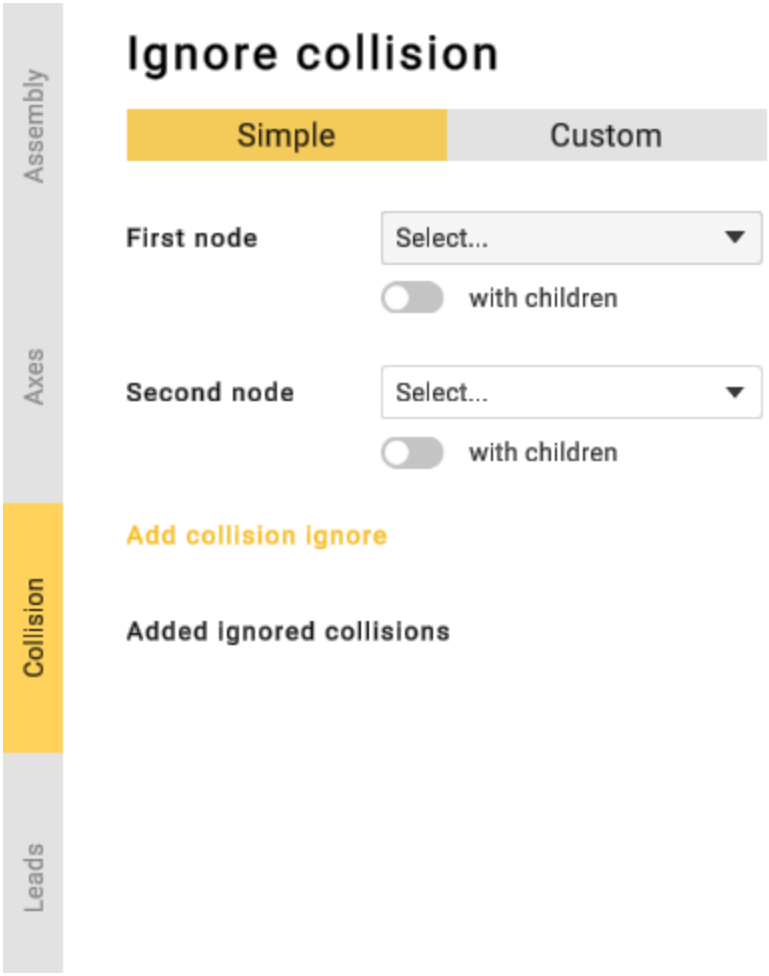
It is not possible to change the robot axis address and index. You can change external addresses only.

It is also possible to define additional axes parameters here: Control type (Continues, Indexed, Manual), Brakes and Shortest path rotation mode.

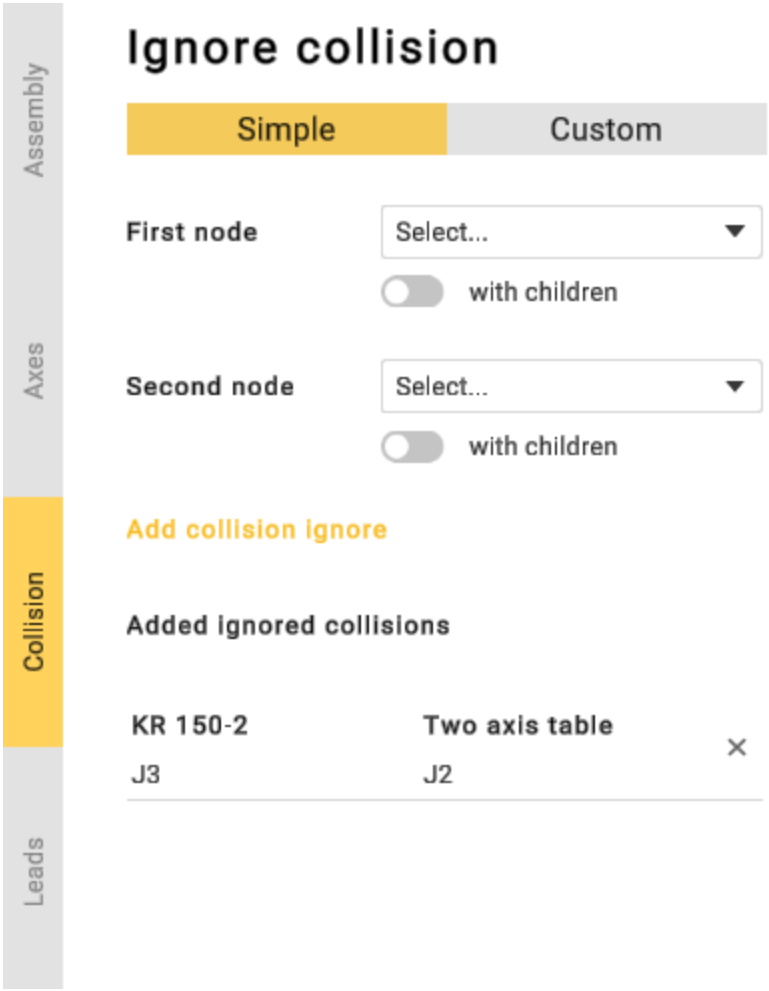
Collision

If you are using inaccurate 3D models, CAM system can detect false-positive collisions between nodes. You can add these nodes to the ignore-list to prevent CAM system from detecting false-positive collisions.

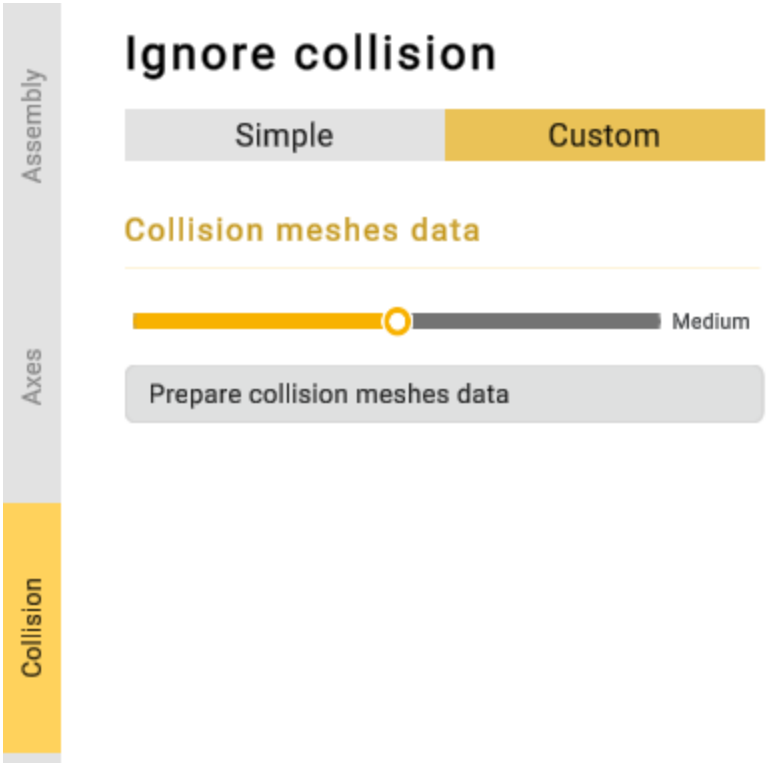
Click  button to open the parameters panel. Then go to the Collisions tab.



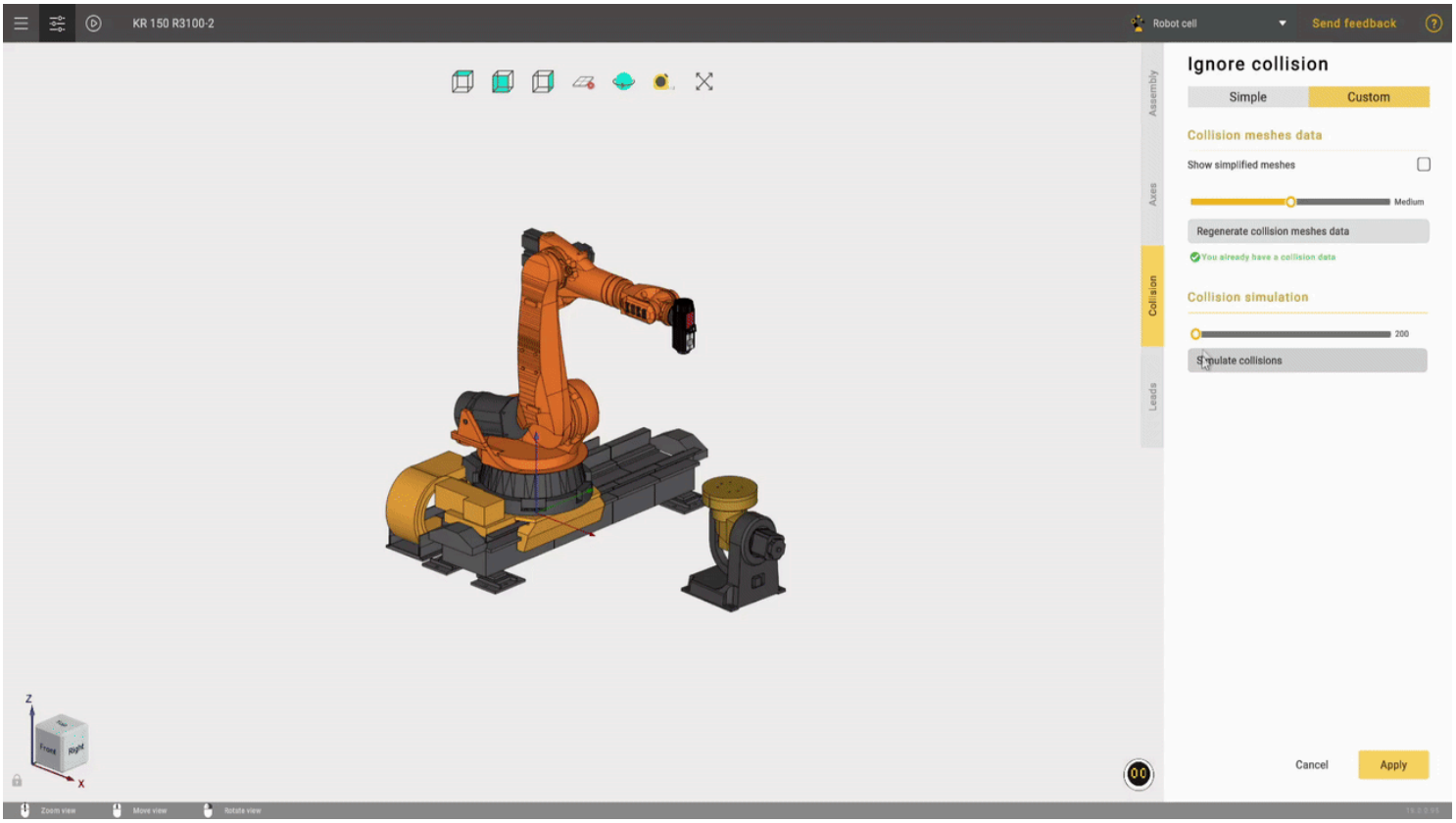
Select first and second nodes and click Add collisions button. Use with children toggle to add node's children to the ignore-list. Use ✕ button to delete a previously added collision from the ignore list.



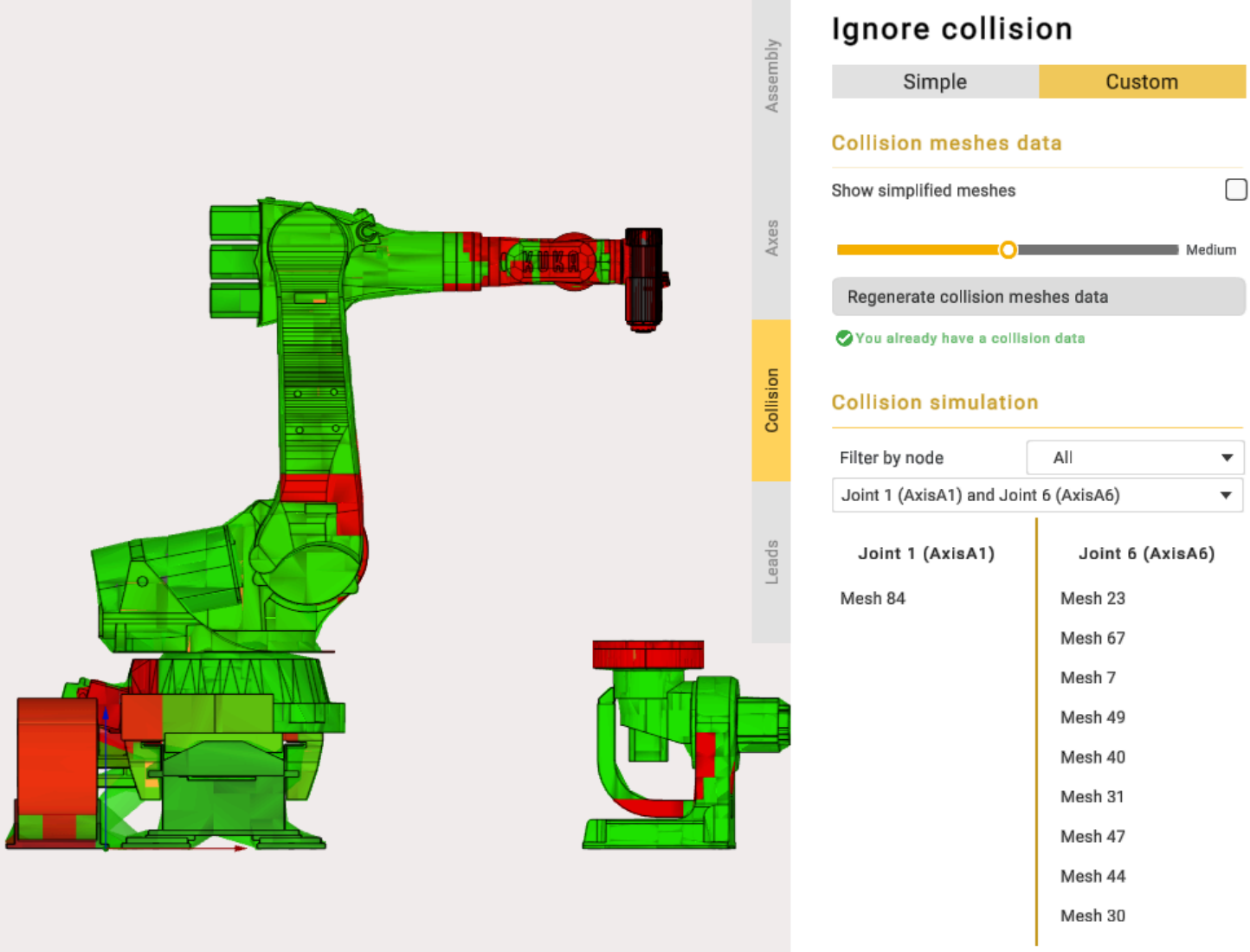
In the custom collision tab, you can manually compute collisions using user-defined parameters. This section allows you to specify the mesh resolution for each mechanism node used by the collision-detection algorithm.



If you click “Prepare collision meshes data”, the application will calculate the number of mechanism positions required for collision detection.



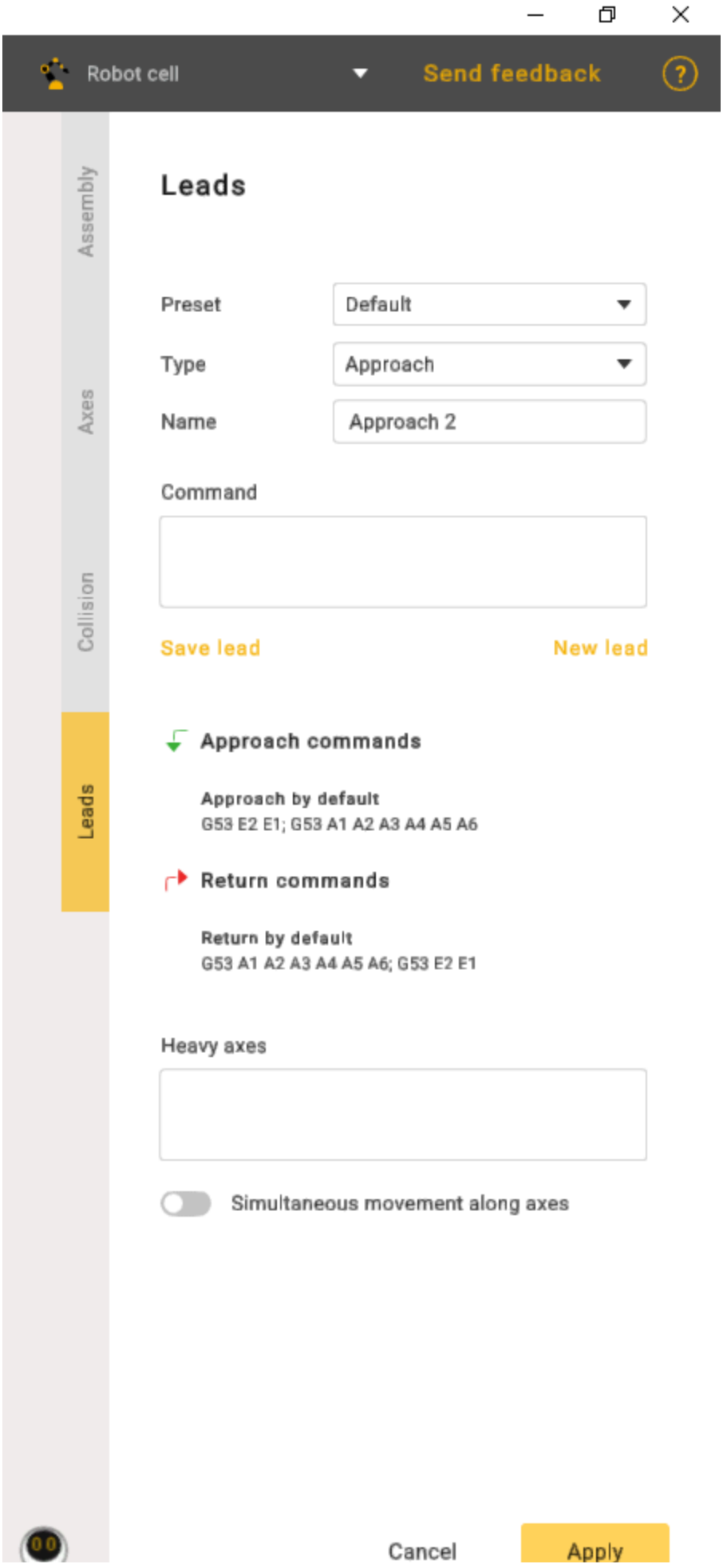
After calculating the number of mechanism positions, you will be able to sort them by nodes and visually inspect collisions on the mechanisms.



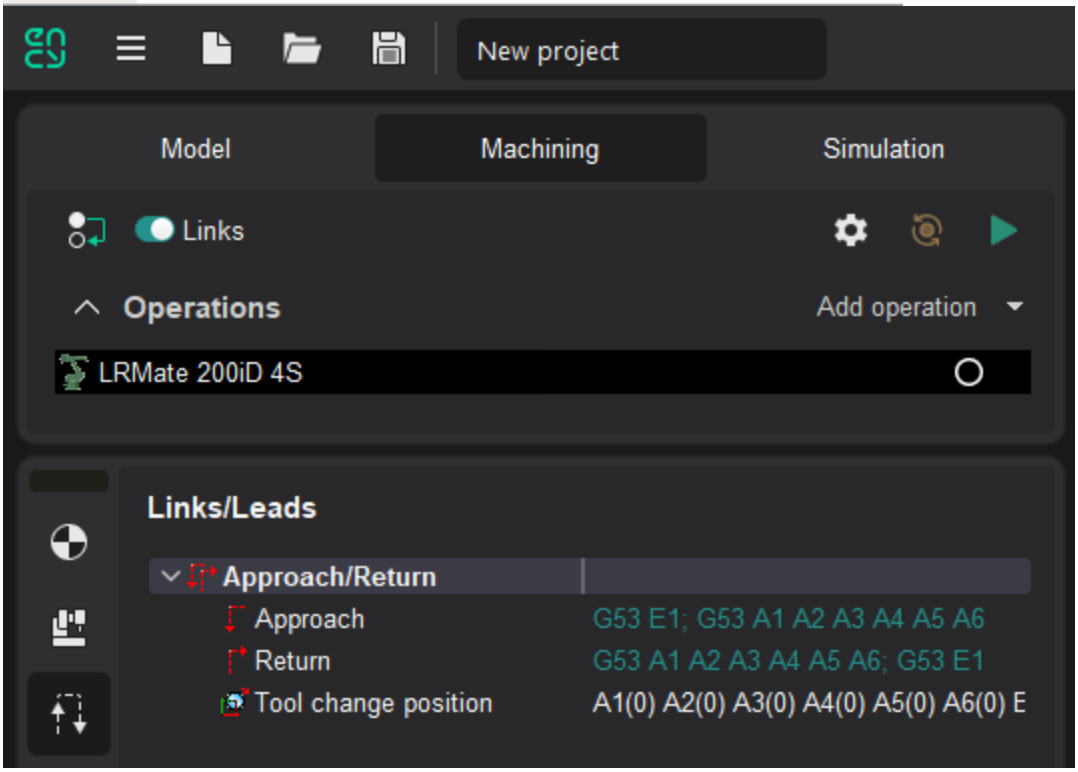
CAM system always ignores collisions between sibling nodes. So it is not necessary to add them to the ignore list.

Links/Leads

Leads tab allows to specify any count of Approach and Return commands.

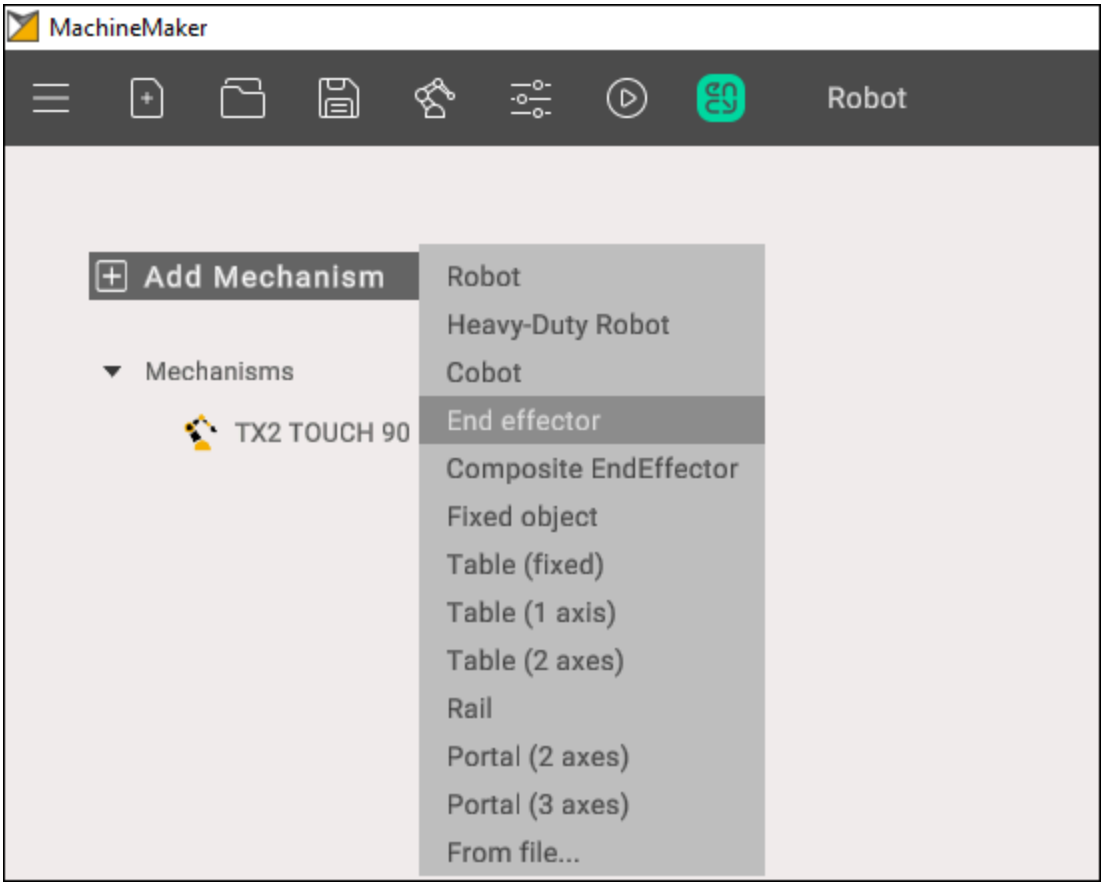

Robot cell
Send feedback
Assembly
Axes
Collision
Leads
Leads
Preset
Default
Type
Approach
Name
Approach 2
Command
Save lead
New lead
Approach commands
Approach by default
G53 E2 E1; G53 A1 A2 A3 A4 A5 A6
Return commands
Return by default
G53 A1 A2 A3 A4 A5 A6; G53 E2 E1
Heavy axes
Simultaneous movement along axes
Cancel
Apply

Check CAM system Links/Lead parameters to verify syntax.



End effectors and TCP calibration

It is possible to equip the robot with a static or movable end effector. More information on movable end effectors can be found on Composite End effectors page.Add a new End Effector and select its 3D model file.

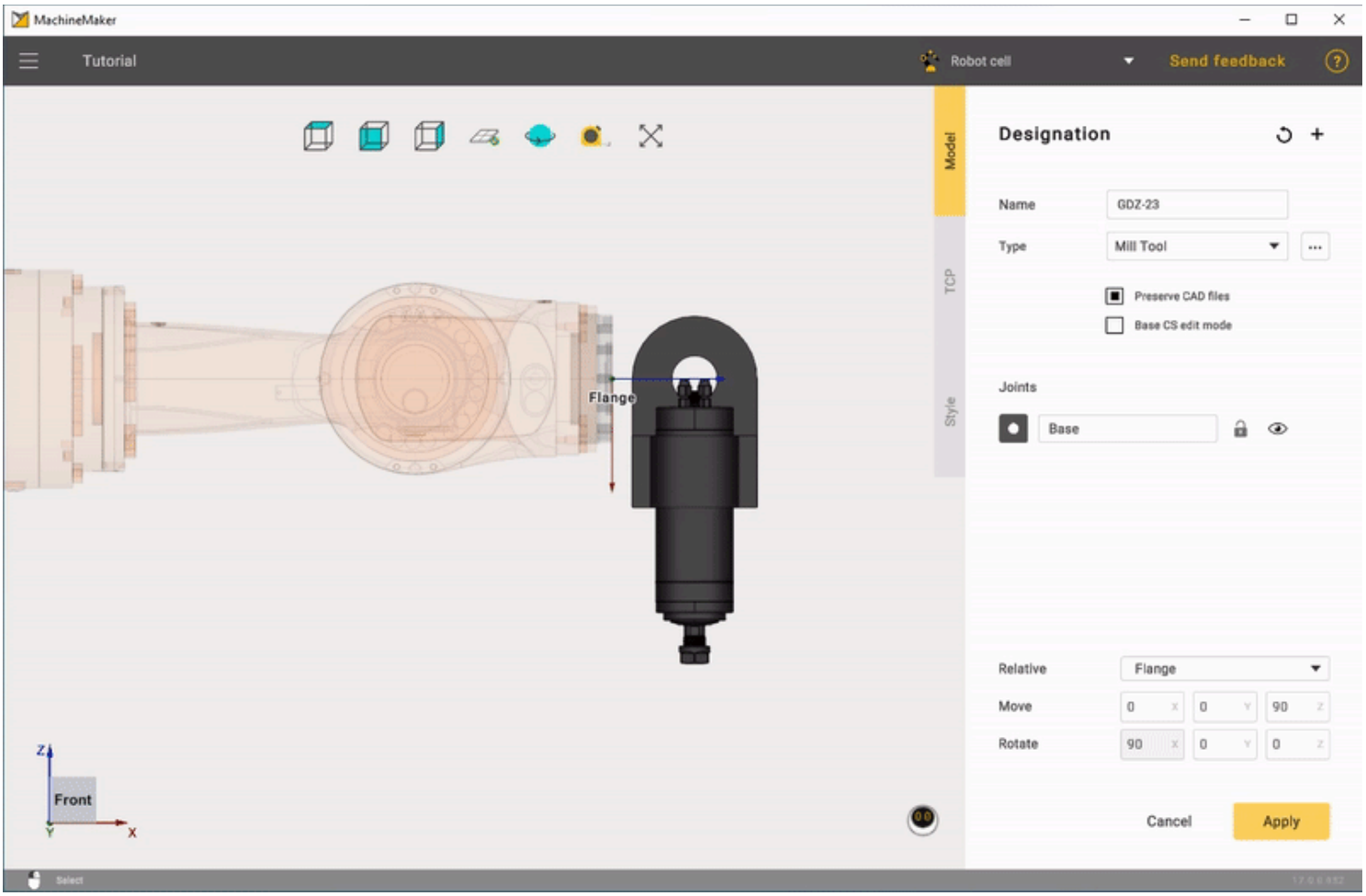


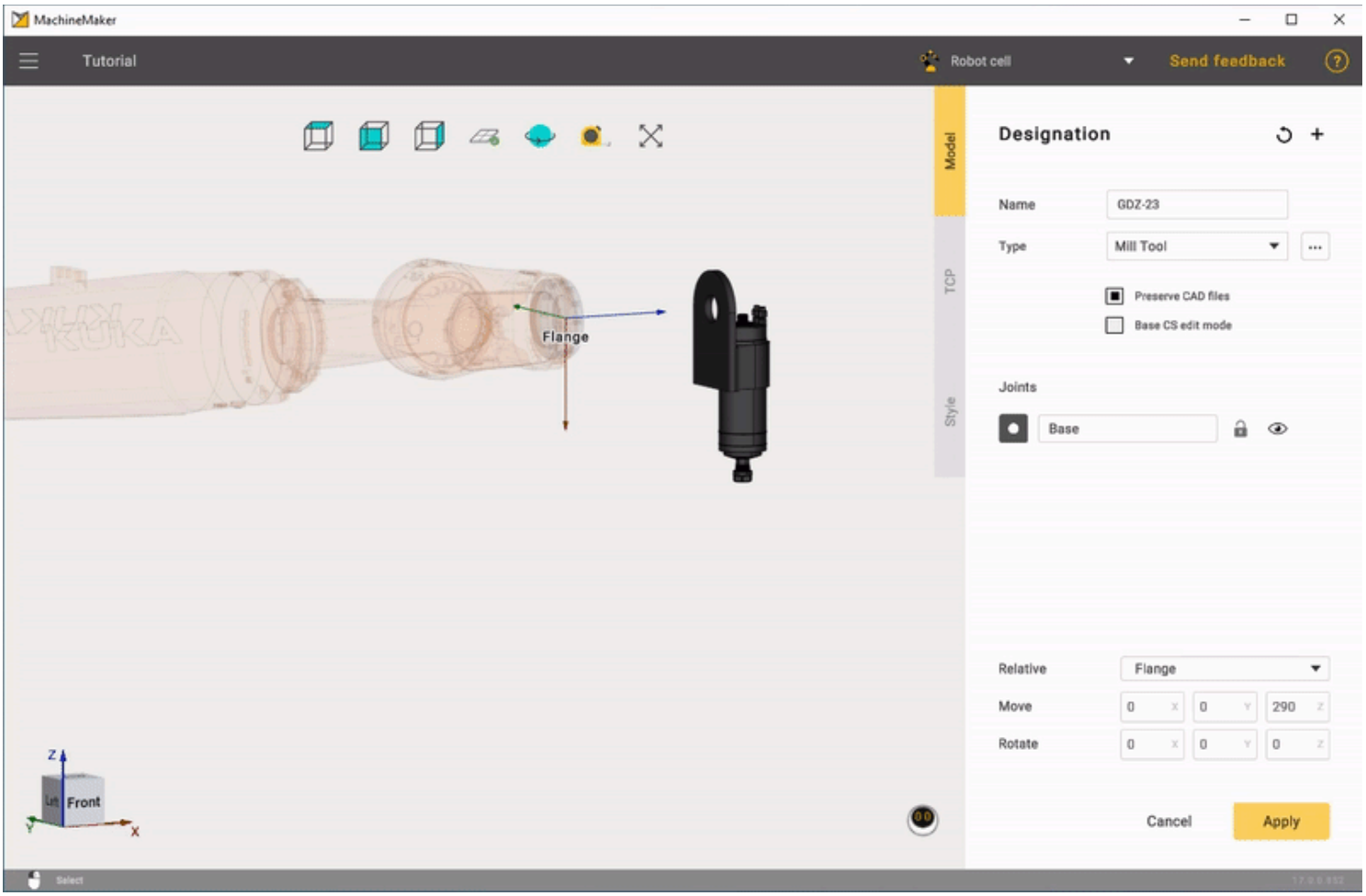
3D model

MachineMaker shows a transparent robot and an imported end effector CAD model. All 3D model elements are marked as Base node by default. Use the right mouse button to ungroup unnecessary elements.

You have to define the name of the End Effector and select supported tool types. Next, place the 3D model on the robot flange. There are 2 ways to specify the correct position:

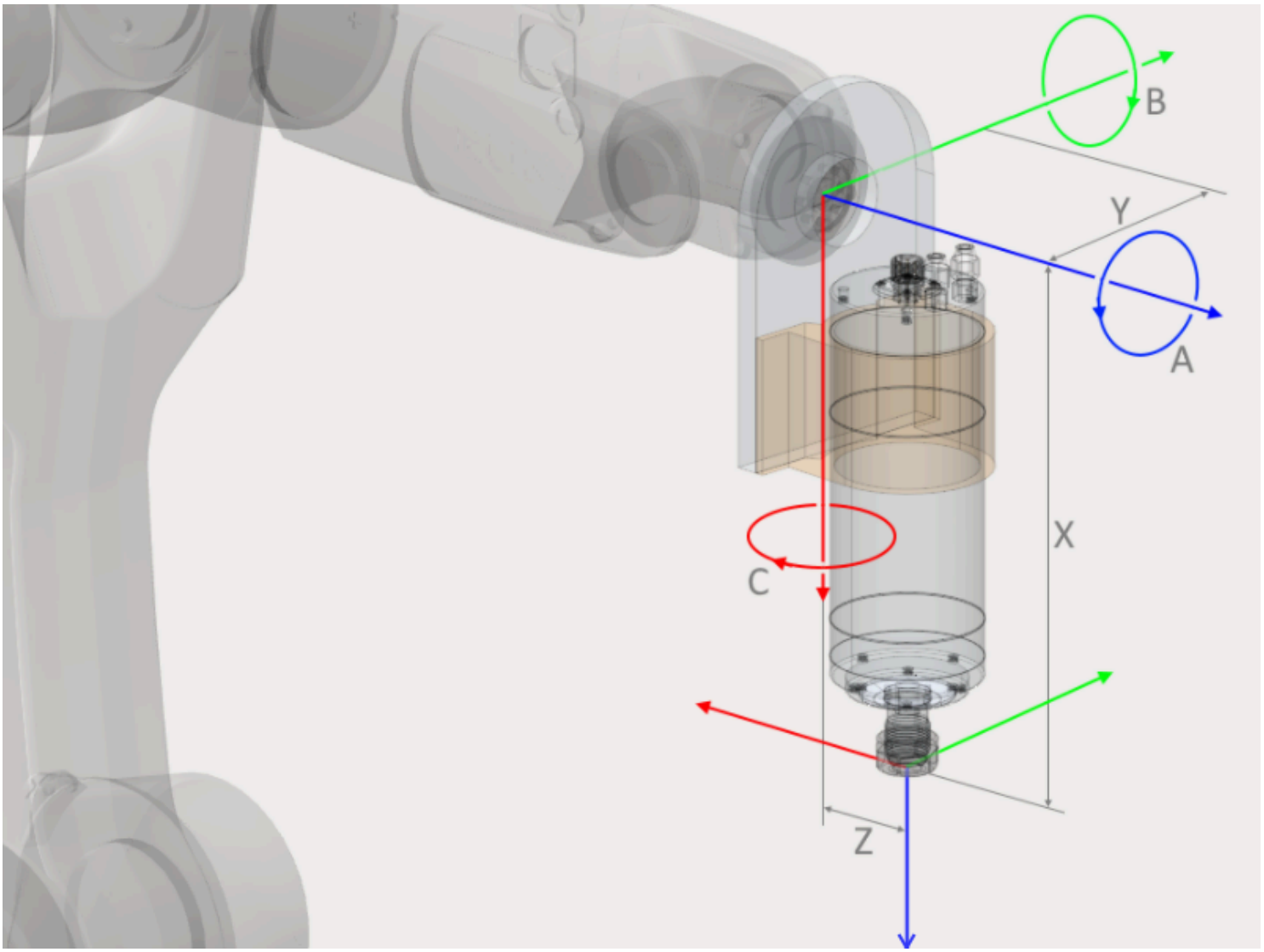
- Use Transformation Panel in the right bottom corner
- Turn on Base CS Transformation mode, hold down the Left Ctrl key and specify the robot's flange connection point using Drag&Drop


MachineMaker
Tutorial
Robot cell
Send feedback
Model
TCP
Style
Designation
Name
GDZ-23
Type
Mill Tool
Preserve CAD files
Base CS edit mode
Joints
Base
Flange
Relative
Flange
Move
0
0
90
Rotate
90
0
0
Cancel
Apply
Front
Select

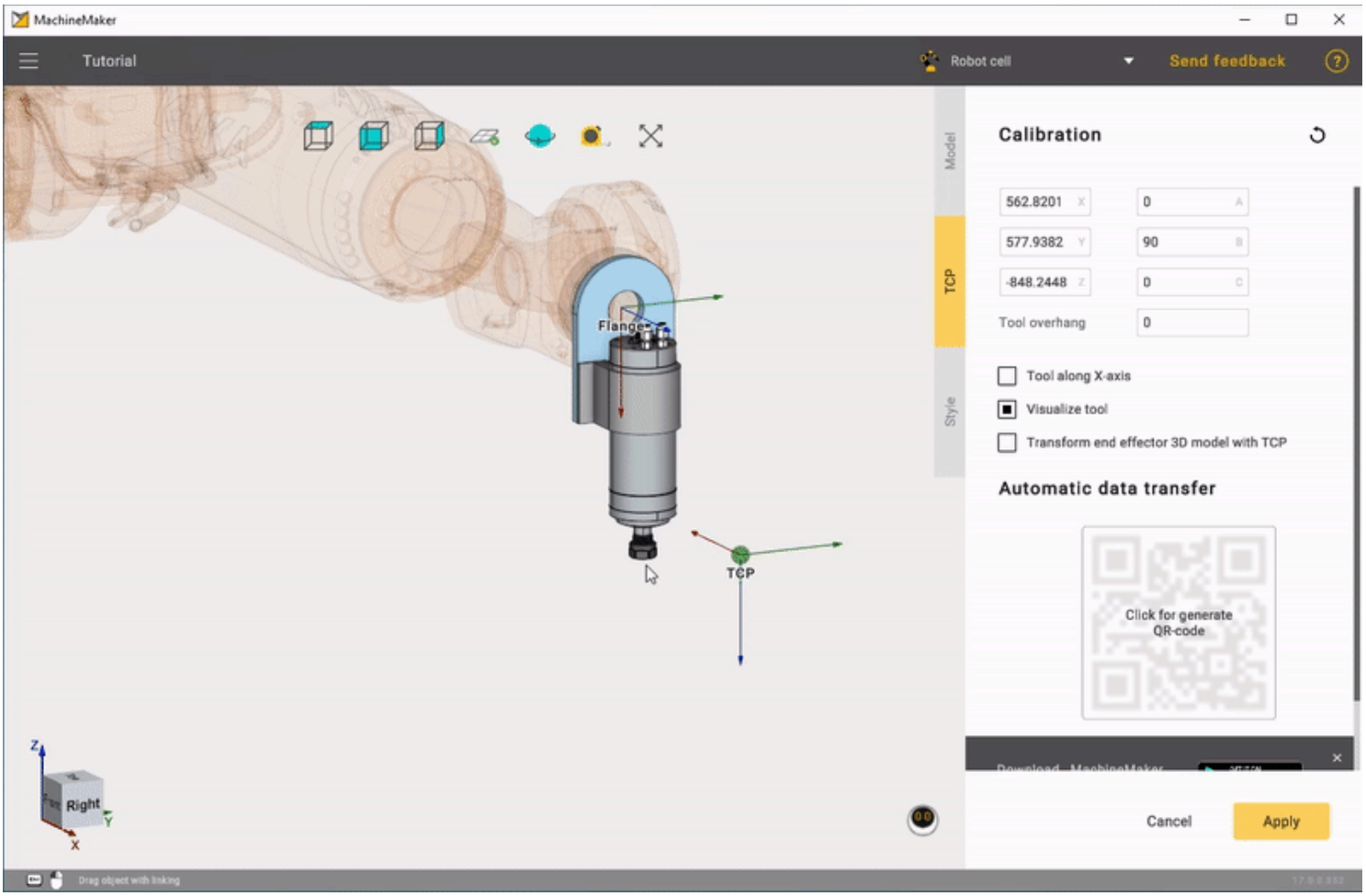


TCP calibration

Click TCP tab to open the tool center point panel. It is necessary to place the tool in the correct position.

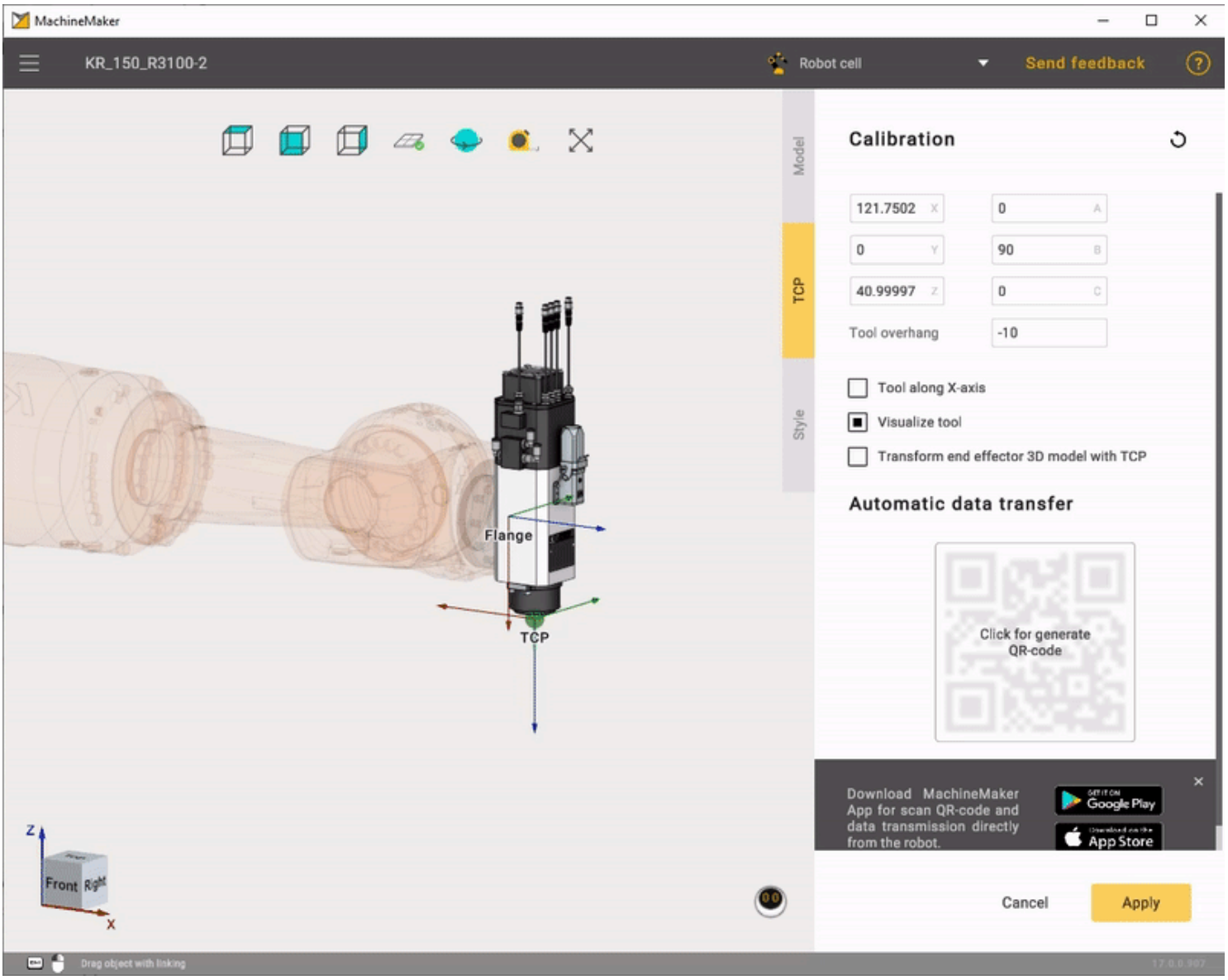


You can use the Transformation Panel or hold down the Left Ctrl key to enter Drag&Drop mode. Use Visualize tool checkbox to show the tool's visibility. Click Reset to clear all fields.

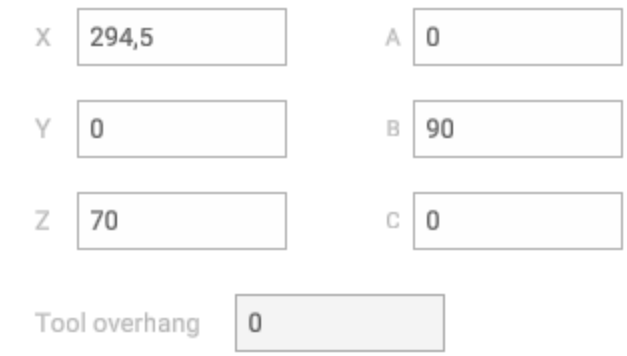


Use Transform End Effector 3D model with TCP to change the 3D model's position.

Subsequently, TCP calibration is performed on the actual robot to obtain real-world values. To avoid visual discrepancies with the real robot, it is advisable to move the TCP in conjunction with the 3D model of the end effector after obtaining actual calibration numbers."



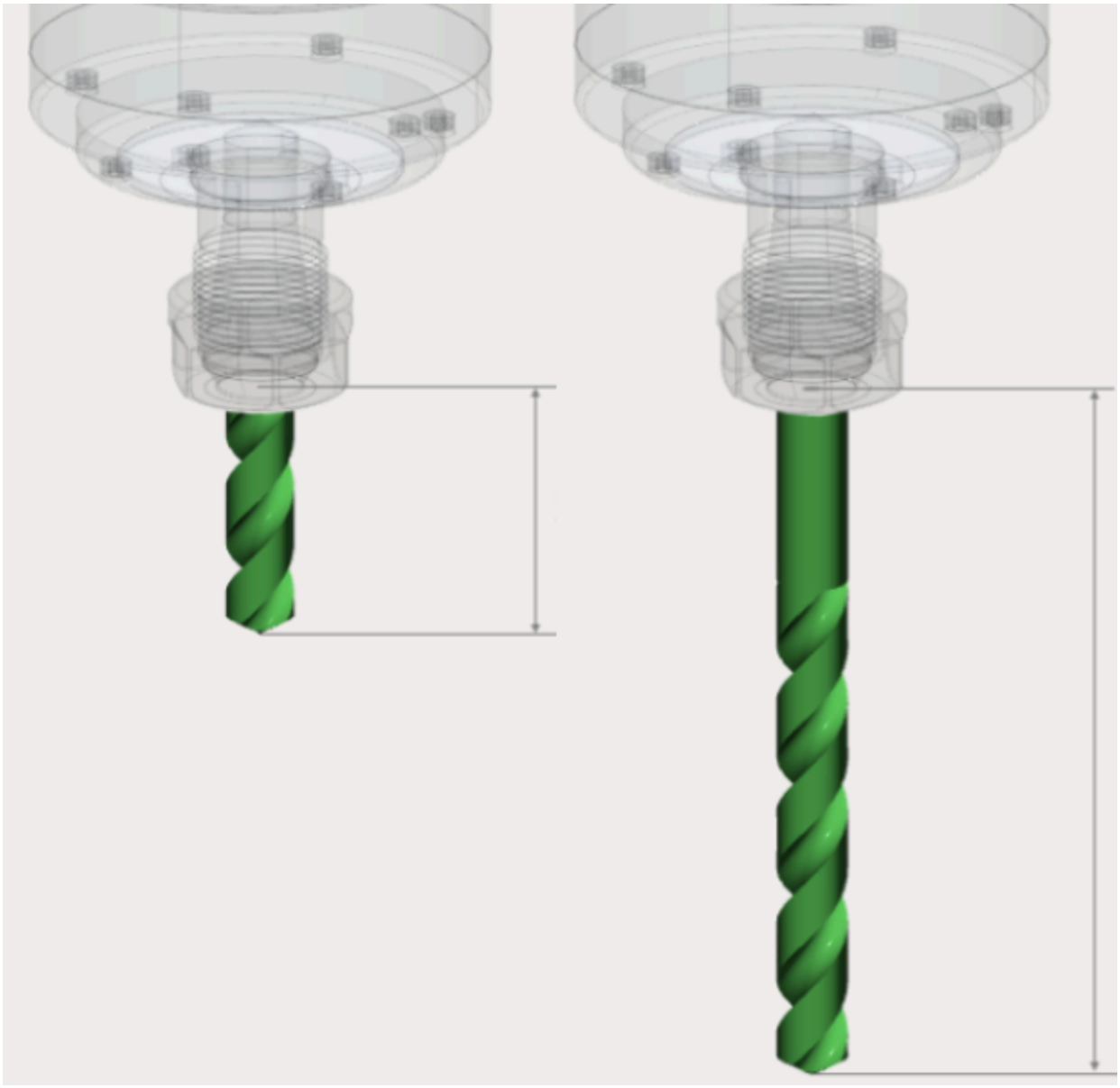
It is also possible to set the tool overhang if you have tool-tip calibration values from the robot and want to enter these values in the XYZ ABC fields.

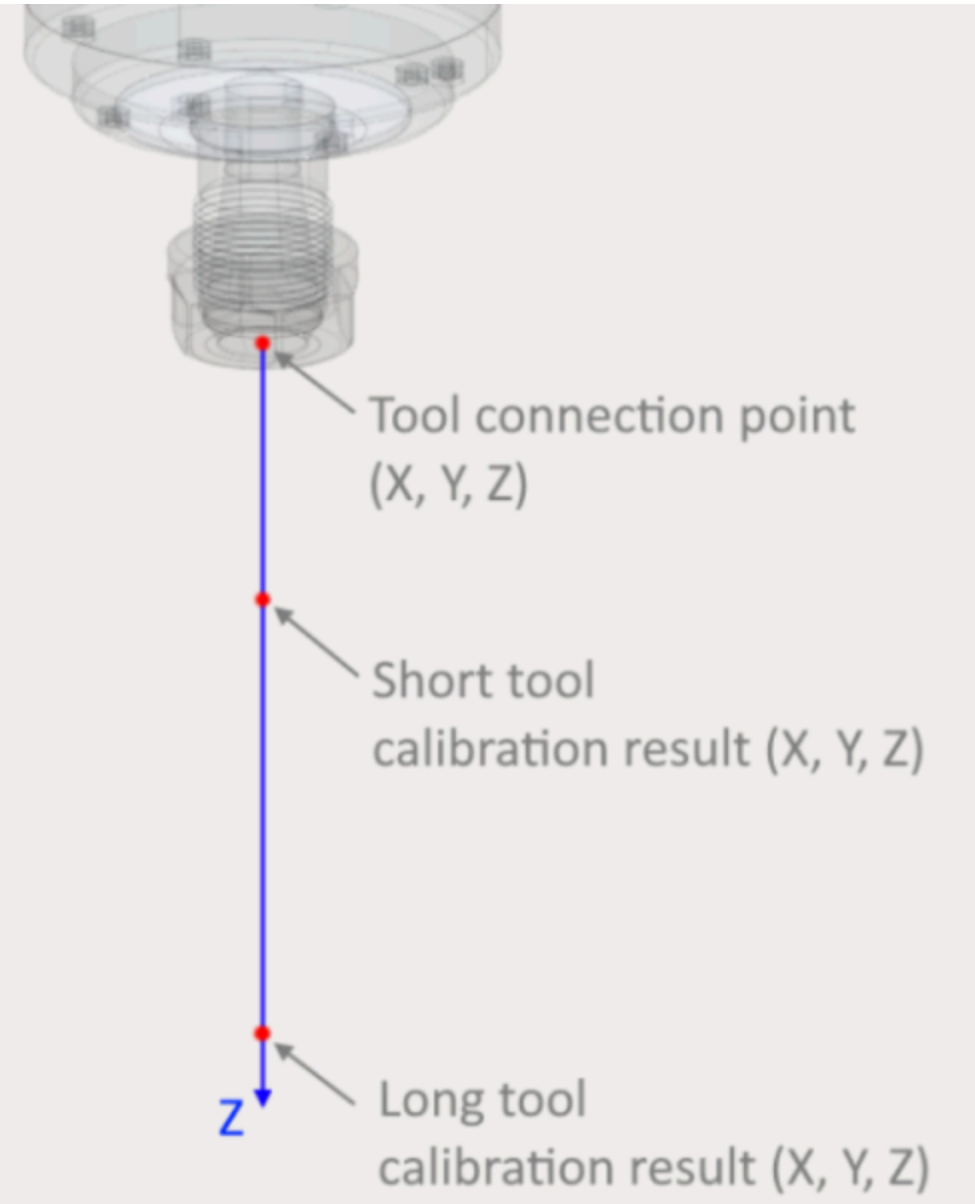


You can set the tool overhang to zero and calibrate the tool base point. Or you can specify the tool overhang and calibrate the tool-tip. In CAM system and MachineMaker both options are available.

Using calibration app

MachineMaker calibration app allows you to make the most accurate TCP calibration using the 2-point calibration method.

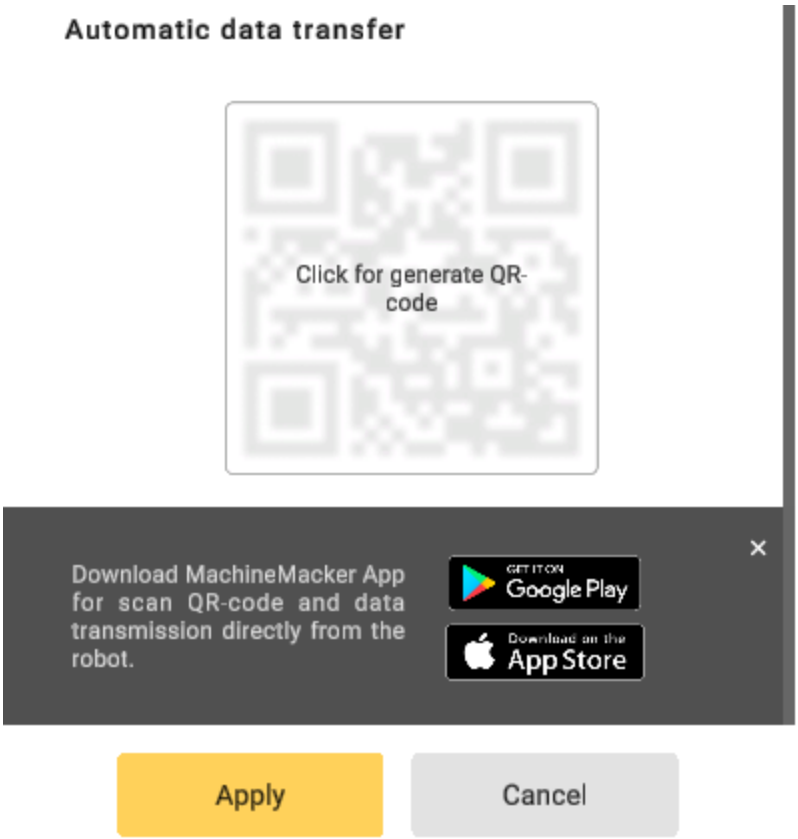




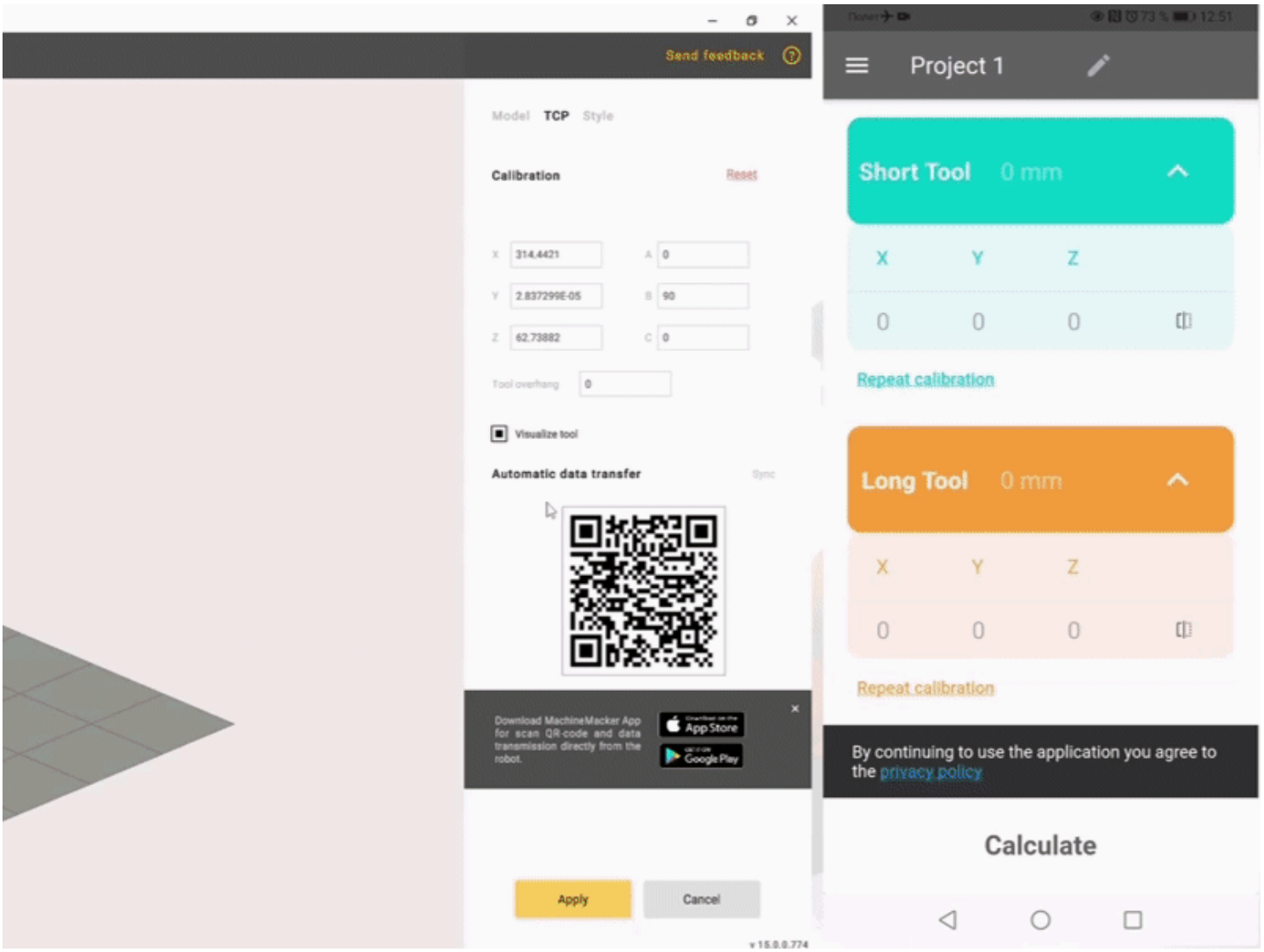
First of all it is necessary to calibrate both long and short tools using your robot's standard 4-points calibration method.



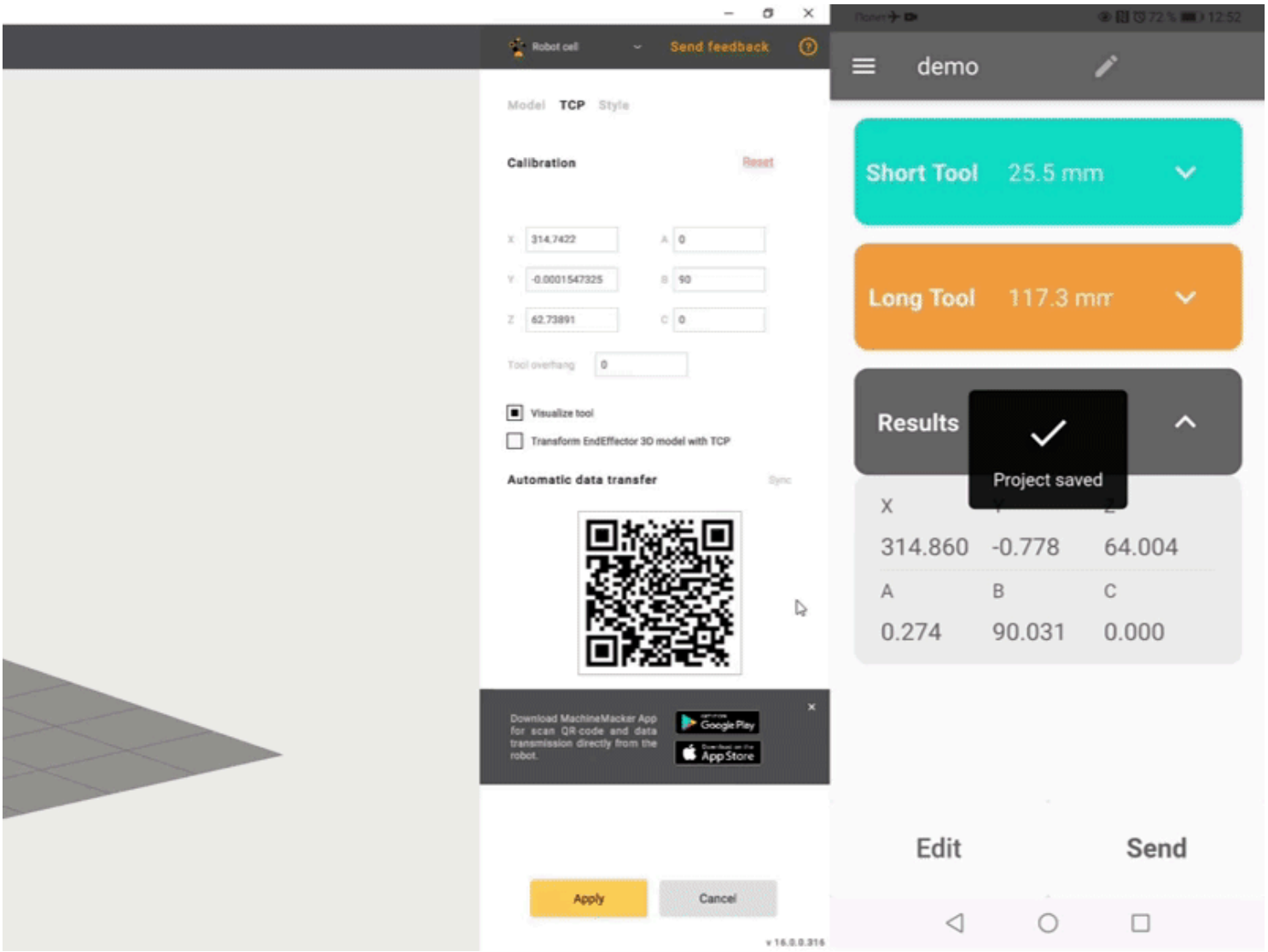
Next, download the latest version of our mobile app using the link in MachineMaker.



Launch the mobile app and fill in calibration values from the robot.

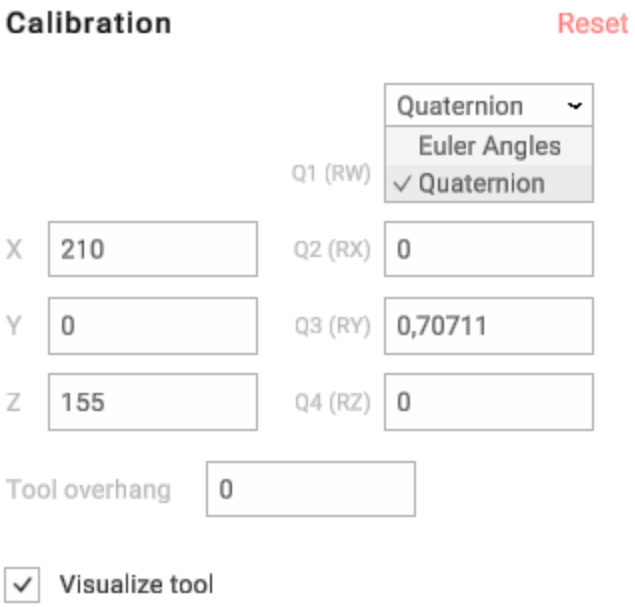


Finally, click Send button and scan the QR code from the MachineMaker. Calculated values will be transferred to your MachineMaker TCP calibration input fields automatically. It is also possible to enter the calculated calibration values manually.



Quaternions, Radians and Euler Angles

Some robots (such as ABB) use quaternions or Radians instead of euler angles. For this kind of robots MachineMaker will show quaternions fields. You can switch to Euler angles if you prefer to use Euler angles.



MachineMaker will save TCP values in the acceptable format for the robot anyway. So, even if you use Euler angles and set tool position in A B C values, MachineMaker will convert it to quaternions automatically.

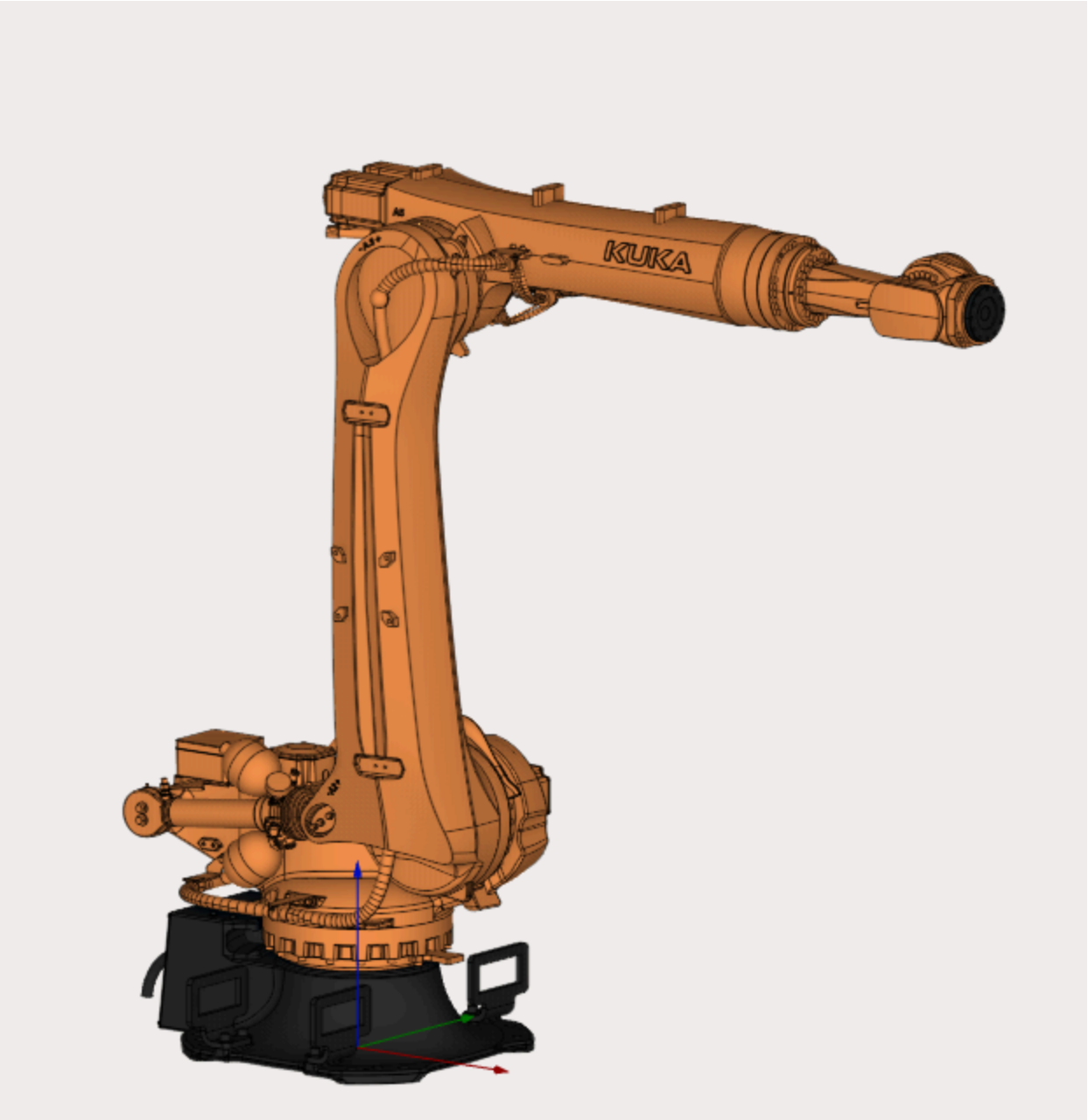
Examples: Robot cell

In this chapter, you will find instructional videos detailing the process of adding and configuring various components in the software. The covered topics include:

1. Simple Robot
    - Instruction on adding a simple robot.
2. Heavy-Duty Robot
    - Guidance on incorporating heavy-duty robot models.
3. Cobot (Collaborative Robot)
    - Instructions for adding and configuring collaborative robot models.
4. End Effectors
    - Tutorial on the addition and setup of end effectors.
5. End Effector TCP (Tool Center Point)
    - Demonstrations on adding and configuring end effector TCP.
6. External Tools
    - Guidance on adding and configuring external tools.
7. Composite End Effector
    - Tutorial covering the addition and setup of composite end effectors.
8. Composite End Effector: Spot Welding
    - Specific tutorial on adding and configuring spot welding composite end effectors.
9. Tables and User Coordinate Systems (CS)
    - Instructional content on adding and configuring tables and user coordinate systems.
10. Rail
    - Tutorial on adding rail components and configuring their settings.
11. H-Bot (Portal)
    - Instructional video covering the addition and configuration of H-Bot (Portal) systems.
12. SCARA Robot
    - Instructions for adding and configuring SCARA robot models.

Simple robot

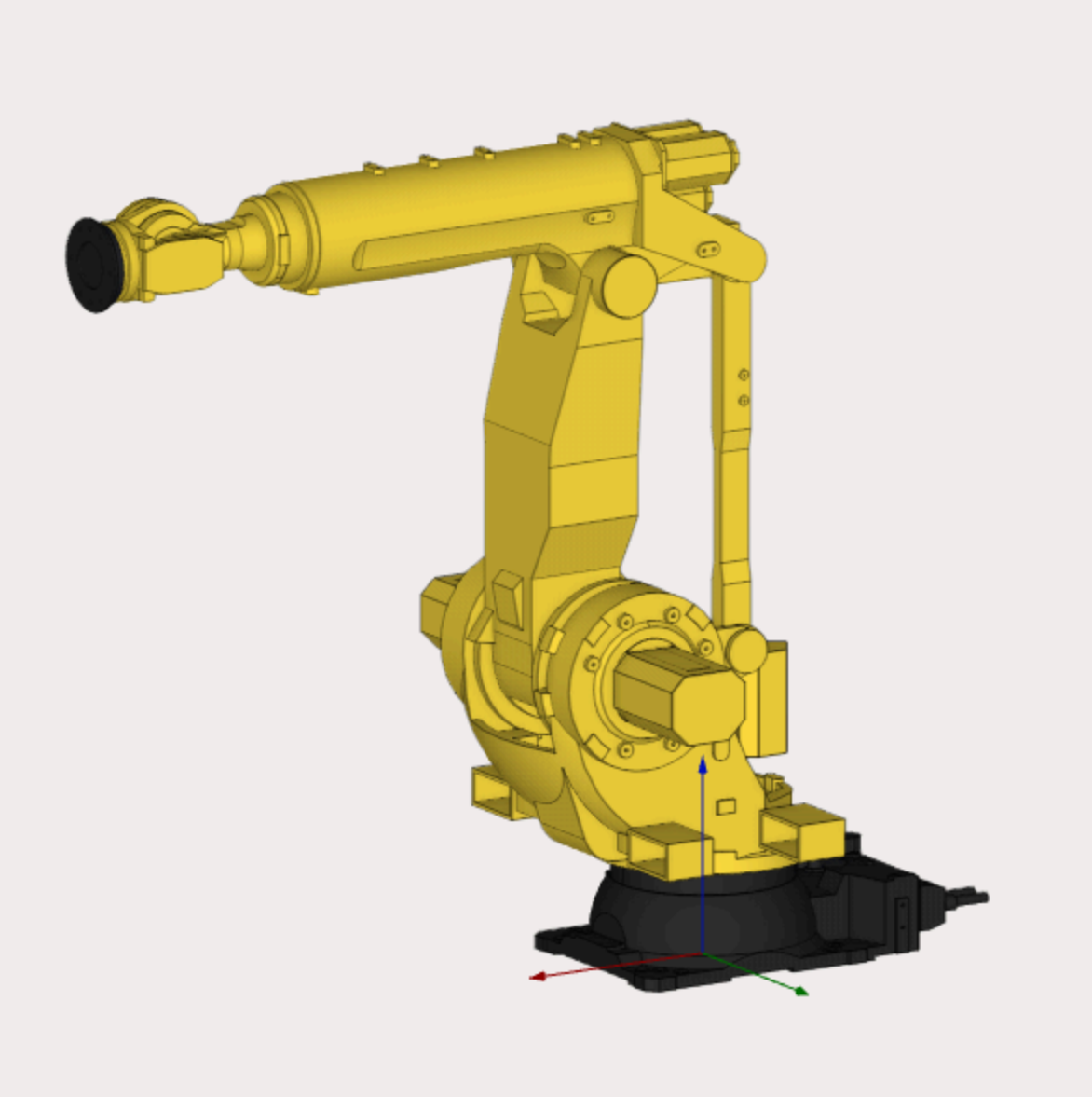
Download Project here: SimpleRobot.zip



You can see the tutorial video at the link

Heavy-Duty robot

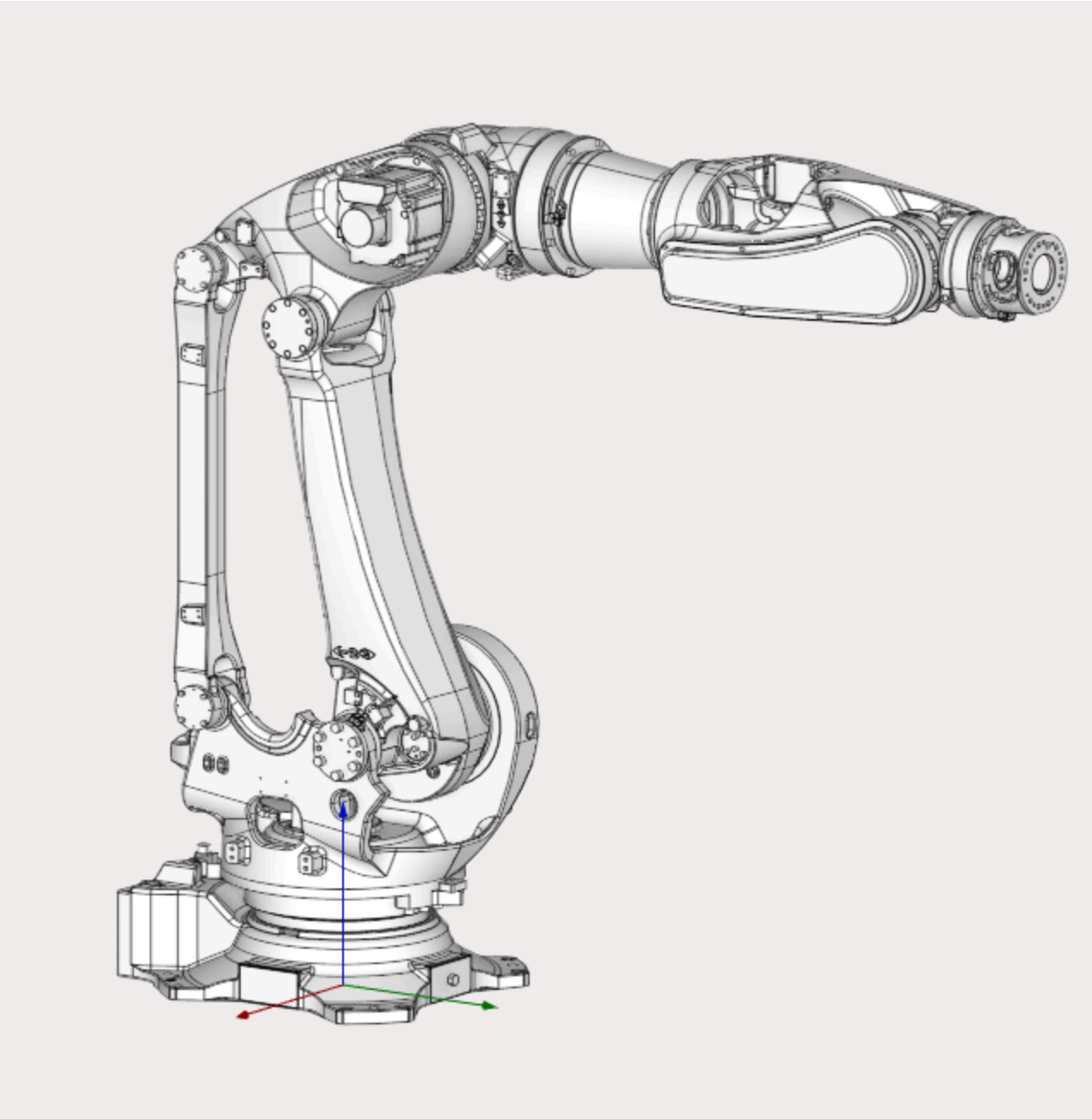
Download Project here: Heavy-Duty.zip



You can see the tutorial video at the link

Flexible Heavy-Duty Robot

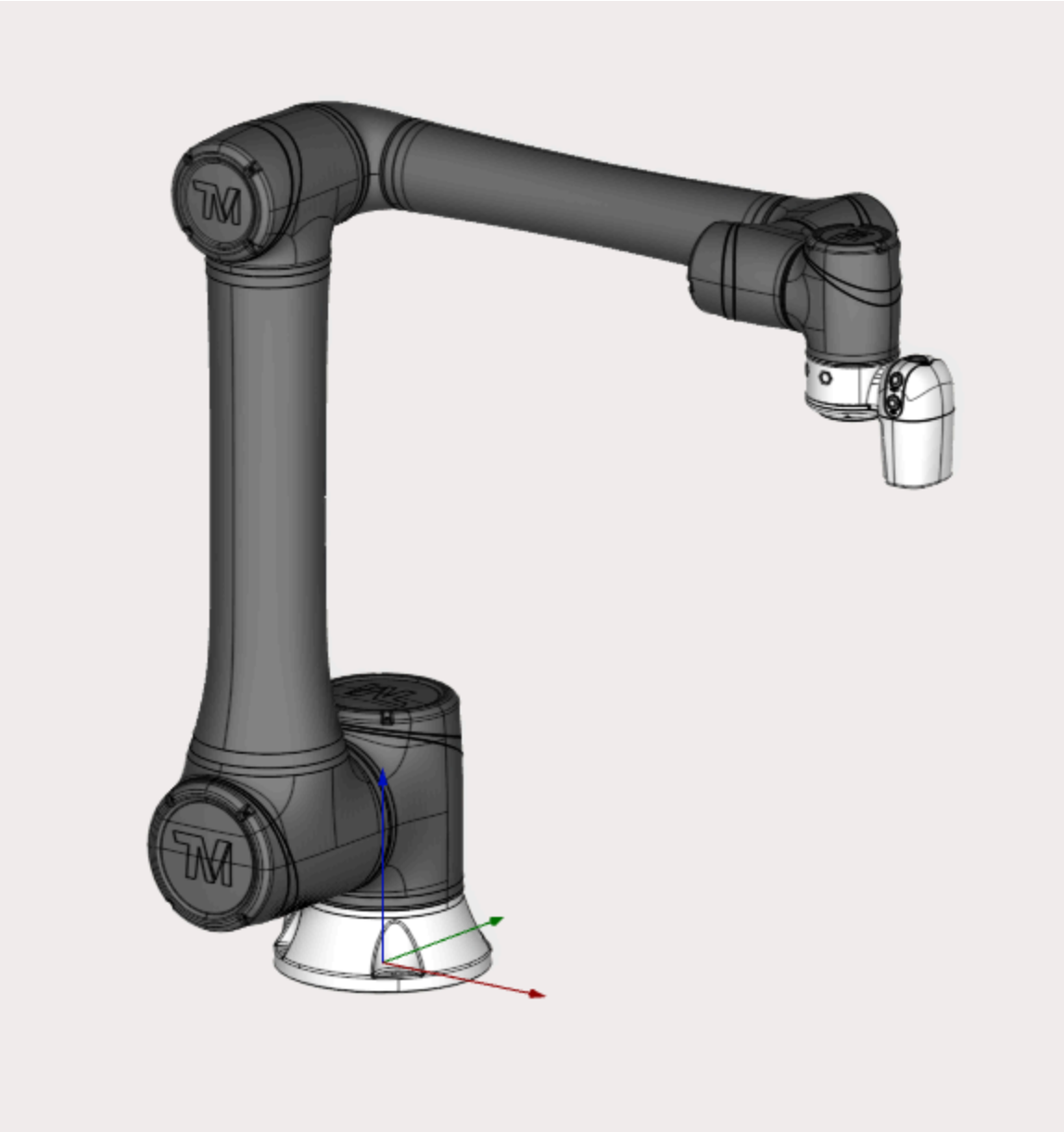
Download Project here: Kawasaki BX300L.zip



You can see the tutorial video at the link.

Cobot

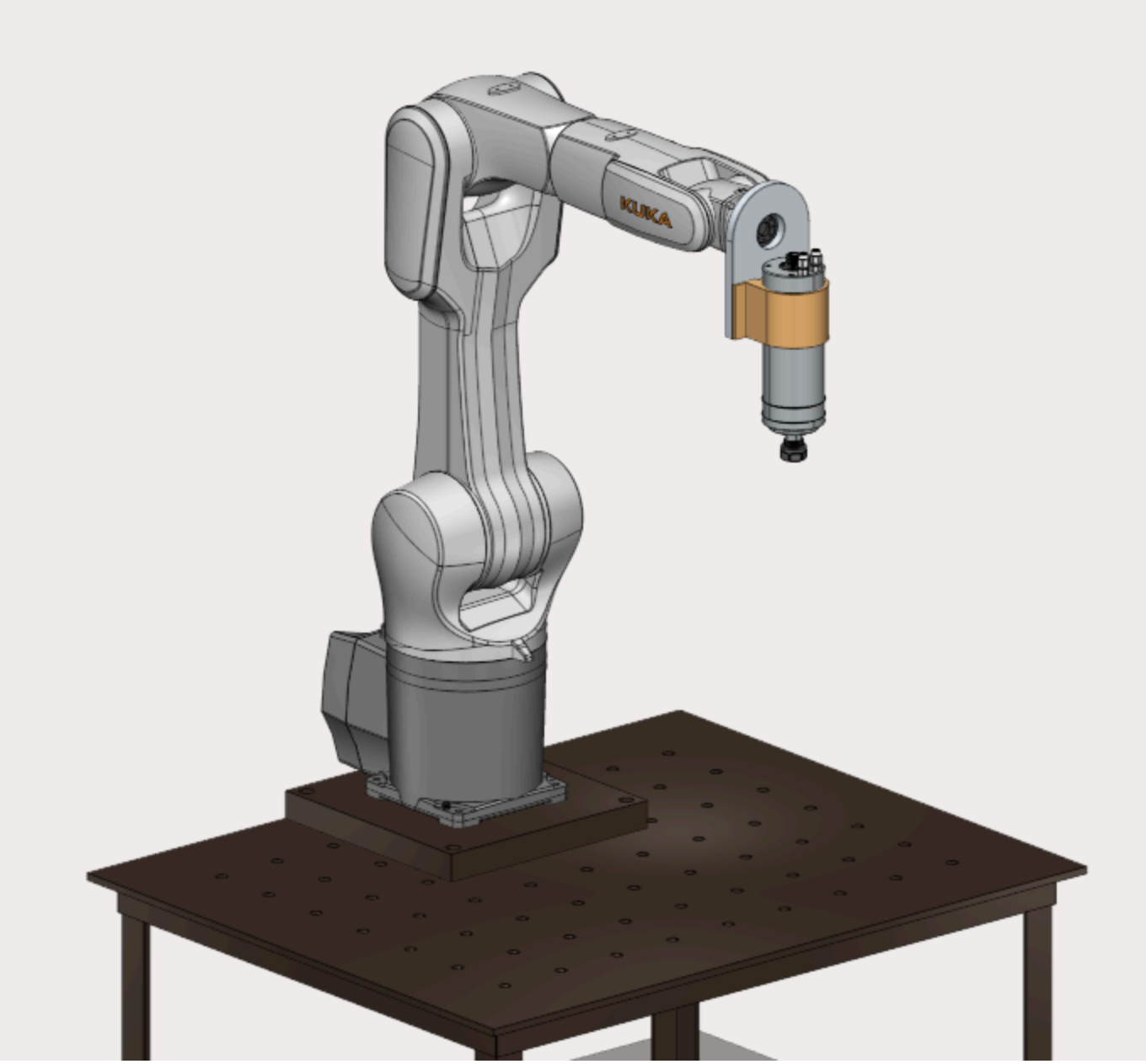
Download Project here: Cobot.zip



You can see the tutorial video at the link

End Effectors

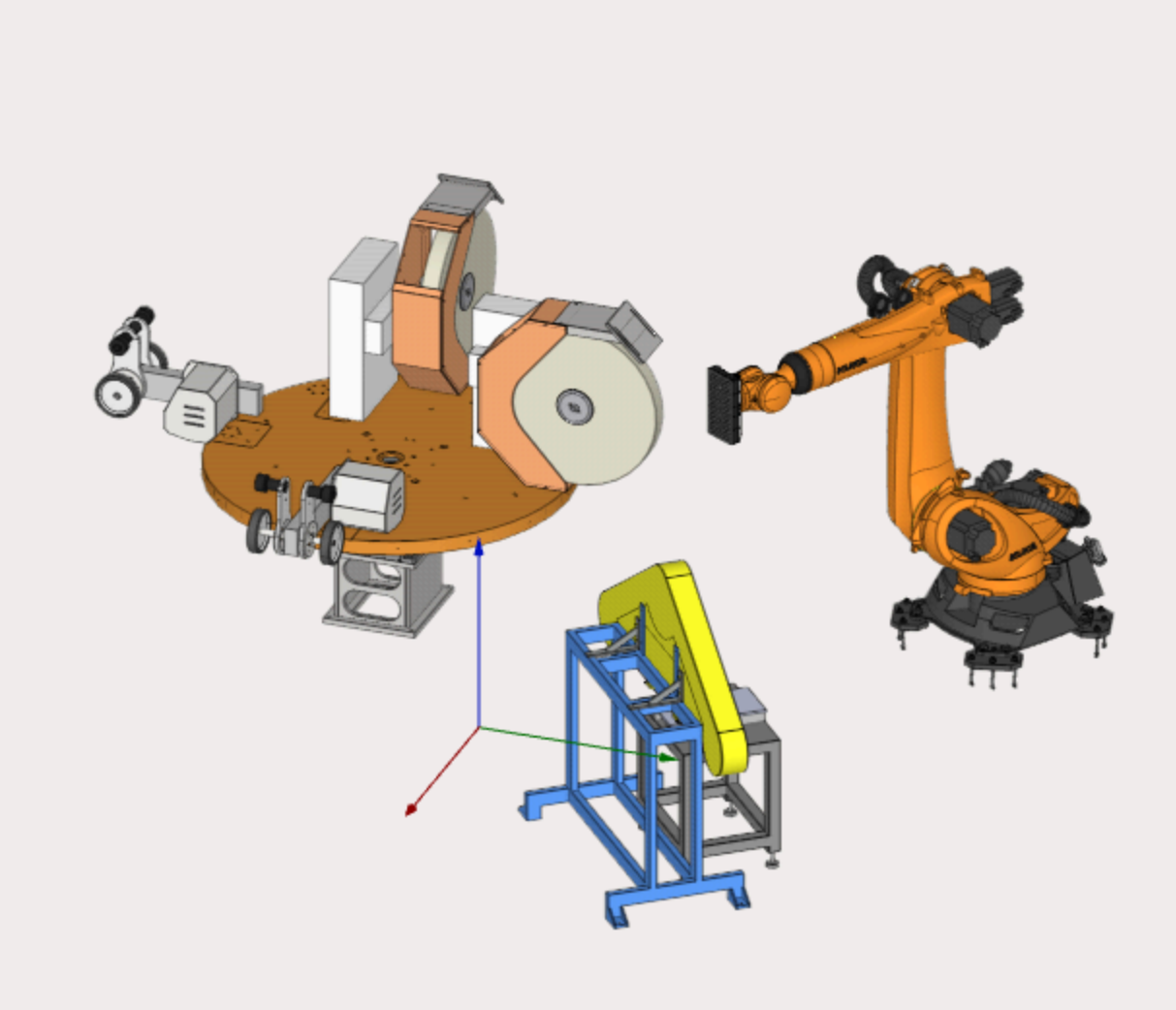
Download Project here: EndEffectors.zip



You can see the tutorial video at the link

External Tools

Download Project here: Grinder.zip



You can see the tutorial video at the link

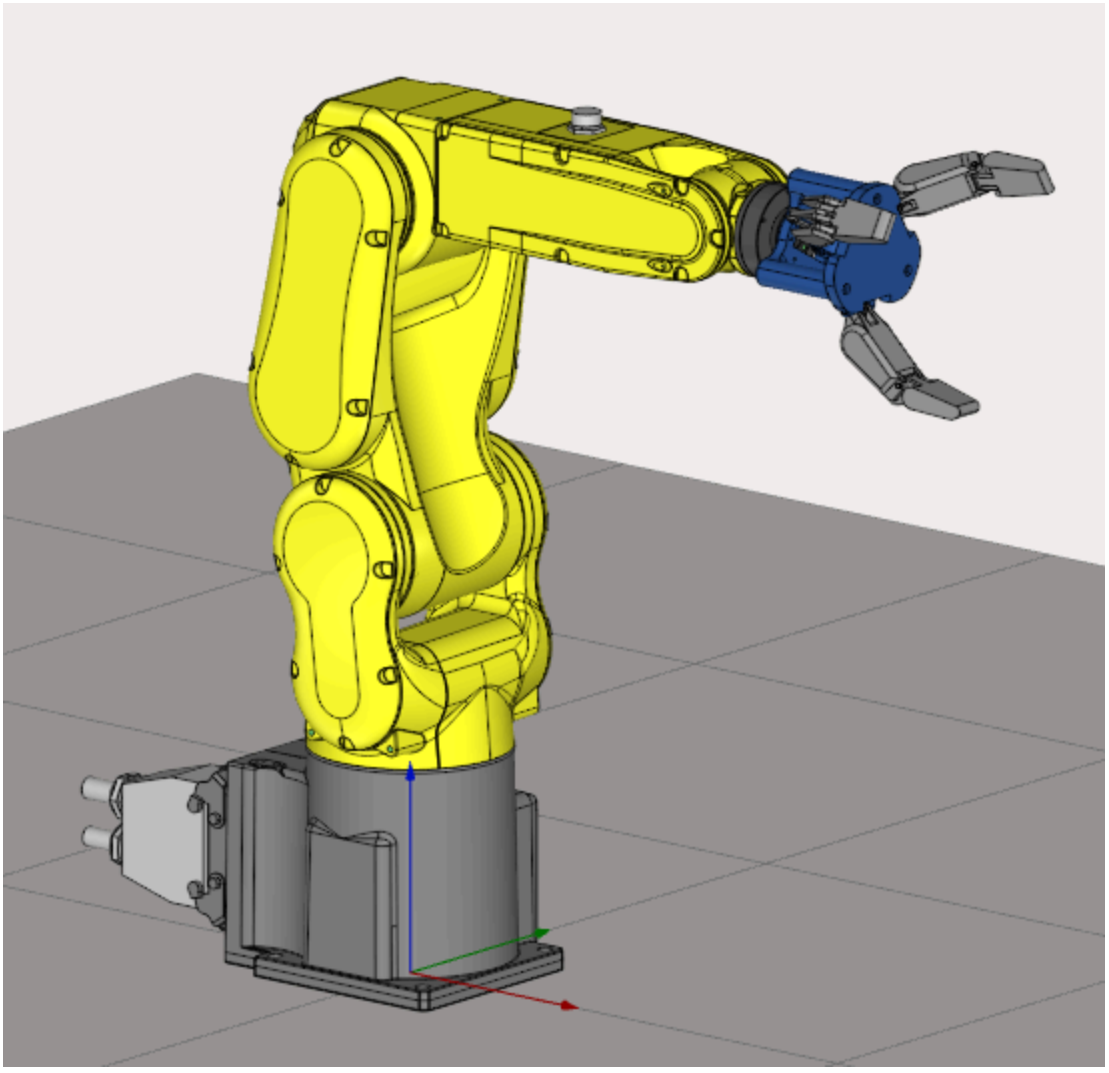
Composite End Effector

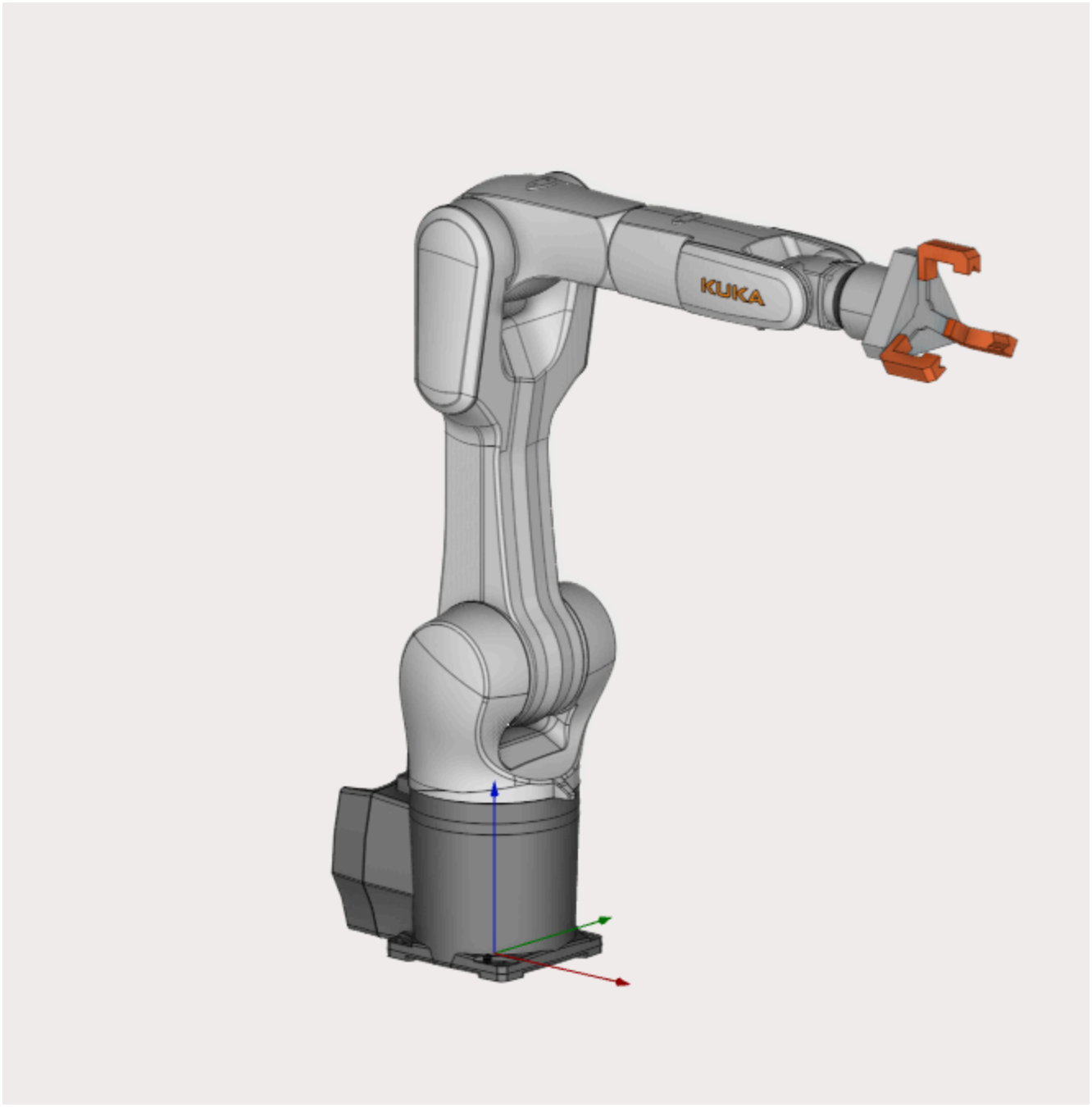
Download Project here: CompositeEndEffector.zip / CompositeEndEffectorLinear.zip

Composite End Effectors have two types:

1. Rotary
2. Linear

In the case of "Rotary" a special configuration is used for flexible limbs of the mechanism. For "Linear" only linear axes are used along which the gripper jaws will move.

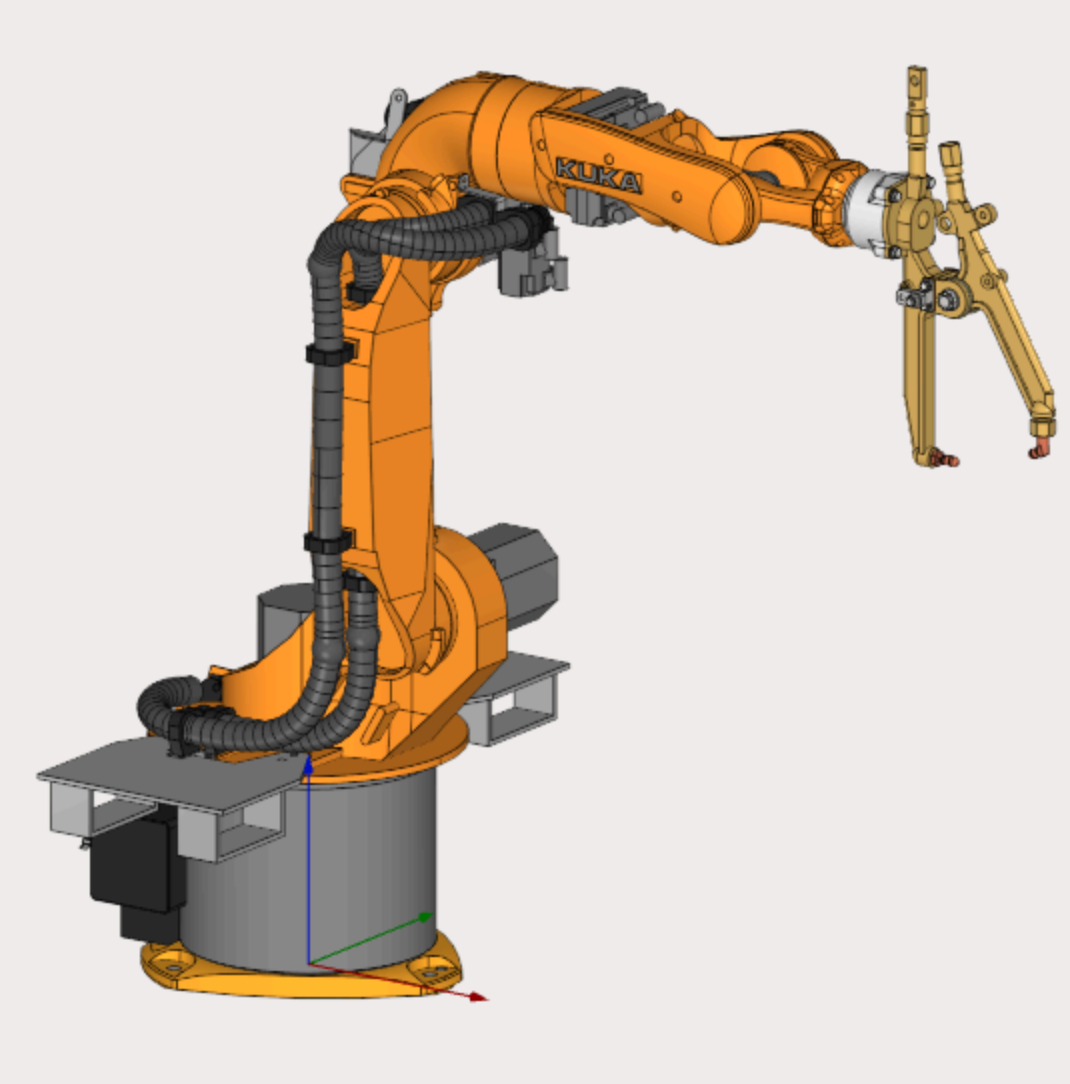




To learn more about these features, we recommend watching our tutorials on rotary and linear Composite End Effectors.

Composite EndEffector: Spot Welding

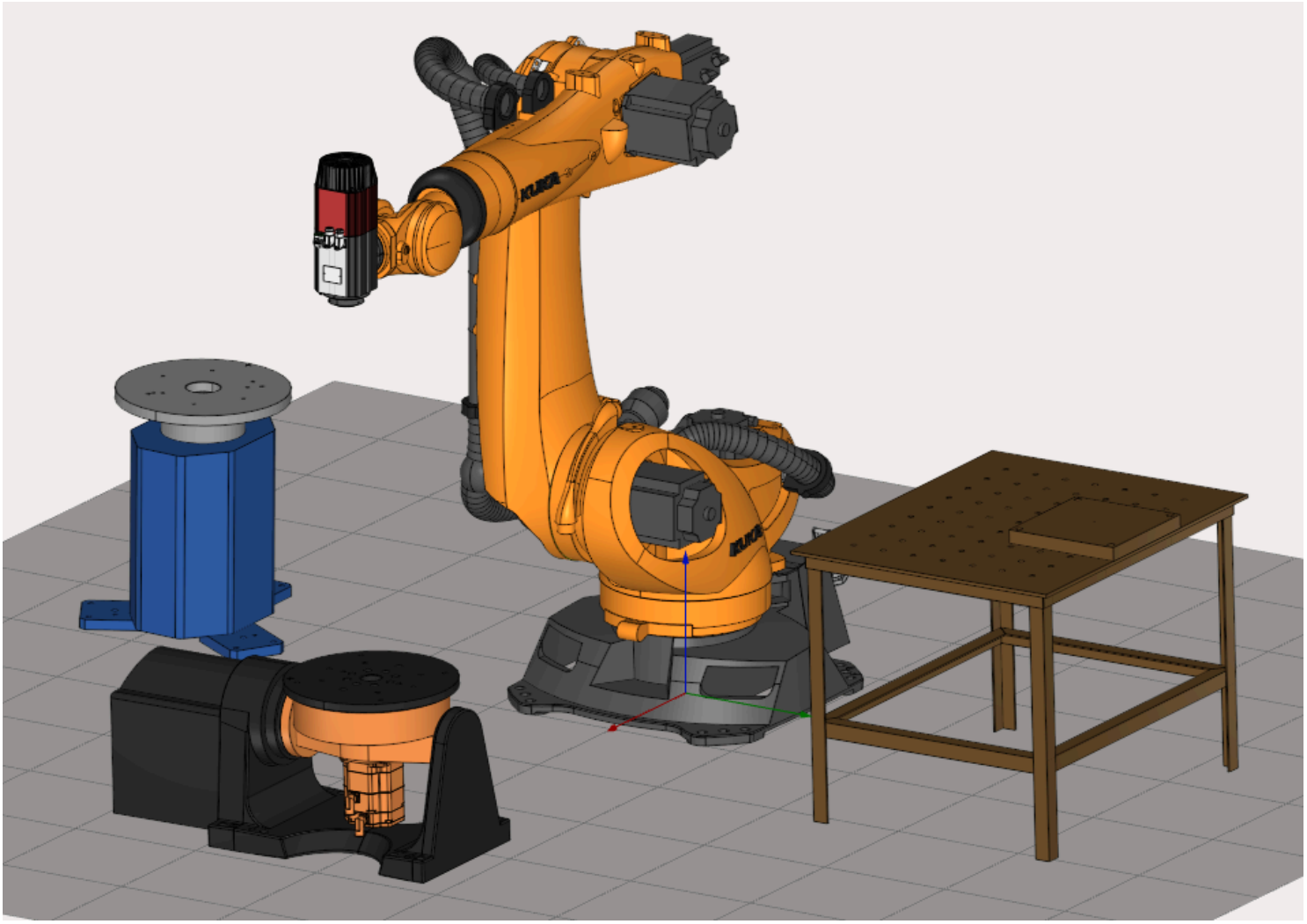
Download Project here: Spot_Welding.zip



You can see the tutorial video at the link

Tables and User CS

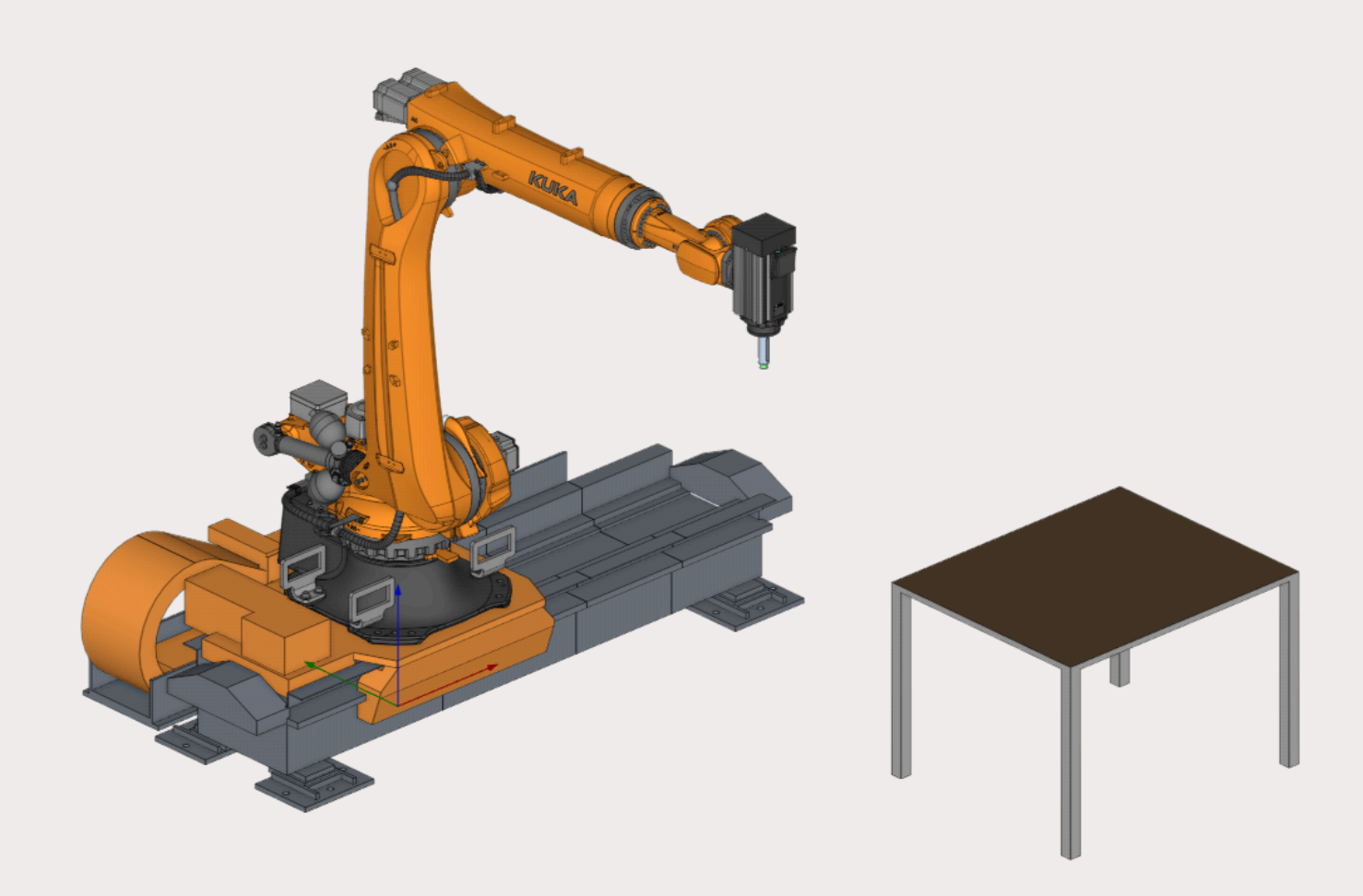
Download Project here: Tables.zip



You can see the tutorial video at the link

Rail

Download Project here: Rail.zip



You can see the tutorial video at the link

H-bot (Portal)

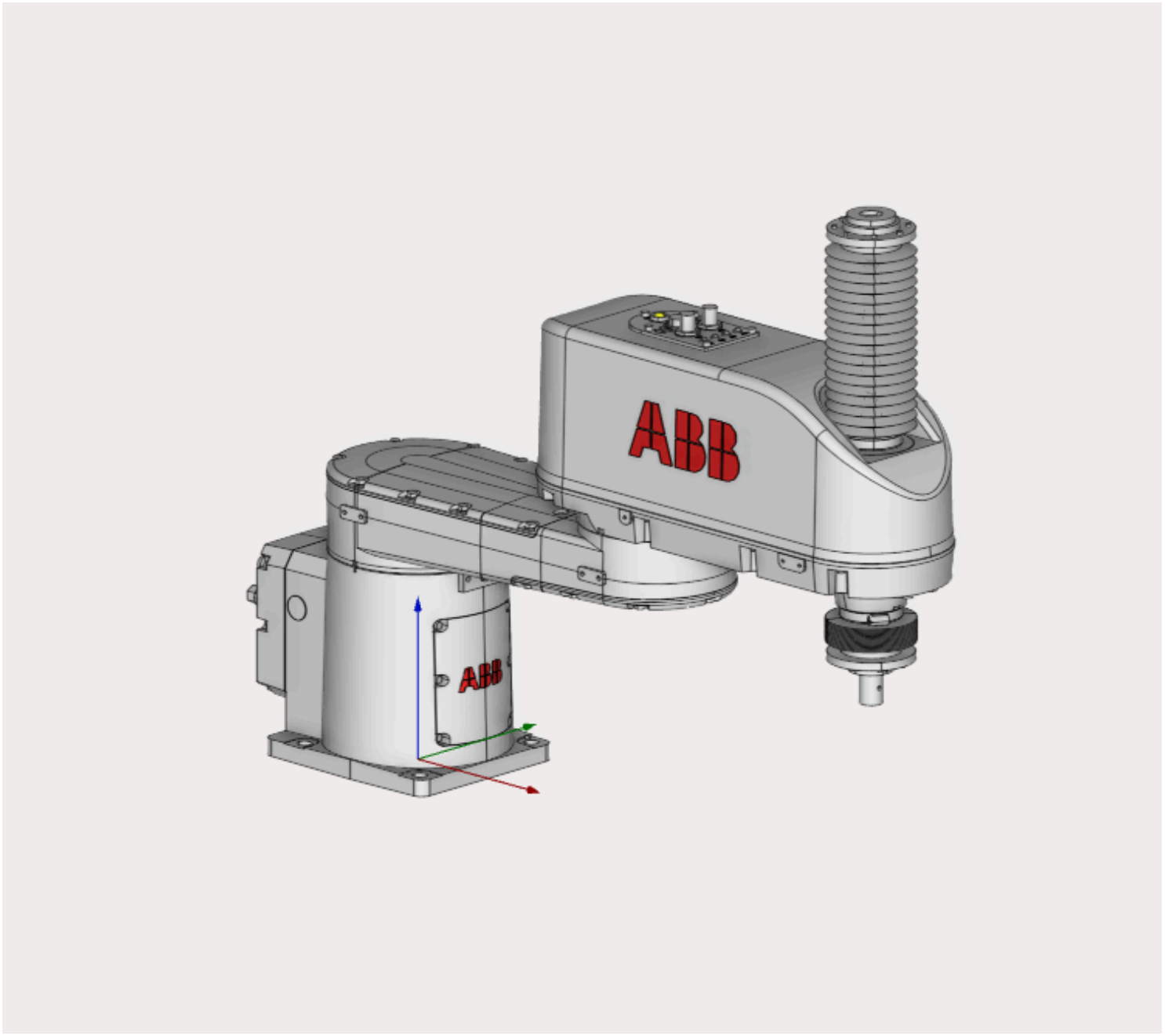
Download Project here: Portal.zip



You can see the tutorial video at the link

SCARA Robot

Download project here: SCARA Robot.zip



You can see the tutorial video at the link.

Column-type robot

Download project here: EZ03V-4525_J4.zip



You can see the tutorial video at the link.

Turn-Milling Machines

This section describes how to create and configure turn-milling (lathe milling) and Swiss type machines in MachineMaker. Select the Lathe milling machine context using Application Mode Selector (see Introduction to MachineMaker).

The steps common to all mechanisms are described in Interface and Getting Started: creating a project, adding a mechanism, preparing and importing 3D objects, grouping elements into nodes, coloring, simulation, assemblies and machine equipment.

Build a machine

- Building a kinematic scheme
- Chuck connector
- Tool block
- Turret head node
- Dual-row tool turret
- Multi Tool Head

Examples

- Examples: Lathe milling machine
- Lathe milling machine
- Lathe milling machine with a dual-row turret
- Swiss type machine

Building a kinematic scheme

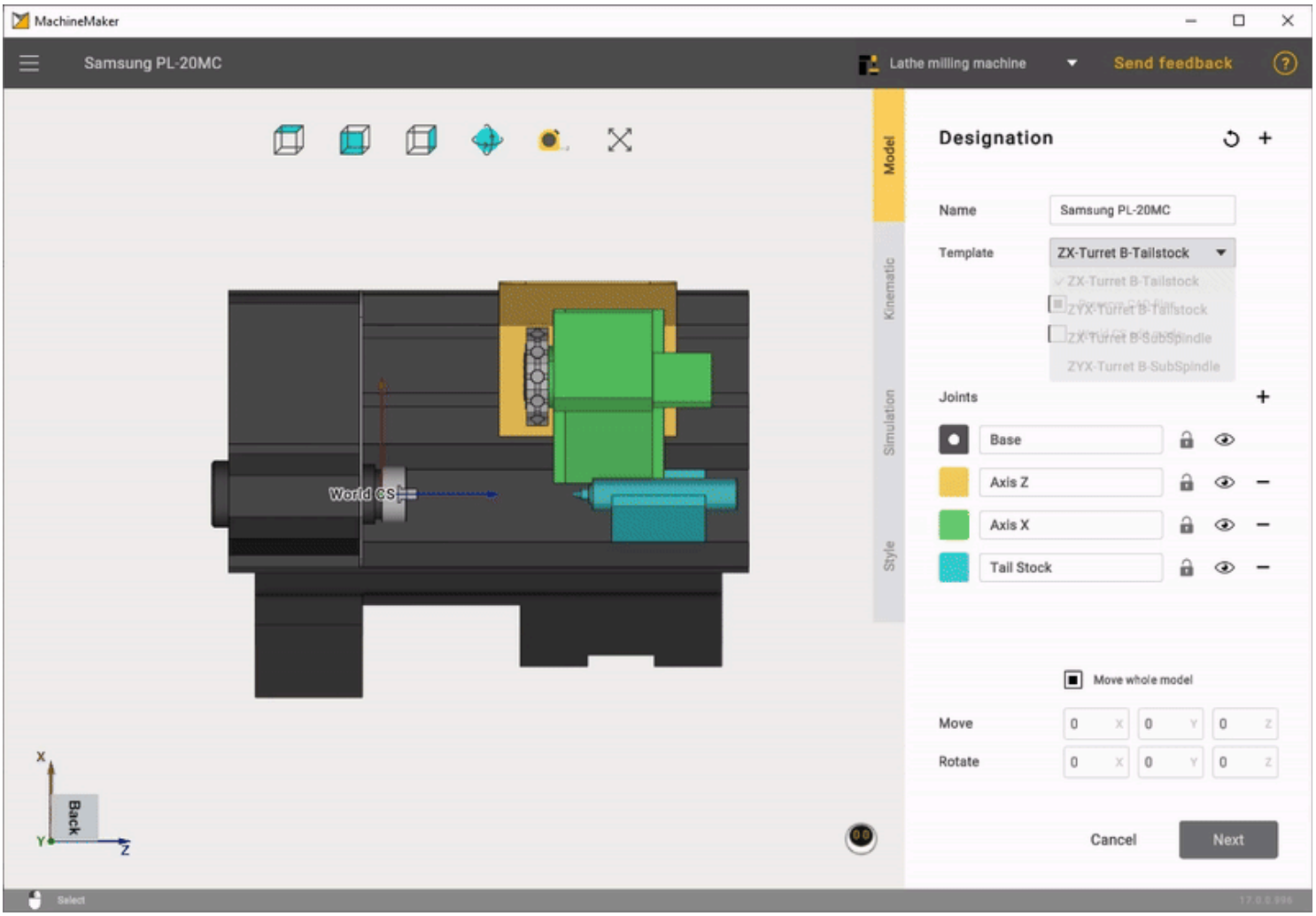
Click *Kinematic*tab to open kinematic parameters panel.



Kinematics

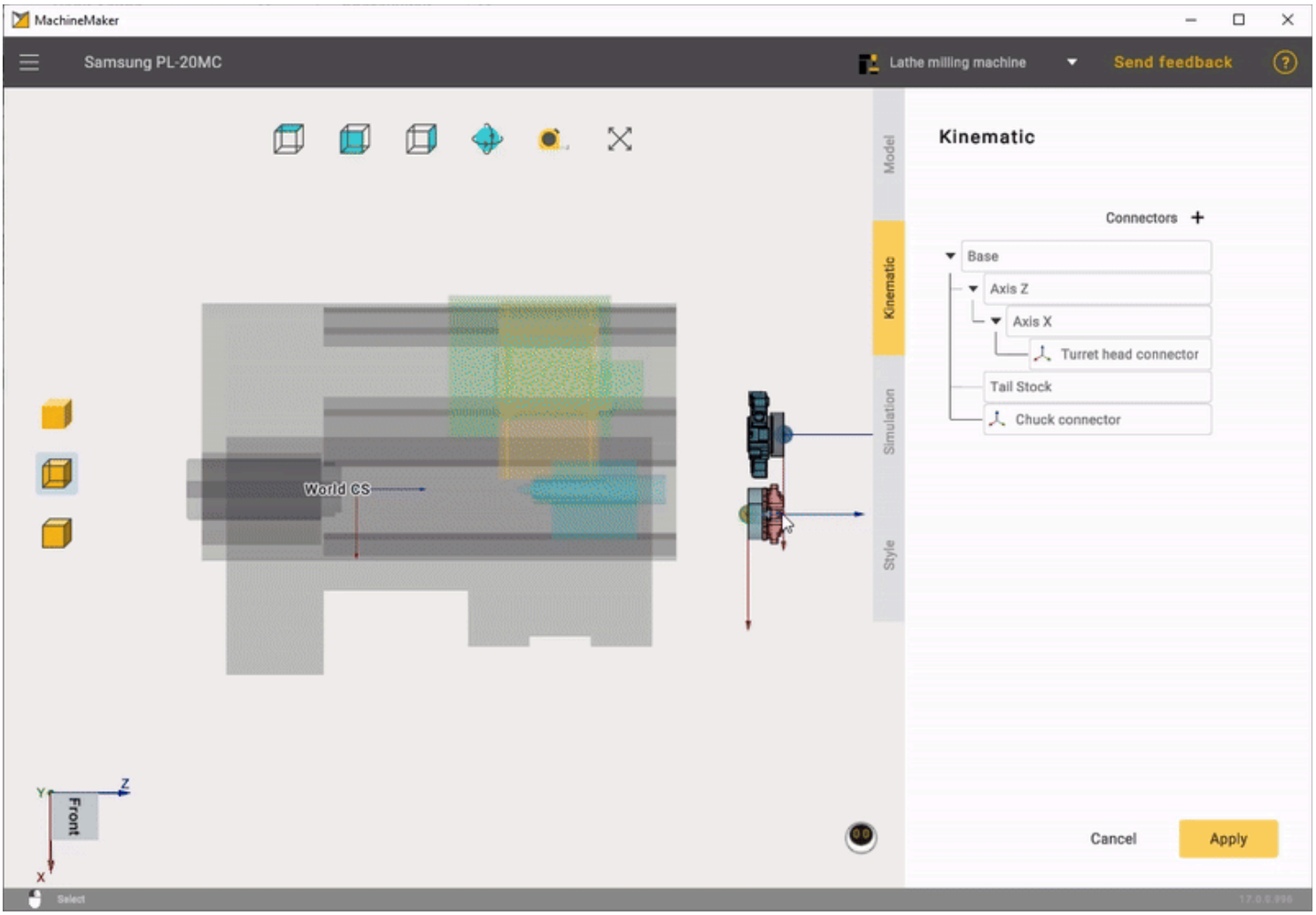
MachineMaker shows the current mechanism's 3D model and kinematic scheme. It is necessary to build correct kinematic linkage by specifying connector's positions.

The kinematic tree of mechanisms will be automatically built because of the pre-selected template on the "Model" tab. In cases if it will be necessary to make any changes in the mechanism tree the name of the template will change to "Custom".

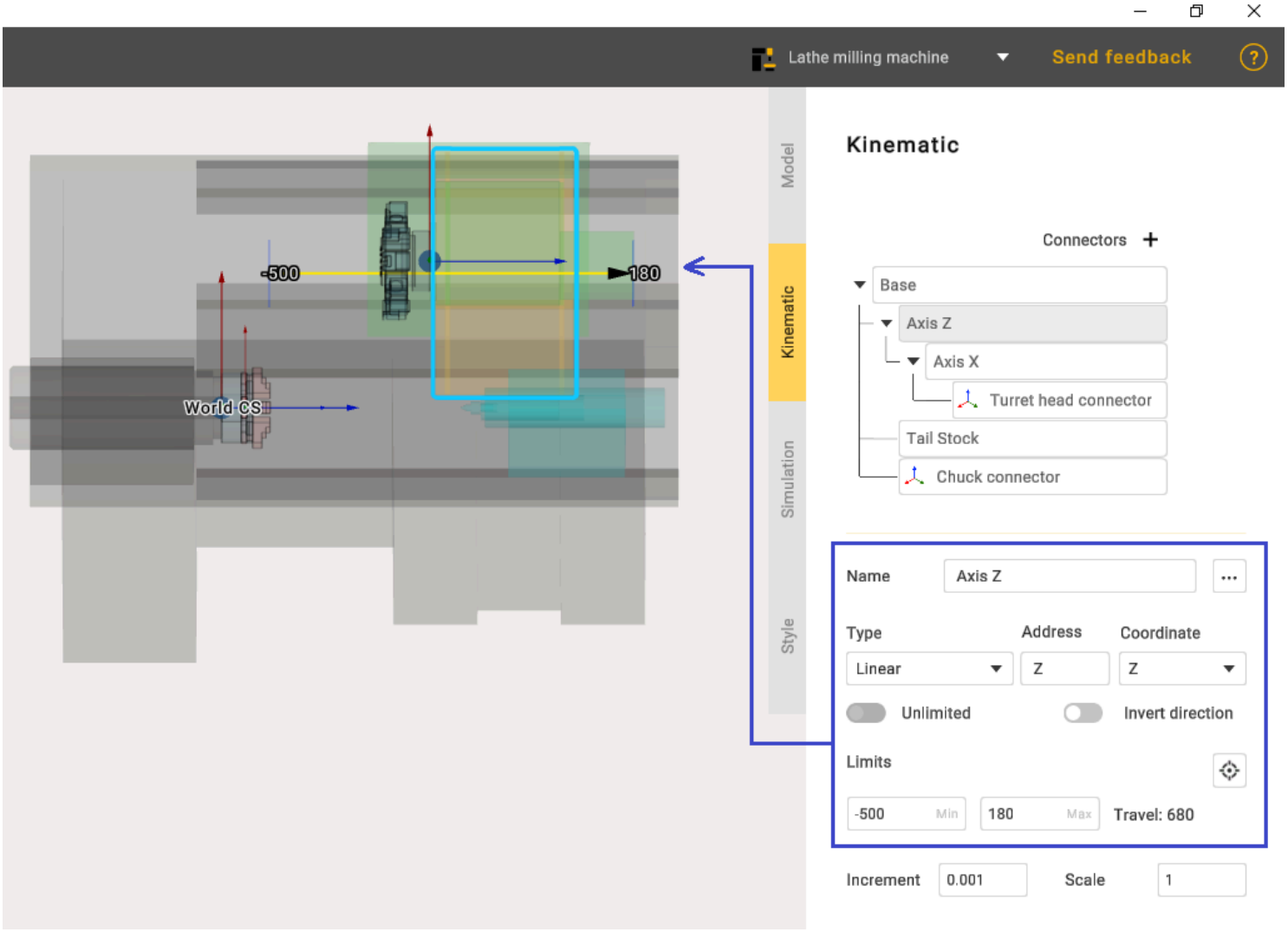


Since the appropriate template was originally selected, the only thing left to do is to position the Turret head connector and Chuck connector in the correct positions. Also set the limits for each node.

Hold down the Left Ctrl key and drag the Turret head connector and Chuck connector to the desired position.



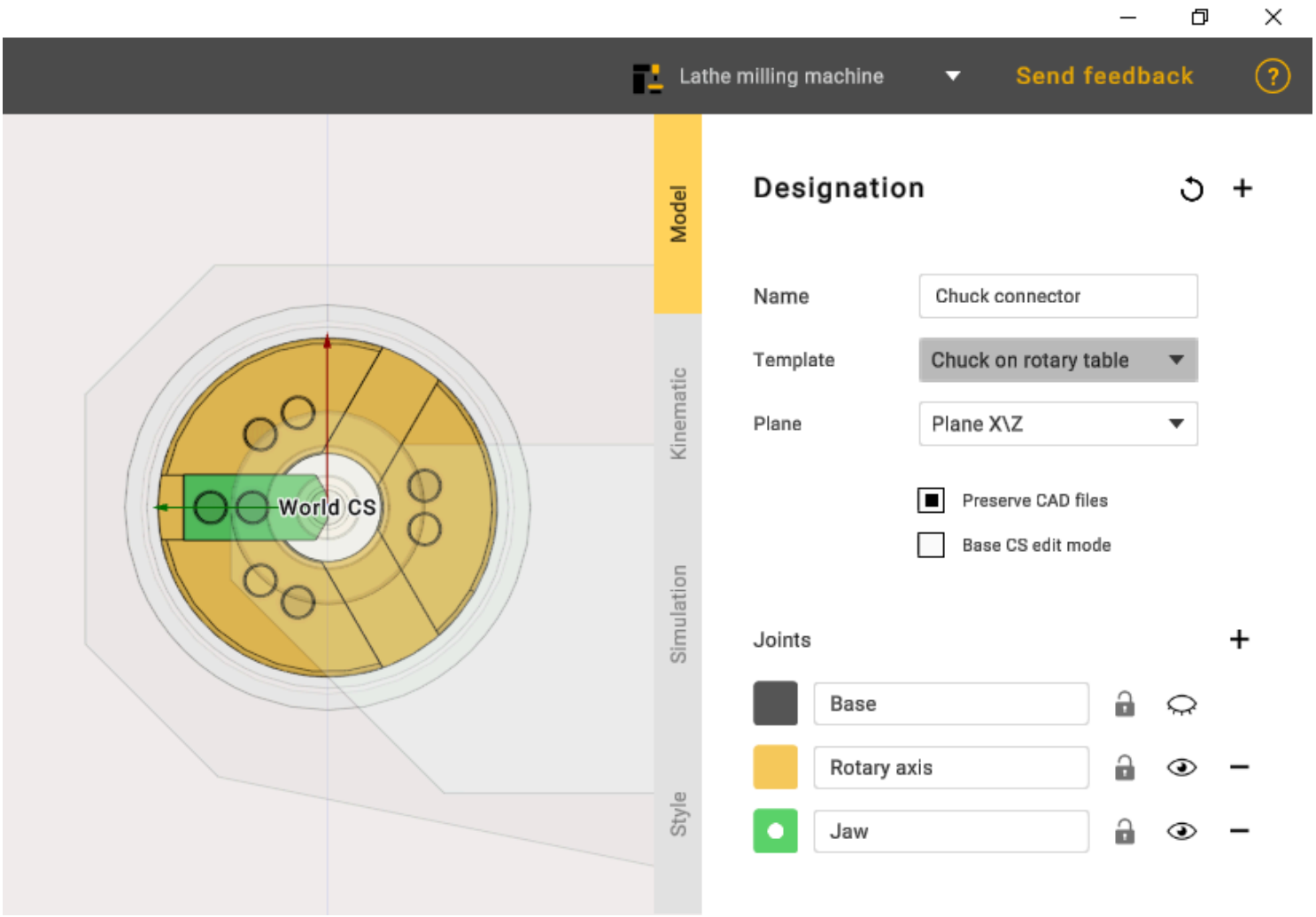
Node limits on lathe milling machine can vary. We recommend that you set the original values for each node.


Lathe milling machine
Send feedback
Model
Kinematic
Simulation
Style
-500
180
World CS
Kinematic
Connectors
Base
Axis Z
Axis X
Turret head connector
Tail Stock
Chuck connector
Name
Axis Z
Type
Address
Coordinate
Linear
Z
Z
Unlimited
Invert direction
Limits
-500
Min
180
Max
Travel: 680
Increment
0.001
Scale
1

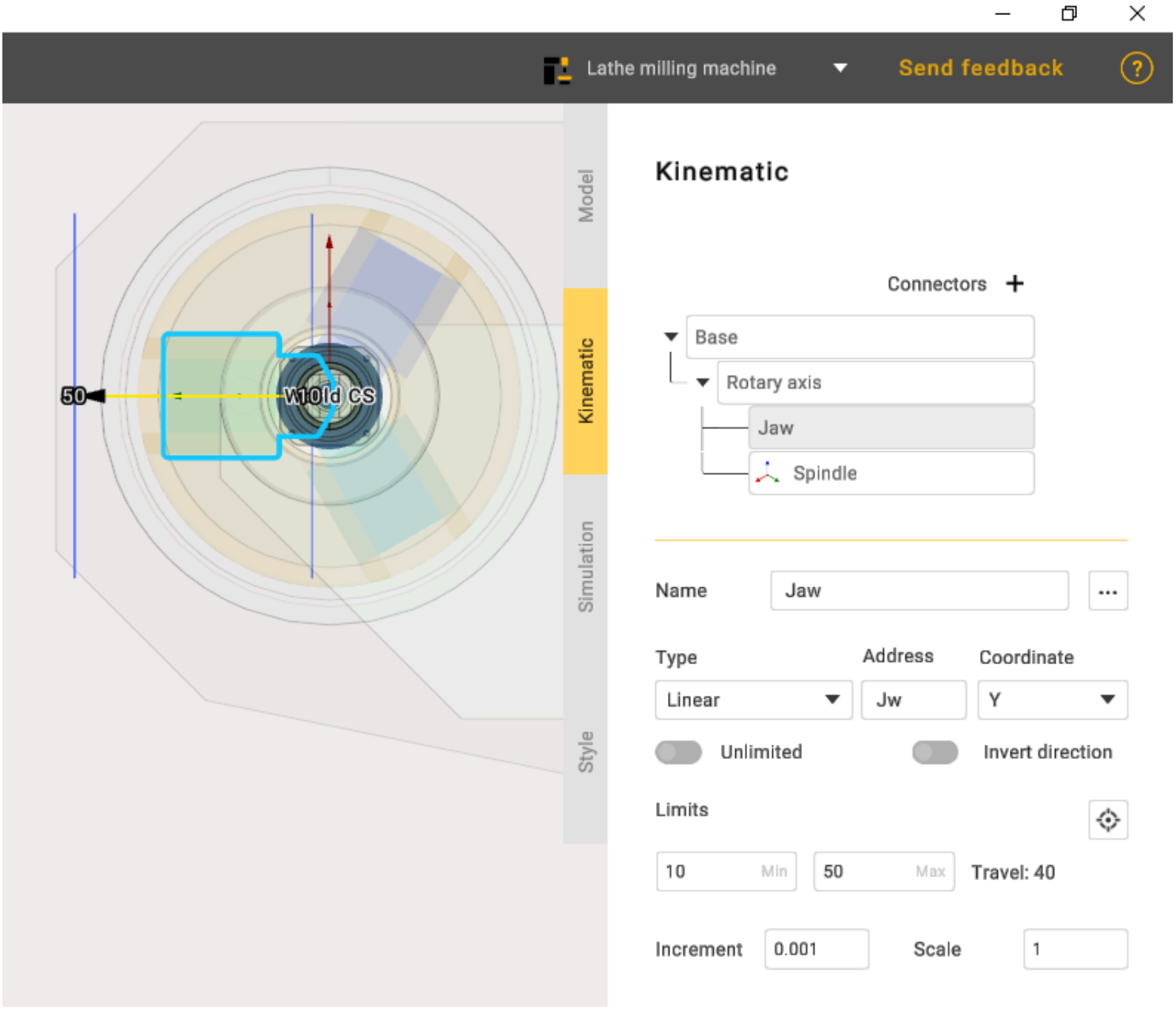
Chuck connector

Once you have built the machine, the next step is to add the Chuck connector.

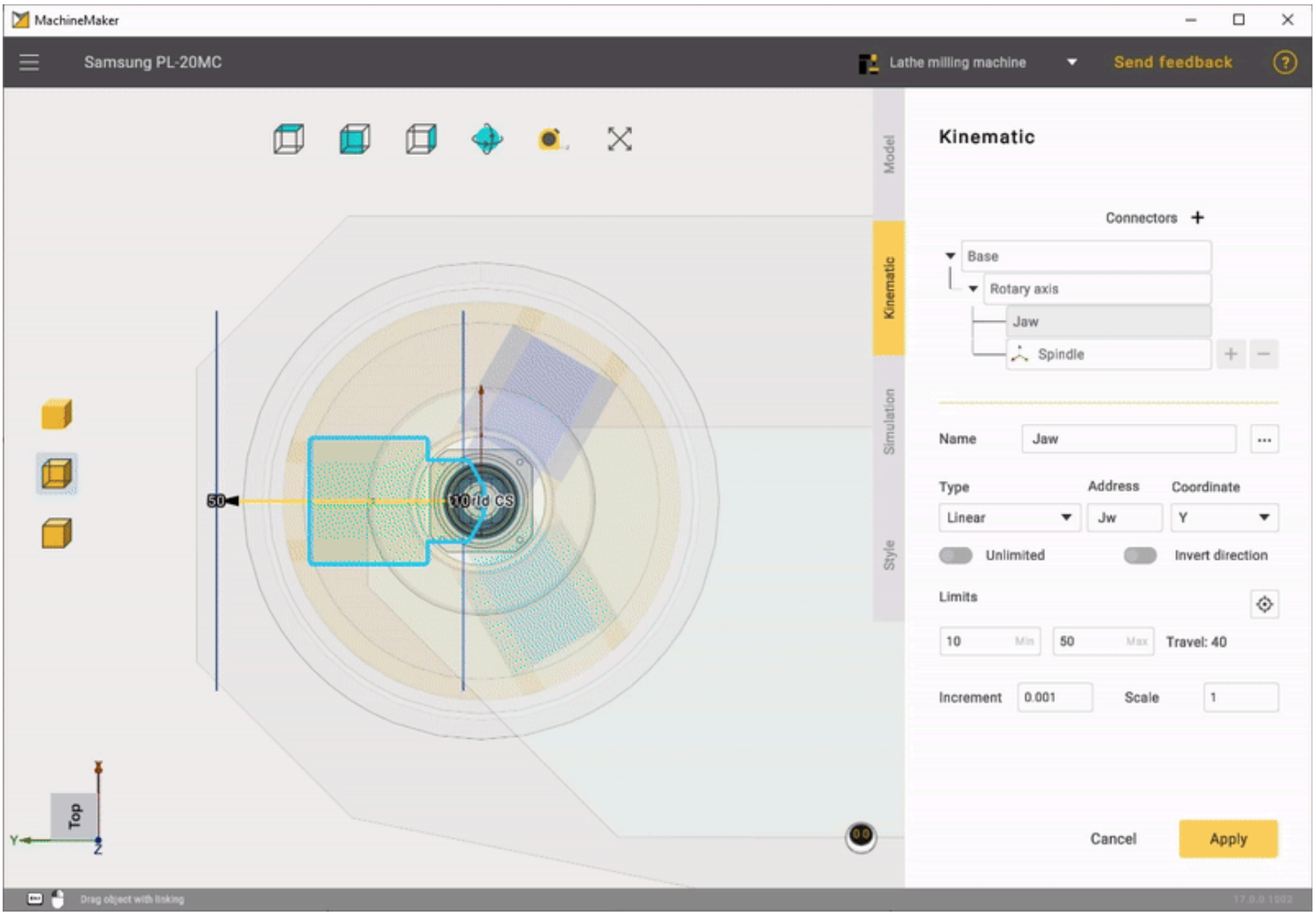
When editing the model, use only rotary axis and jaw joints.



Since the Rotary axis is initially already set correctly, only the cam limits and the coordinates at which they will move should be edited.

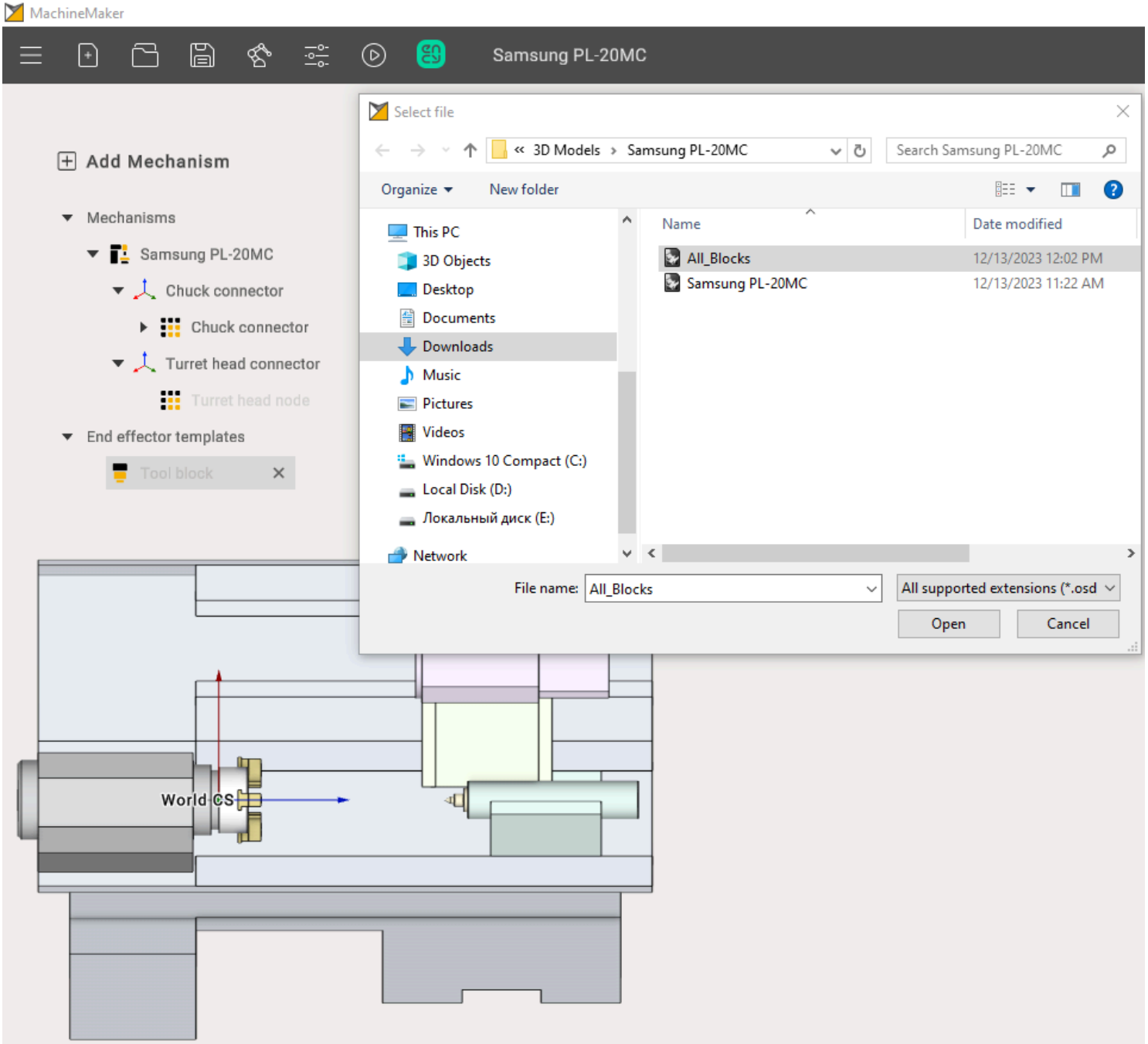


The next step is to set the home position of the jaws, test that the mechanism works correctly in the simulation and apply.

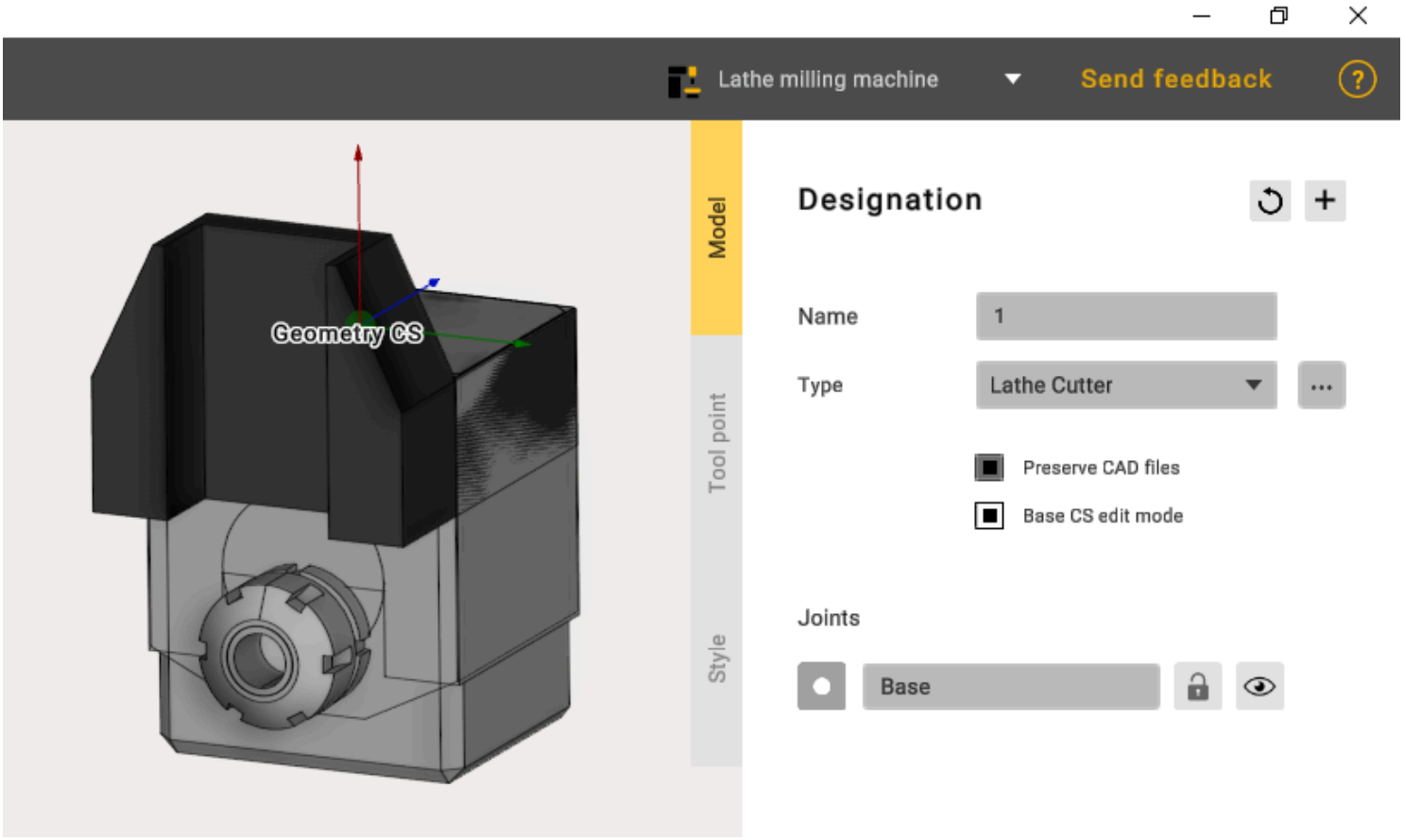

MachineMaker
Samsung PL-20MC
Lathe milling machine
Send feedback
Kinematic
Model
Kinematic
Simulation
Style
Connectors
Base
Rotary axis
Jaw
Spindle
Name
Jaw
Type
Address
Coordinate
Linear
Jw
Y
Unlimited
Invert direction
Limits
10
Min
50
Max
Travel: 40
Increment
0.001
Scale
1
Cancel
Apply
50
World CS
Top
Y
Z
Drag object with linking

Tool block

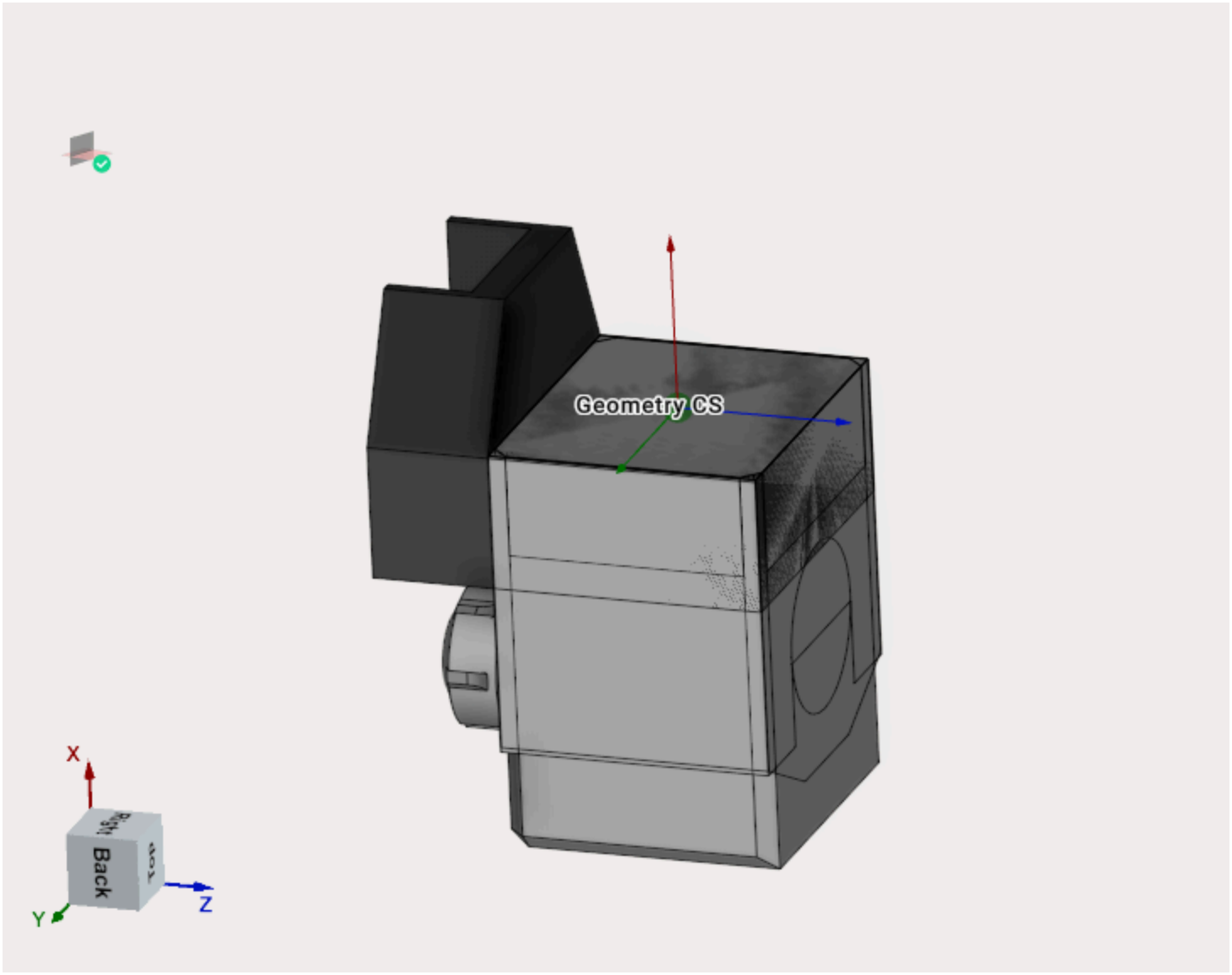
The next step is to add two Tool blocks.



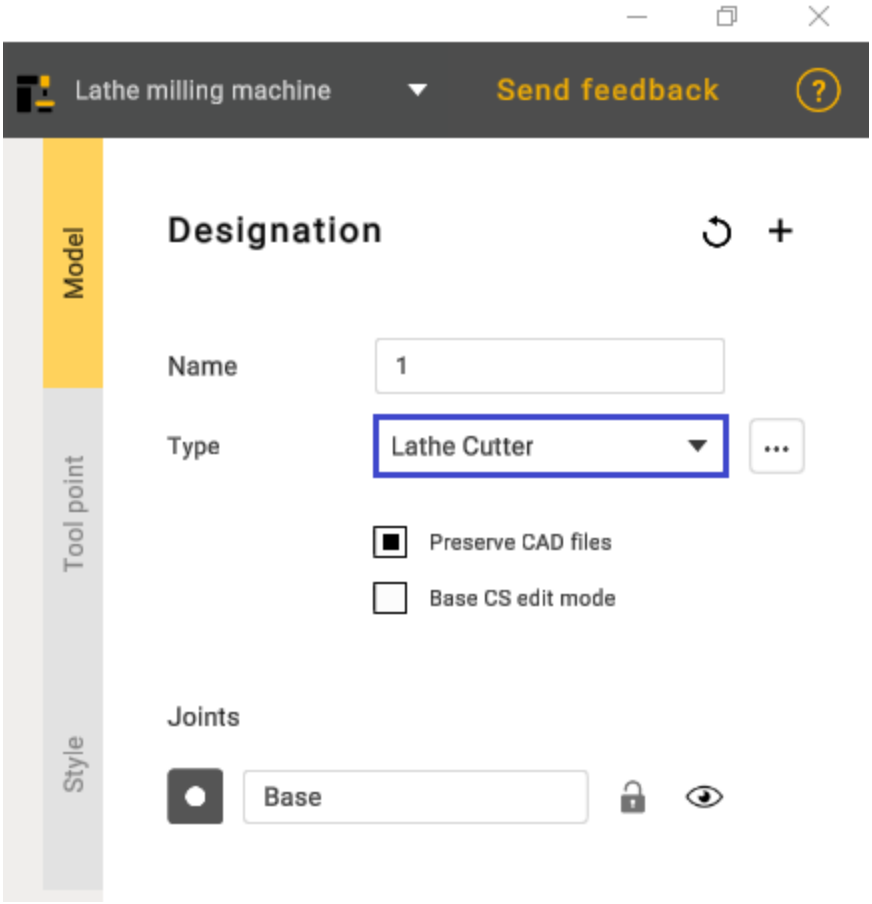
The first to be added is the turning tool. For this purpose it is necessary to paint the upper area of the added model.



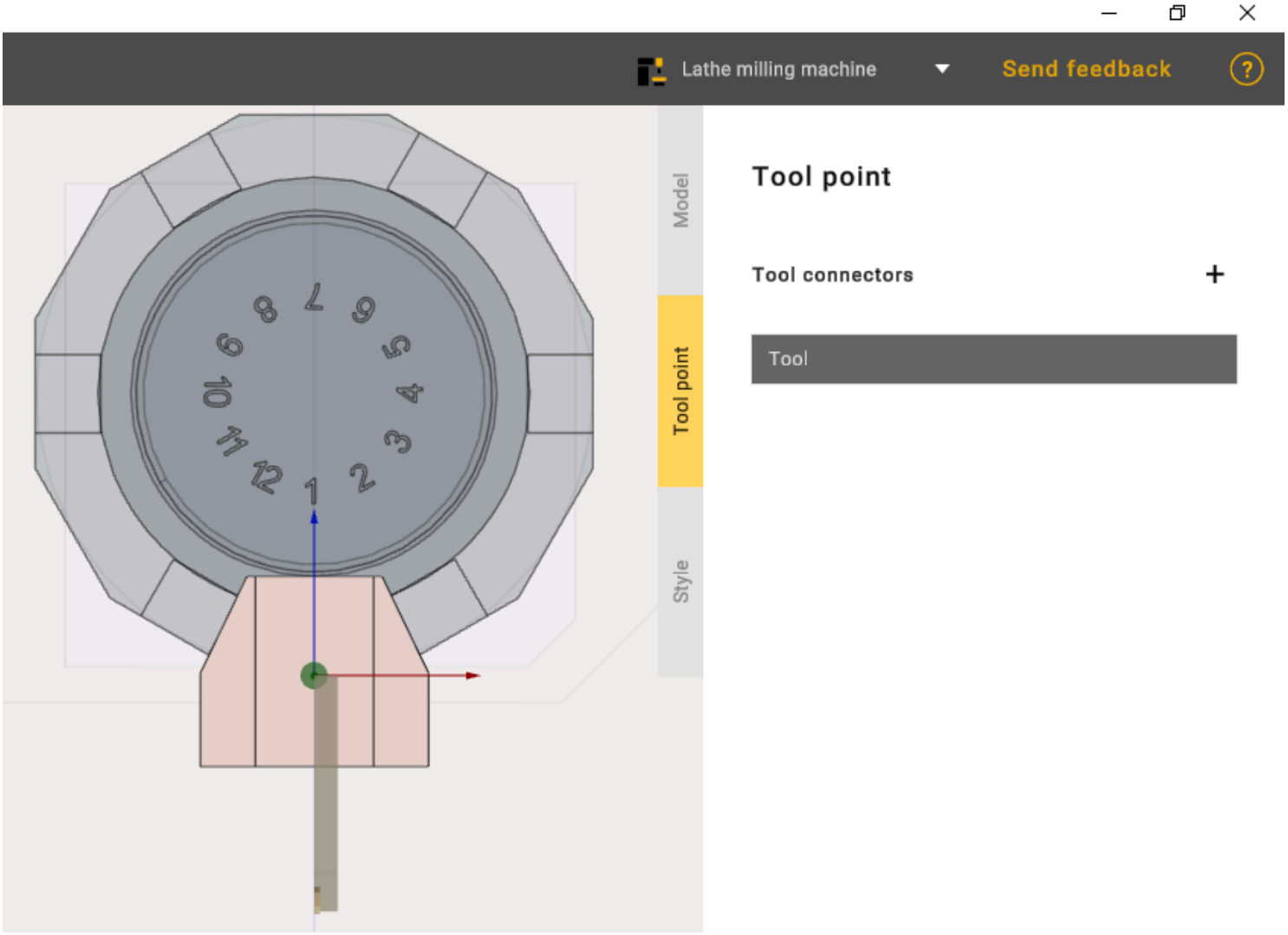
It is important that the Geometry CS match the common coordinate system.



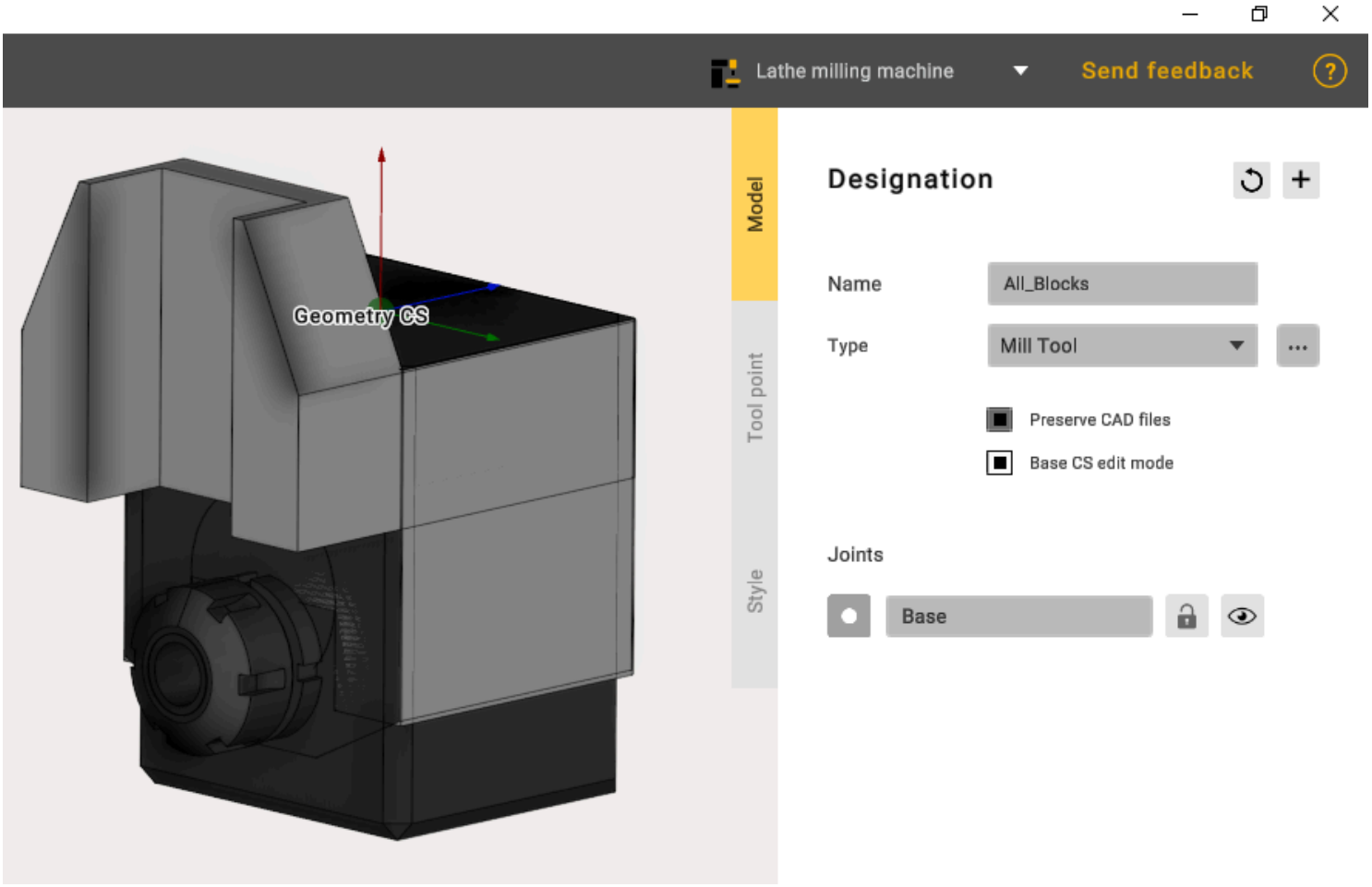
Select the desired tool type



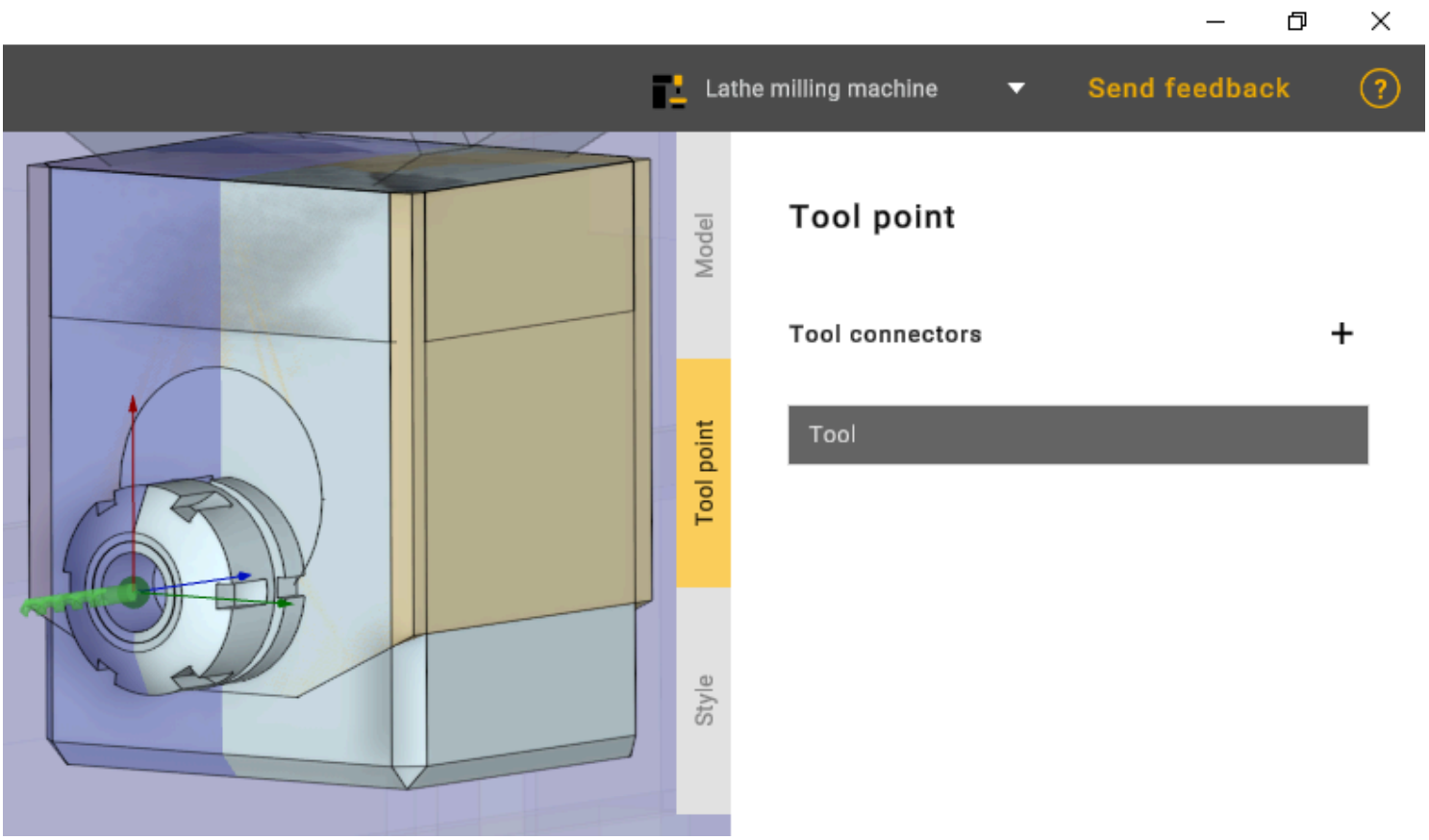
On the Tool point tab, position the tool as shown in the picture:



Add a second Tool block and paint the lower part of the model. Select the type of Mill tool.



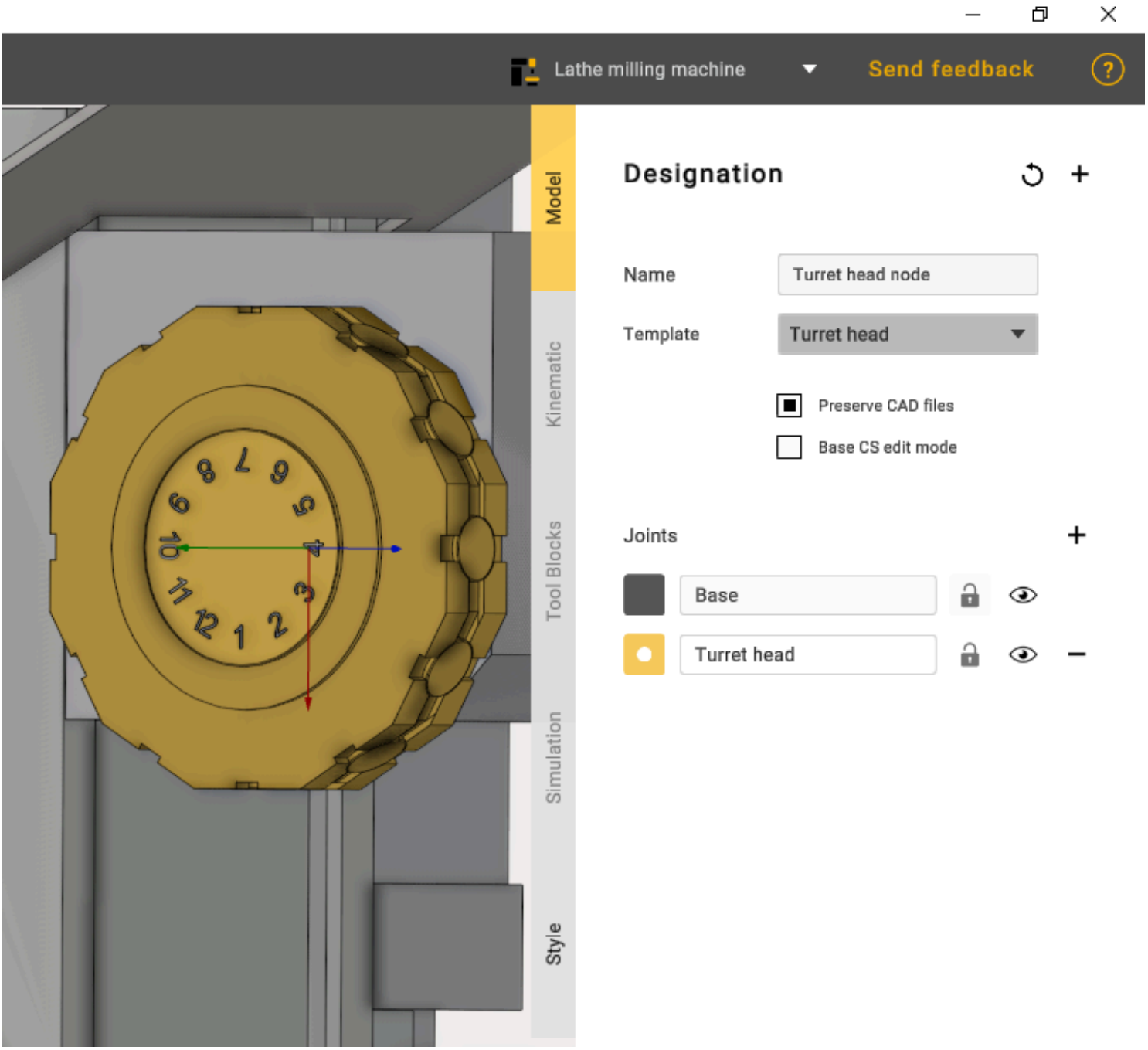
On the Tool point tab, position the tool as shown in the picture:



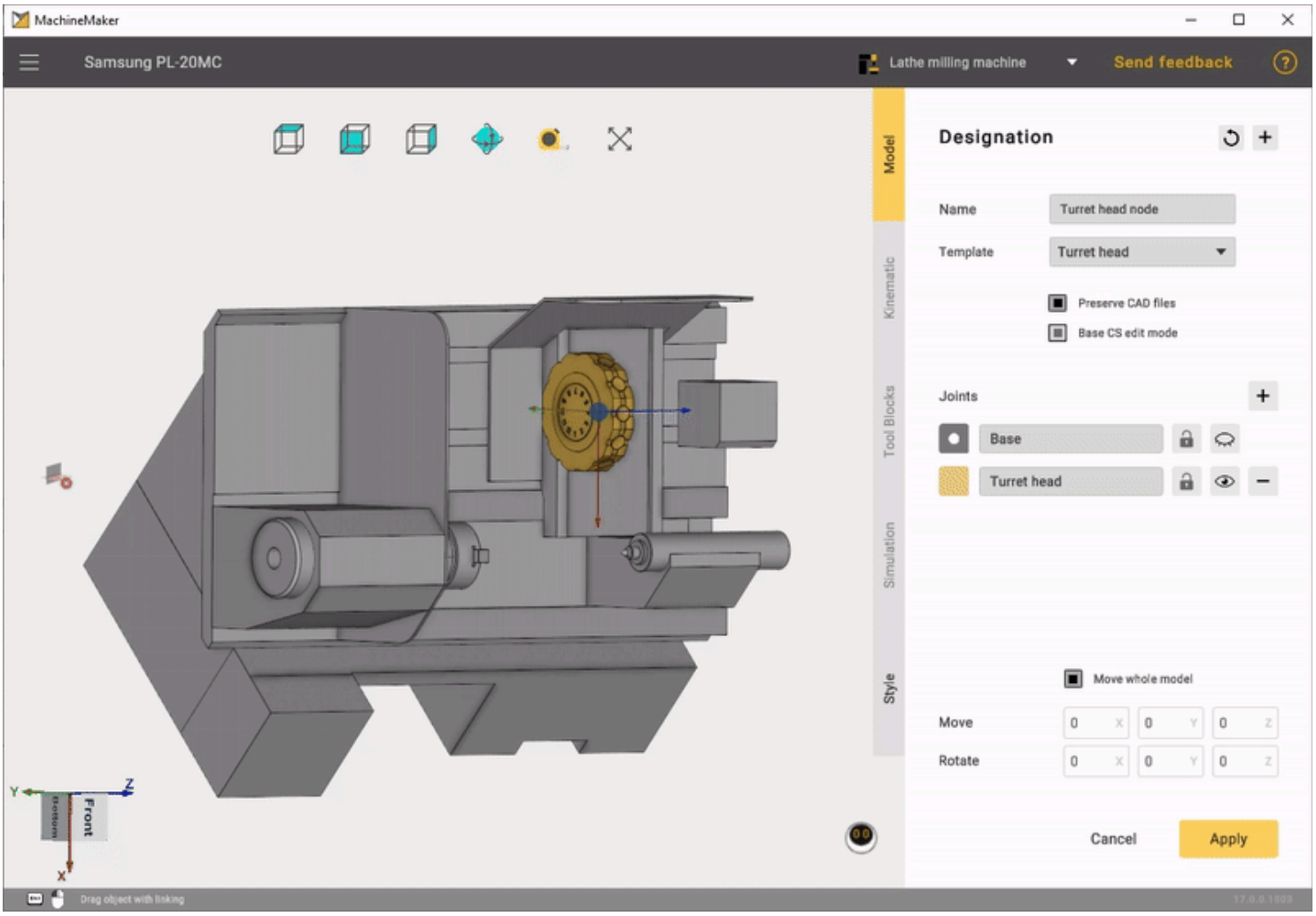
Then click apply and this is the end of adding two tool blocks.

Turret head node

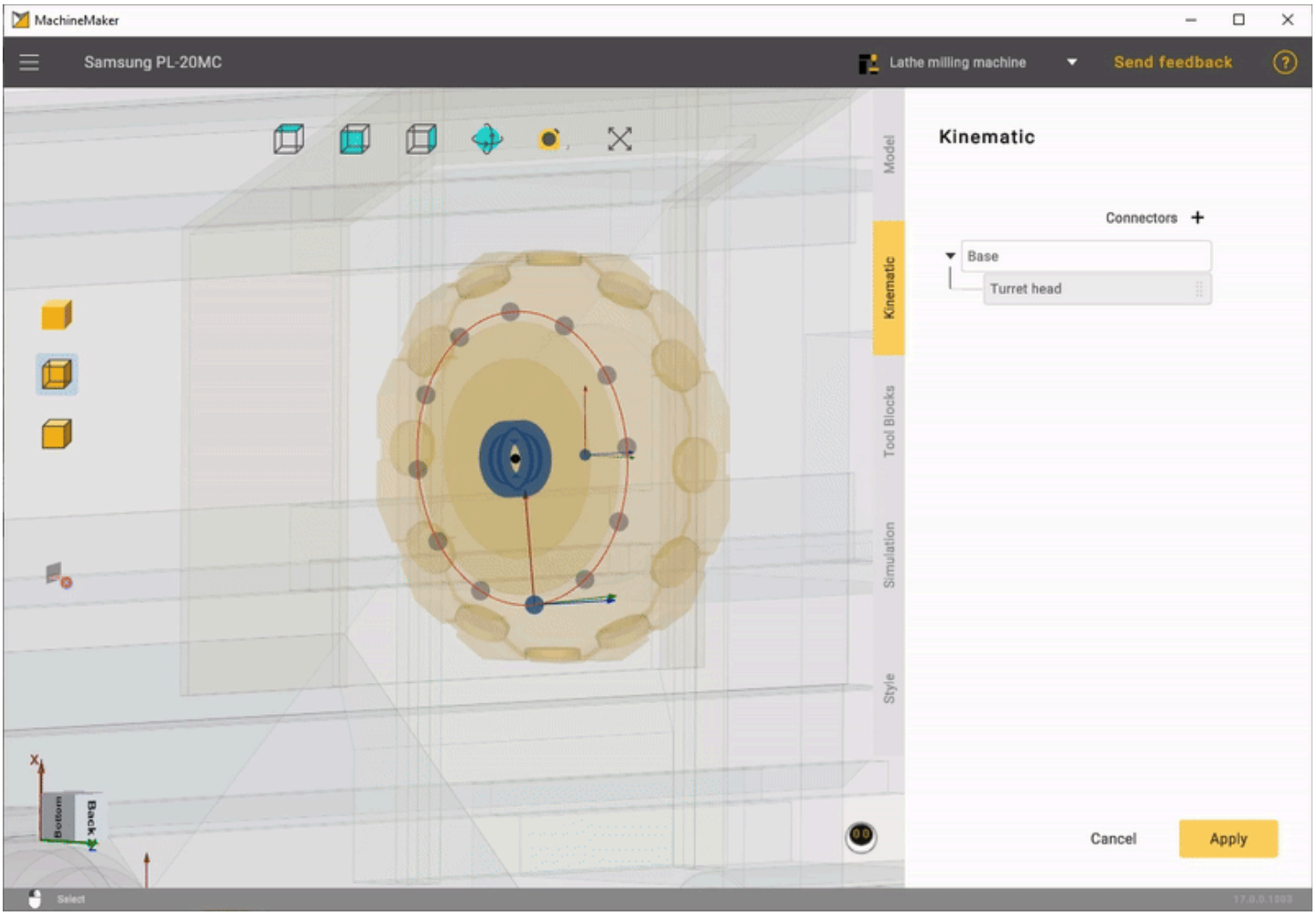
Next, you need to add a Turret head node.



It is important to position the Base CS on the back of the mechanism.

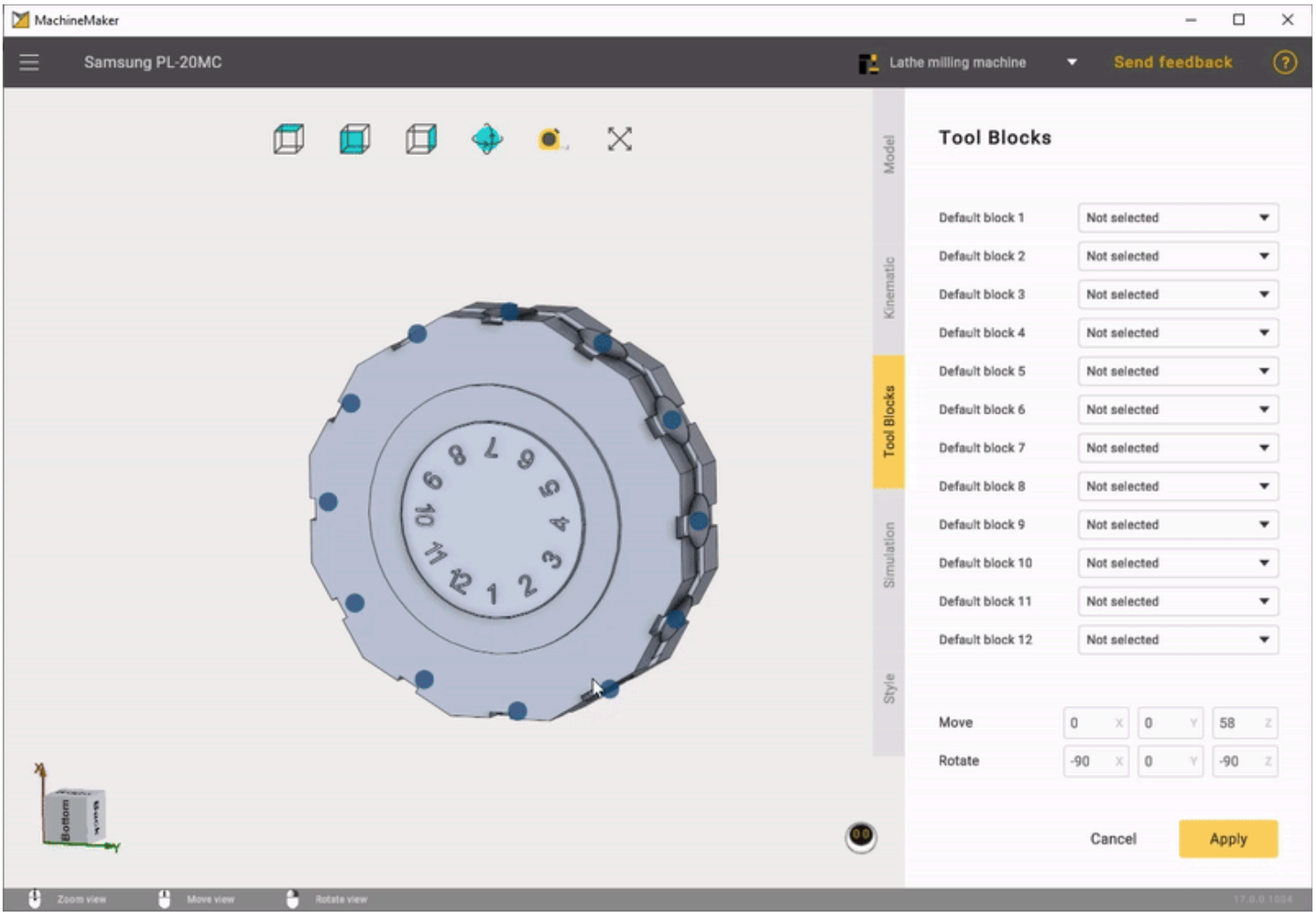


Next, you need to position the connection points of the blocks. To do this, you can use Interactive mode, which helps you to perform this task quickly. By dragging 1 point it automatically sets other points as well.

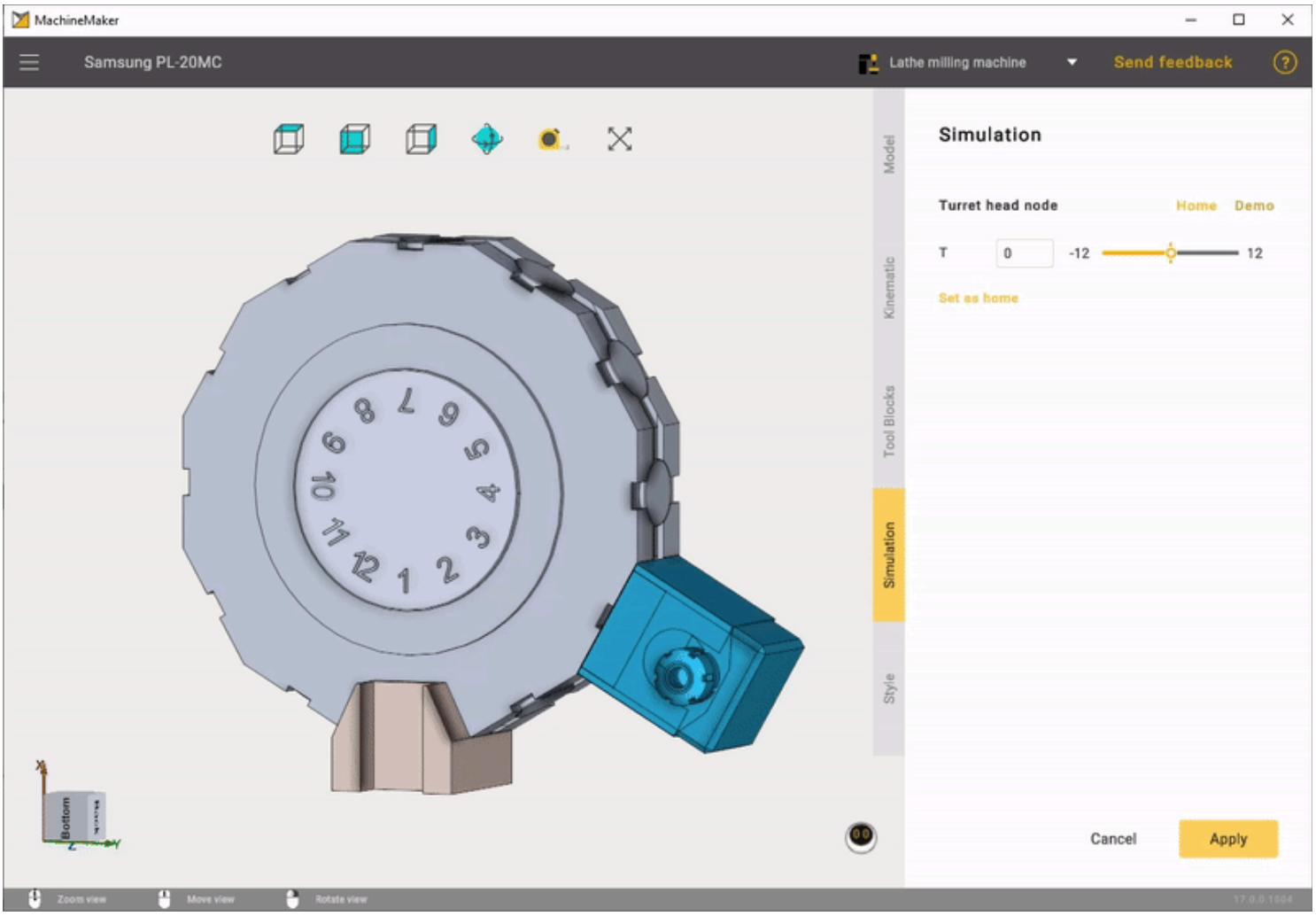


The next step is to place the tool blocks on the connecting points. You can add tools in 2 ways:\

1. Use the right mouse button;\
2. Select the desired tool from the drop-down menu.



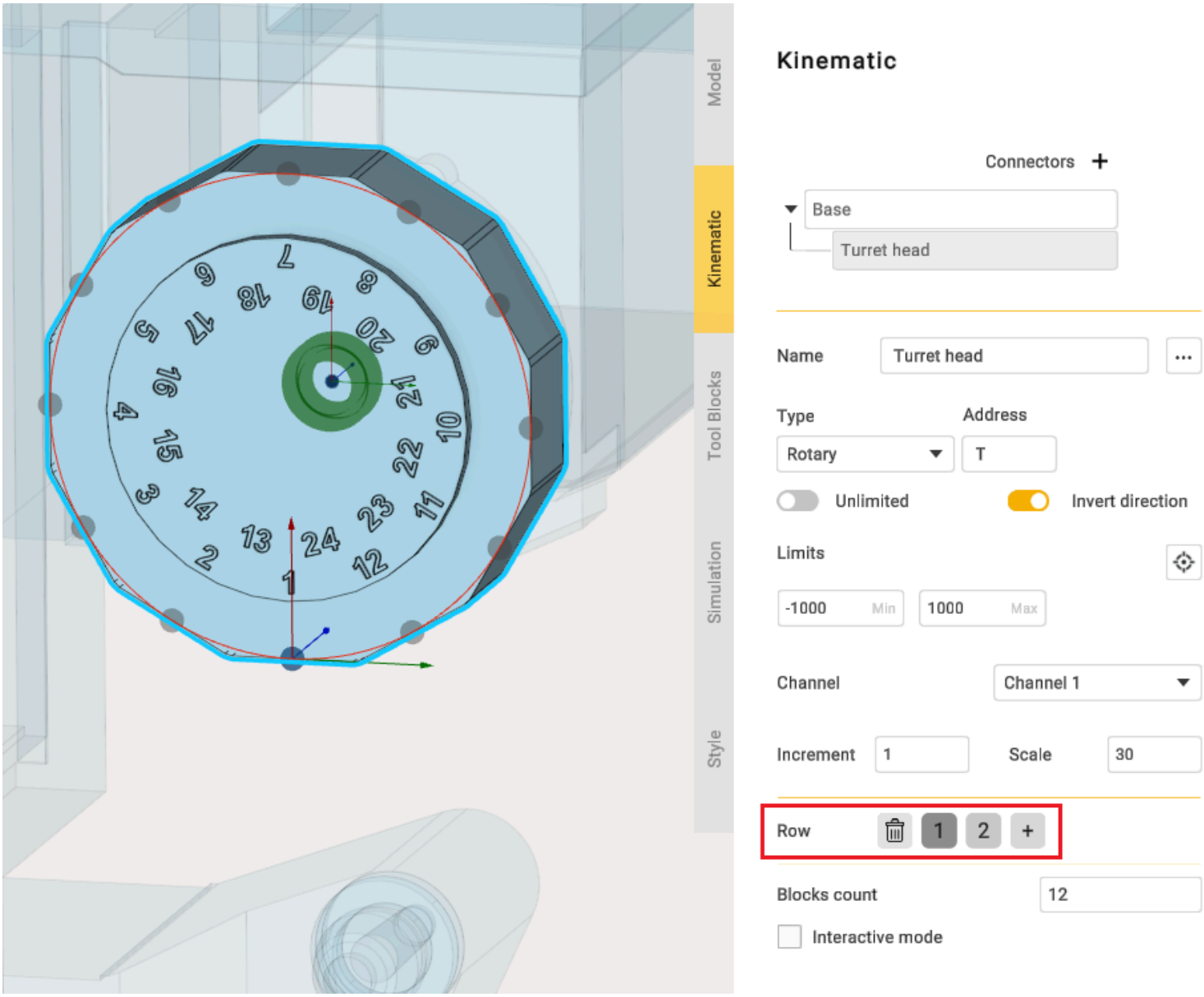
On the Simulation tab make sure that the Turret head moves correctly and click apply.



At this point, the build of the lathe milling machine is complete.

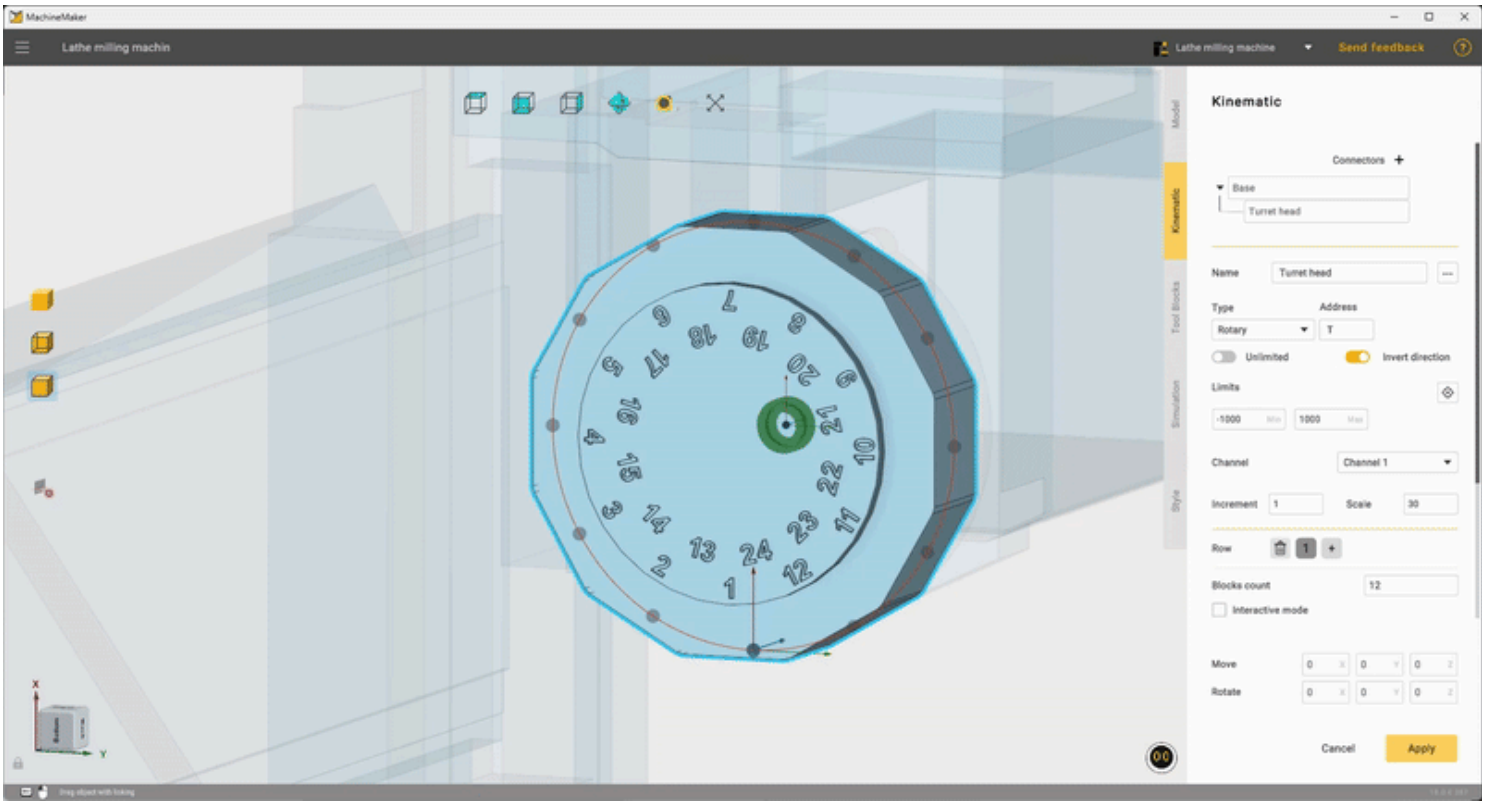
Dual-row tool turret

In this chapter, we will look at setting up the dual-row tool turret.

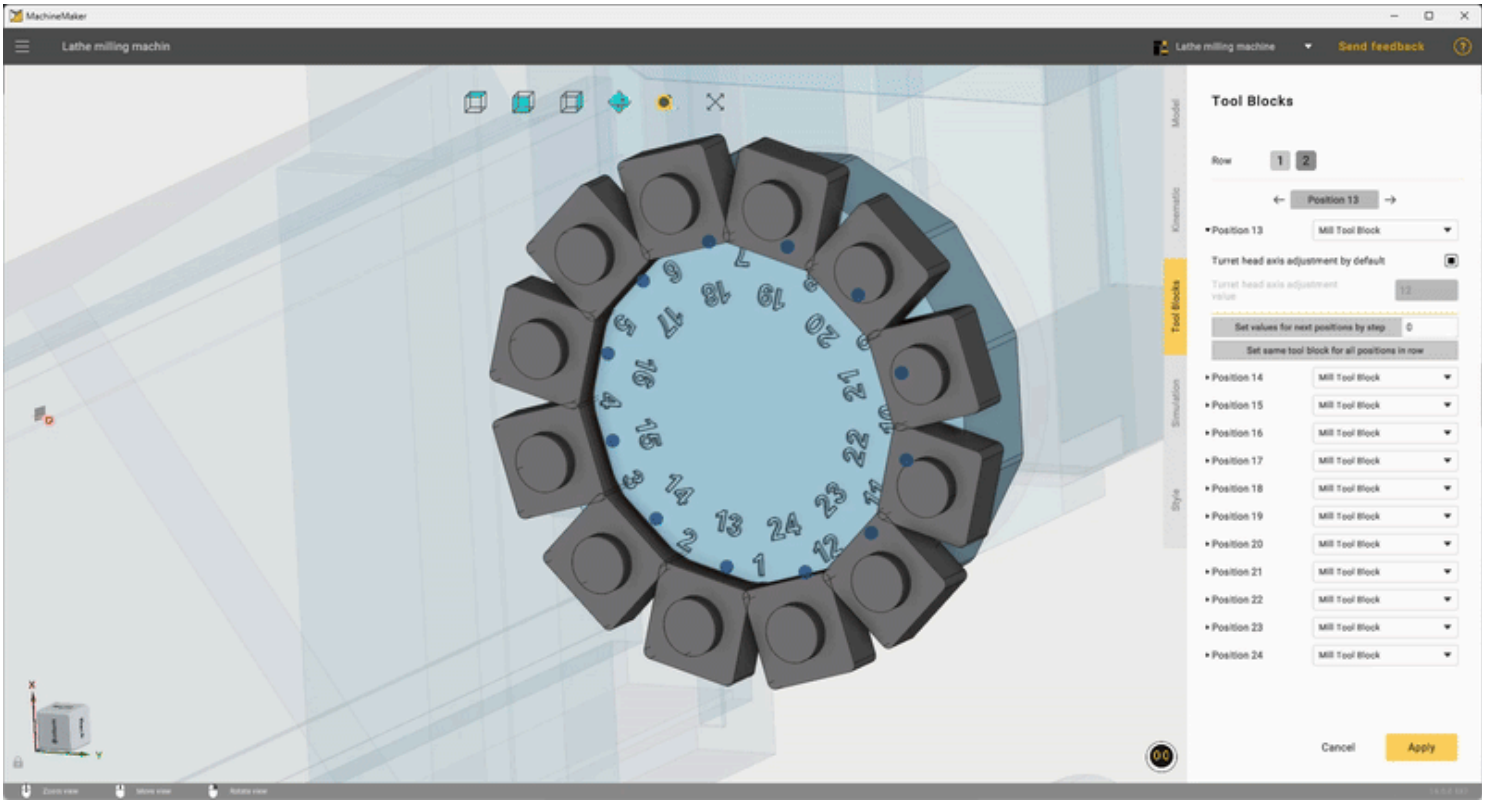


Now you can use button + in the kinematic settings to add additional rows of connection points for tool placement on the turret.

If needed, the added block can also be removed using button 🗑



On the "Tool Blocks" tab, you may see that by default the added tool uses all connection points. If you want to use only some of the points, click the "Set same tool block for all positions in row button". This will clear the turret, so you can place the tools as you need.

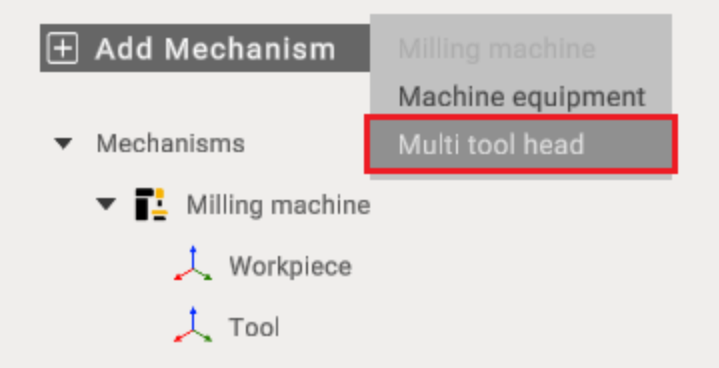


You can see the tutorial video at the link.

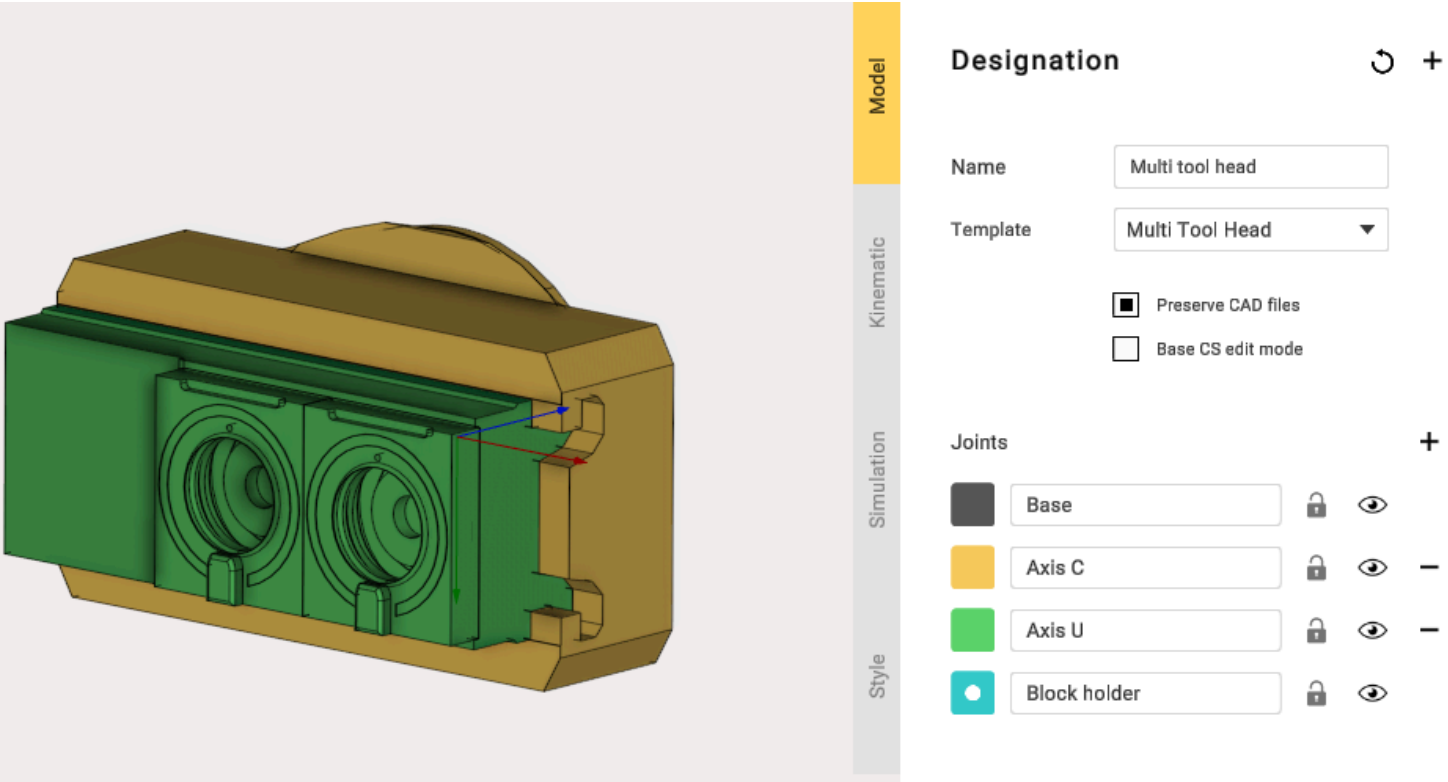
Multi Tool Head

The Multi Tool Head is made to hold any number of tool blocks, which can be easily configured and adjusted.
You can build fully custom Multi Tool Head.

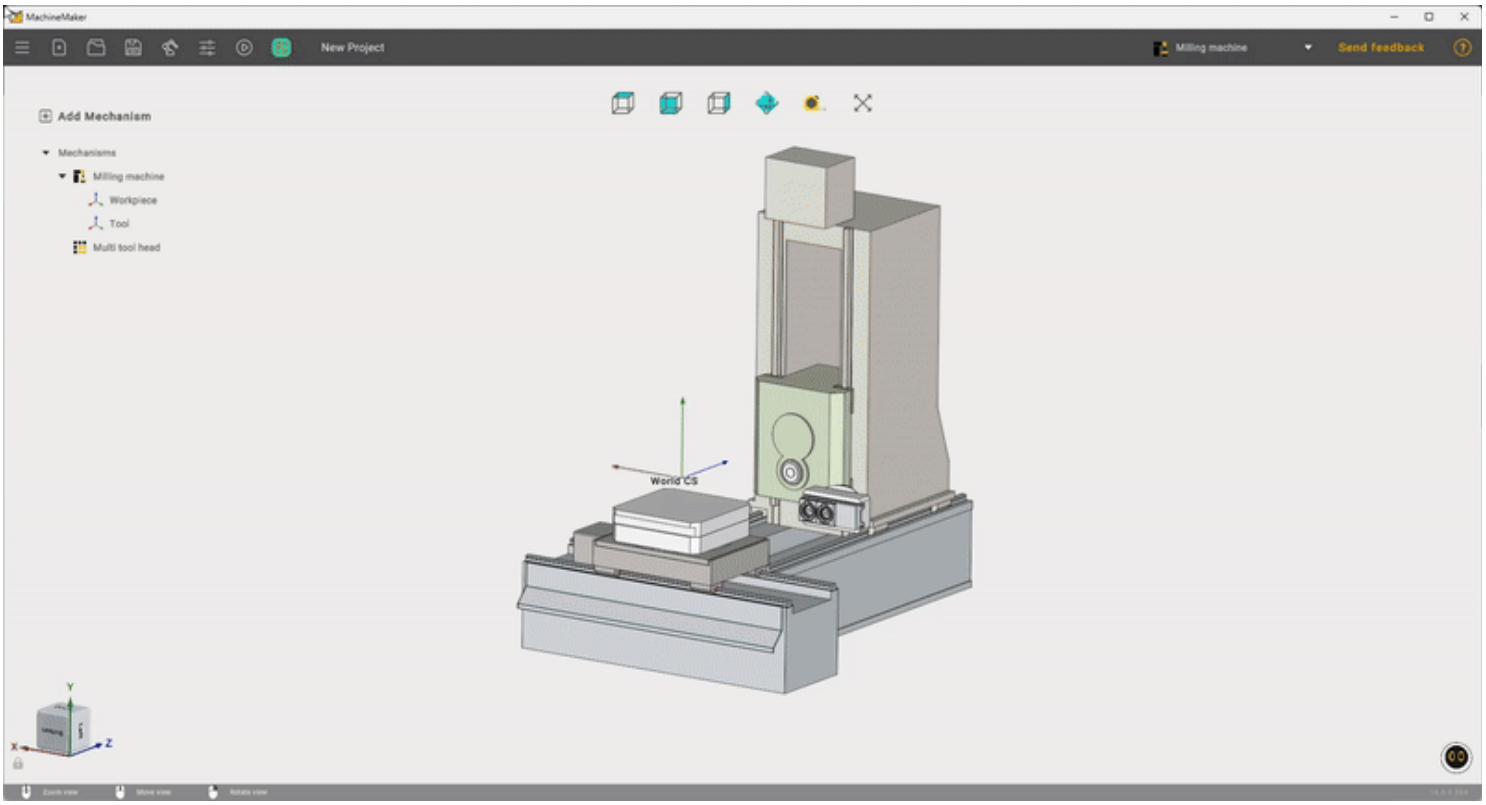
To add it you need to create a project with a milling machine.



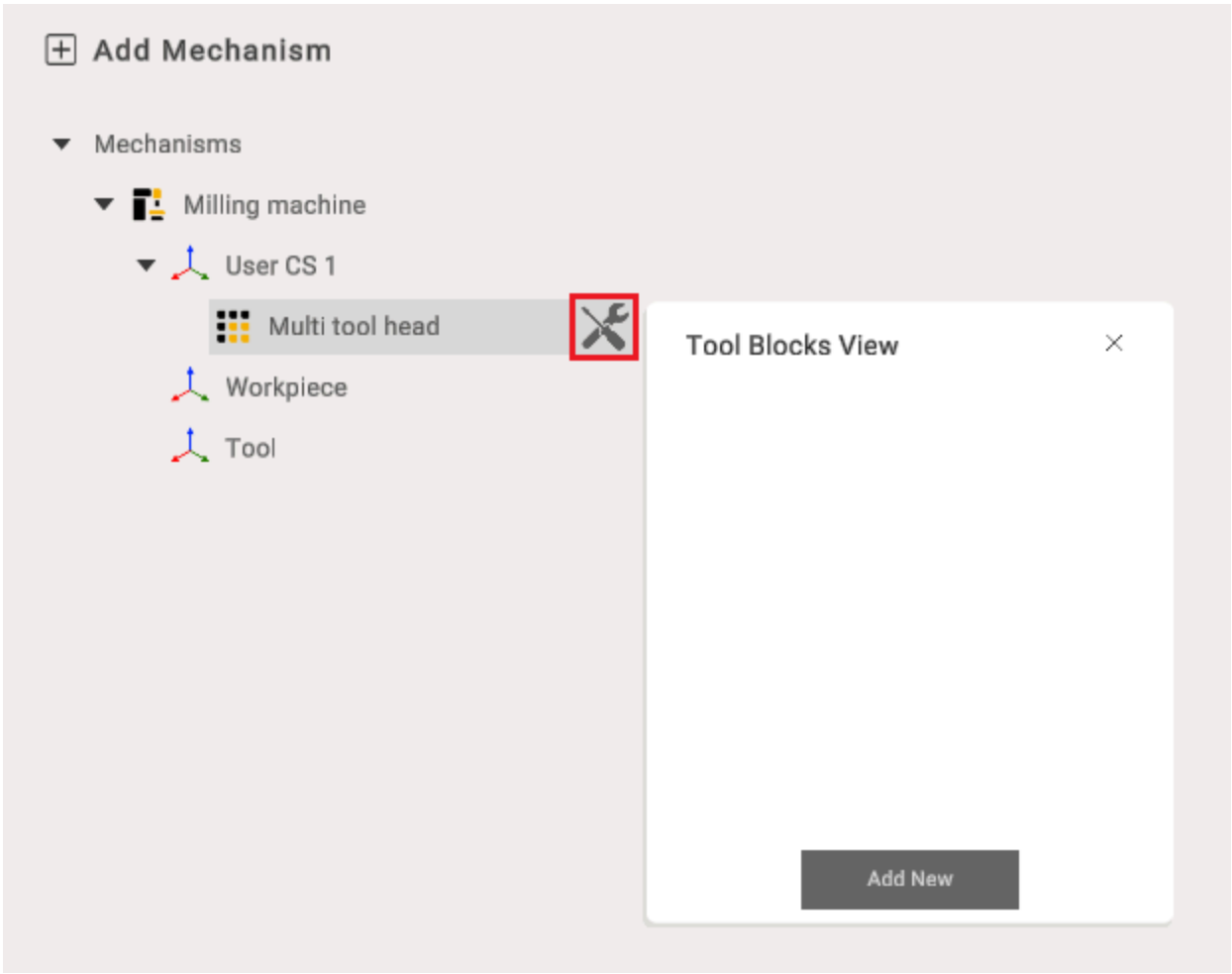
Attach a mounting point to the rear of the Multi Tool Head and identify its moving components.



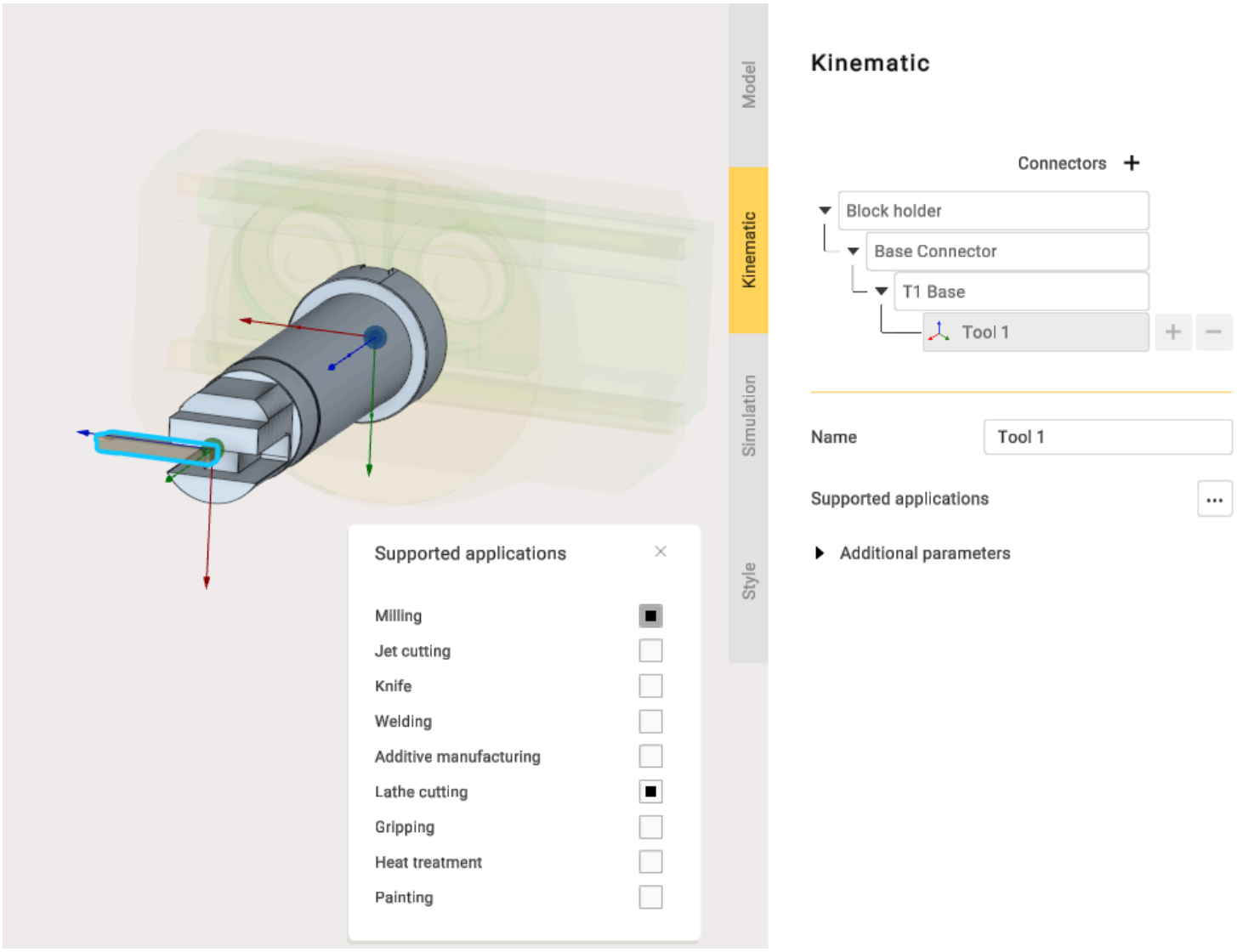
Next, create a mounting point on the milling machine and slightly customize Workpiece settings.



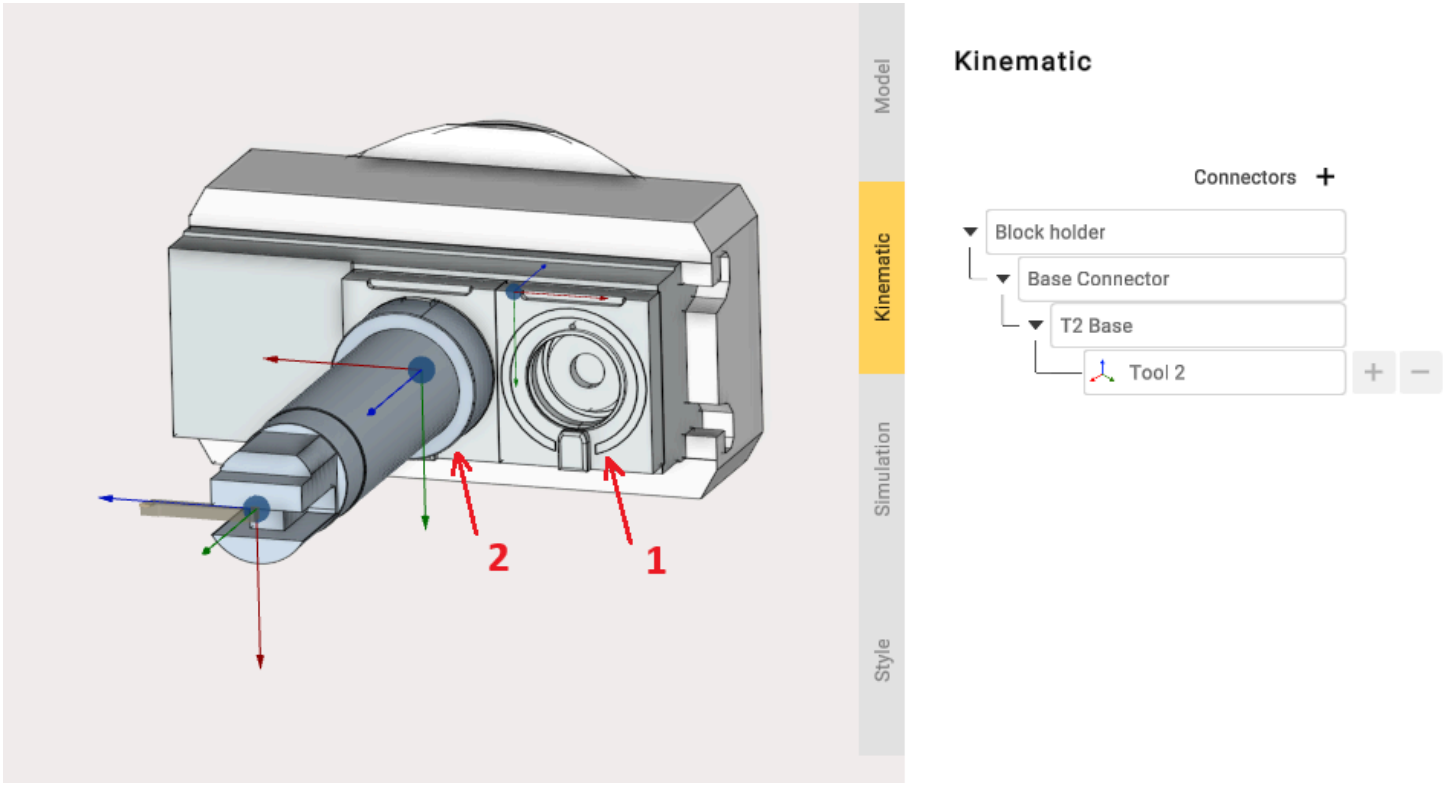
After mounting the Multi-Tool Head on the milling machine, open the Tool Blocks View window and use it to add the new tool for installation



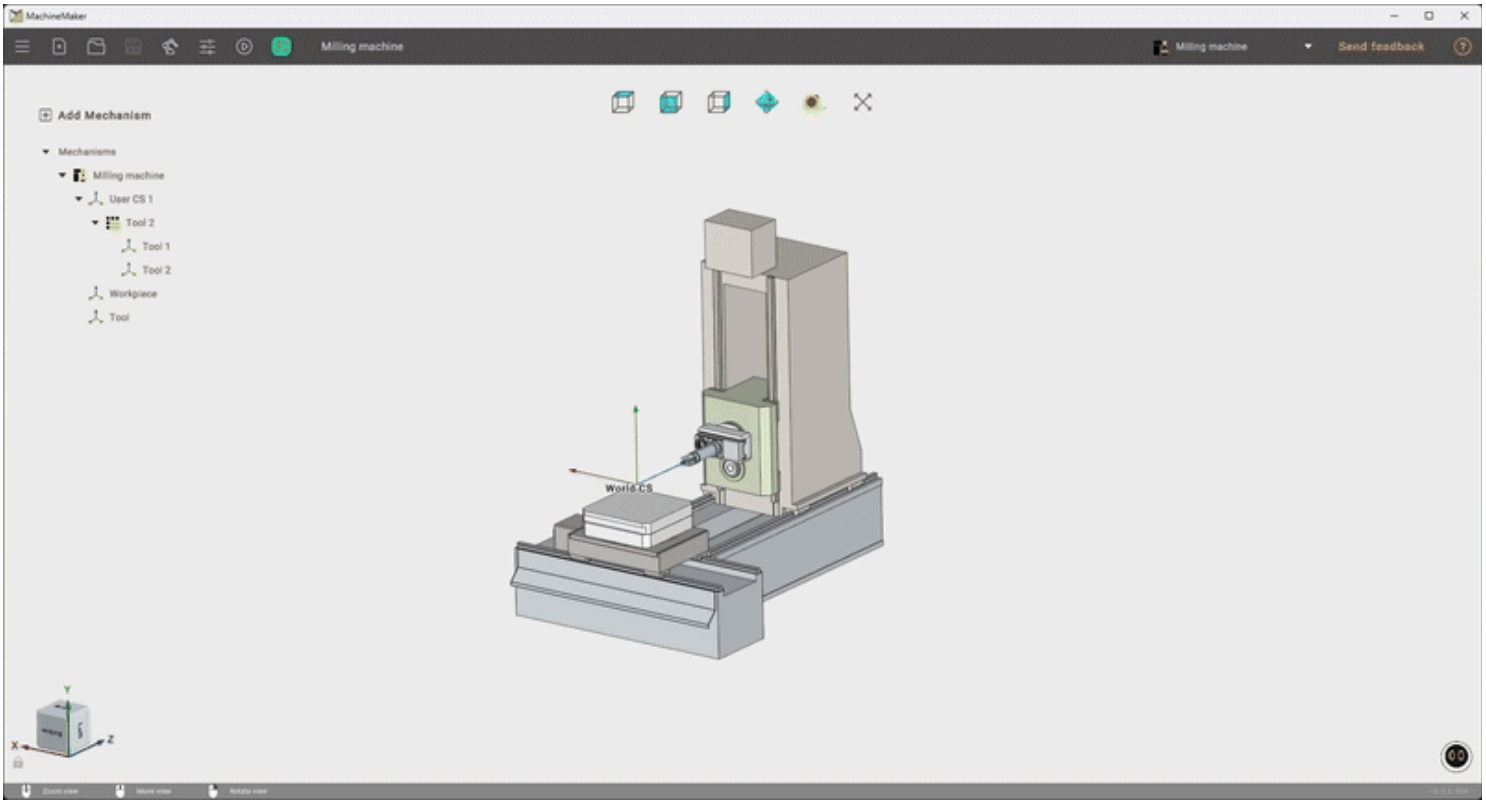
When adding a tool, you may select any type listed under Supported Applications. In this case, Lathe Cutting will be used.



When adding multiple tools, ensure proper placement of each tool. To reposition a tool, adjust the location of its Base Connector.



After exporting the project, you can test the machine equipped with the Multi Tool Head.



You can see how to build a machine with this Multi Tool Head at the link.

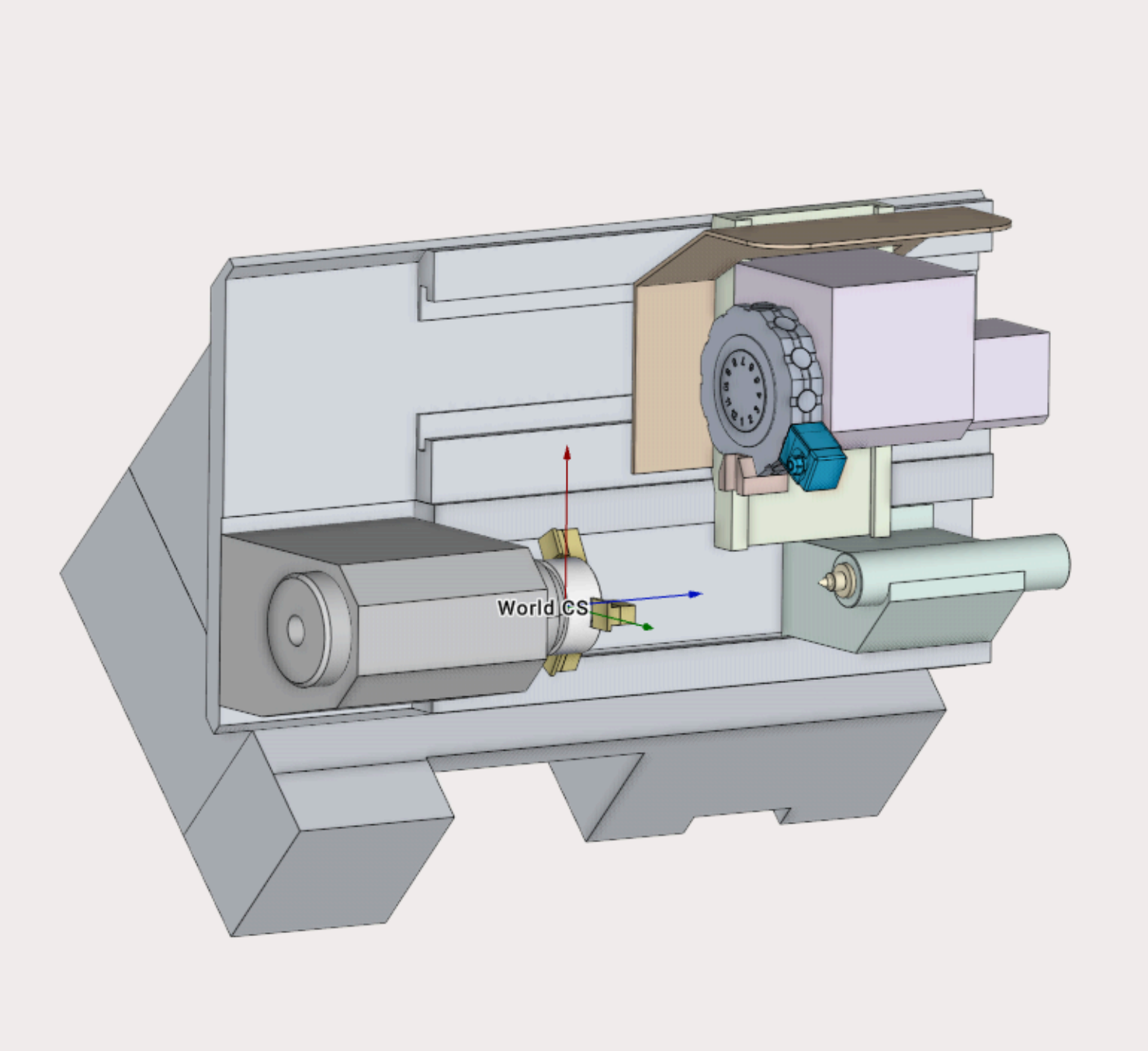
Examples: Lathe milling machine

In this chapter, you will find instructional videos on how to add and configure:

- Lathe milling machine

Lathe milling machine

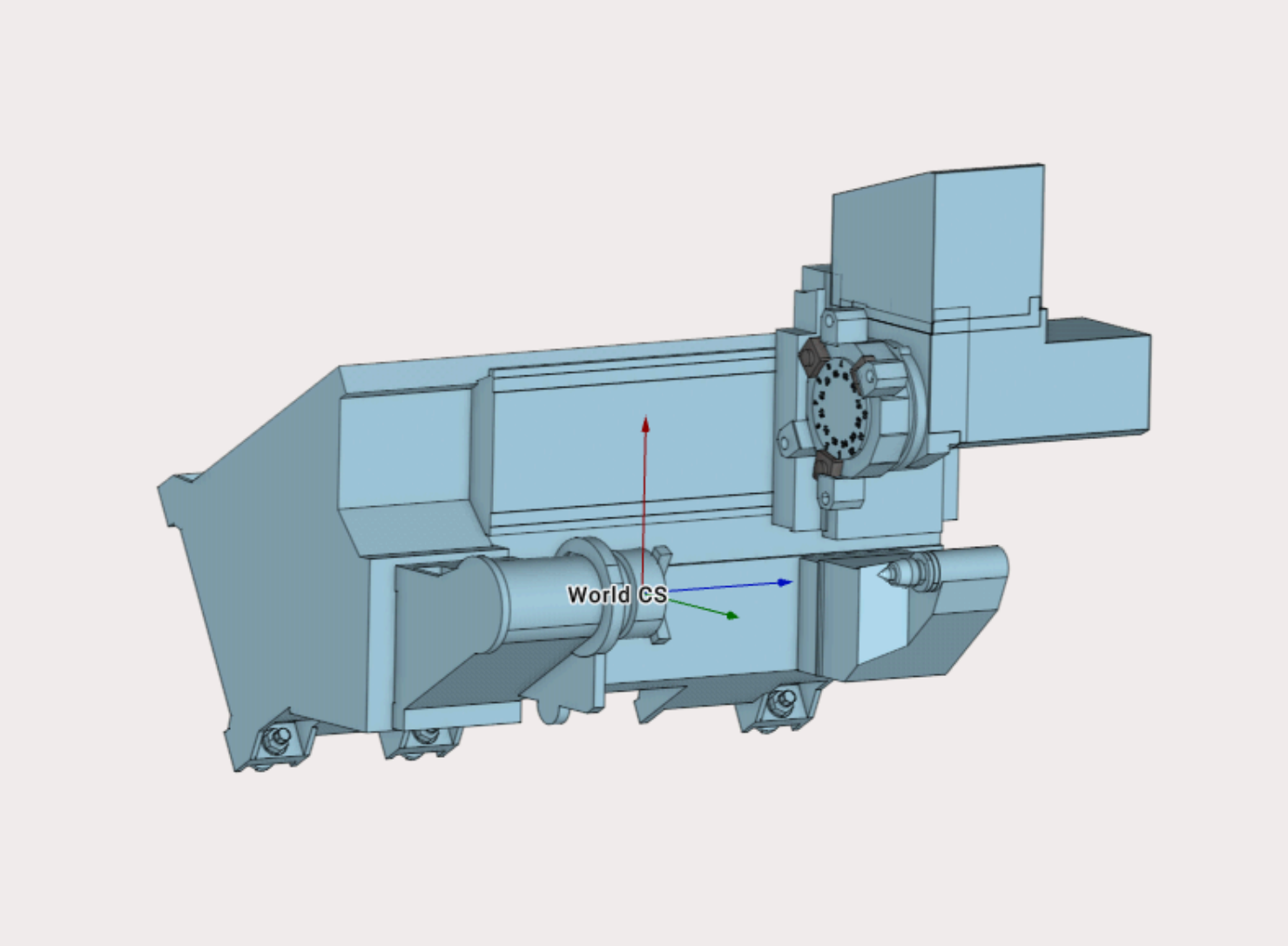
Download Project here: Samsung PL-20MC.zip



You can see the tutorial video at the link

Lathe milling machine with a dual-row turret

Download Project here: Lathe milling machine.zip



You can see the tutorial video at the link.

Swiss type machine

This chapter explains how to build a Swiss-type machine in MachineMaker using the Hanwha XD10 as an example. You will import the machine model, assign geometry to its nodes, configure the kinematics and tool positions, add tools with holders, and check the movement of the machine components in simulation.



Hanwha XD10, the machine used in this example. Image from the XD_10.pdf documentation.

You will need the `Hanwha_XD10.SLDASM` assembly and the `live_mill_tool.SLDPRT` and `mill_tool.SLDPRT` holder models. The values below apply to this training configuration in MachineMaker. For another machine, use its kinematic layout and technical documentation to determine the settings.

Example files. Download Hanwha XD10 3D models (ZIP, 1.13 MB) — the `Hanwha_XD10.SLDASM` assembly, machine parts and holder models used in this tutorial.

Download the Hanwha XD10 machine configuration (ZIP, 0.56 MB) — the `MachineSchema` folder containing the machine configuration, CAD files and node geometry.

Before importing the 3D models, extract the entire archive into one folder and keep the file names unchanged. Open `Hanwha_XD10.SLDASM` from that folder so that the assembly can find its referenced parts.

1. Creating a project and importing the model

1. Open MachineMaker and create a new project.
2. Select Swiss type machine in the Application Mode Selector on the top toolbar.
3. Click Add Mechanism and select the `Hanwha_XD10.SLDASM` assembly. Wait for the import to finish.
4. On the Model tab, enter the name `Hanwha_XD10` and select the Type A (X2 along Y) template.
5. Enable Preserve CAD files to keep the source geometry available for subsequent editing.
6. Check the assembly orientation relative to the coordinate system. For the source assembly in the video example, with Move whole model enabled, the translation values are X = 0, Y = 0, Z = 0, and the rotation values are X = 0°, Y = −90°, Z = 90°. If the model is already oriented correctly, no further rotation is required.

2. Assigning parts on the Model tab

In the Designation panel, select a node and then select the corresponding parts in the viewport. Assign the parts the color of that node. Parts with the same color belong to the same group.

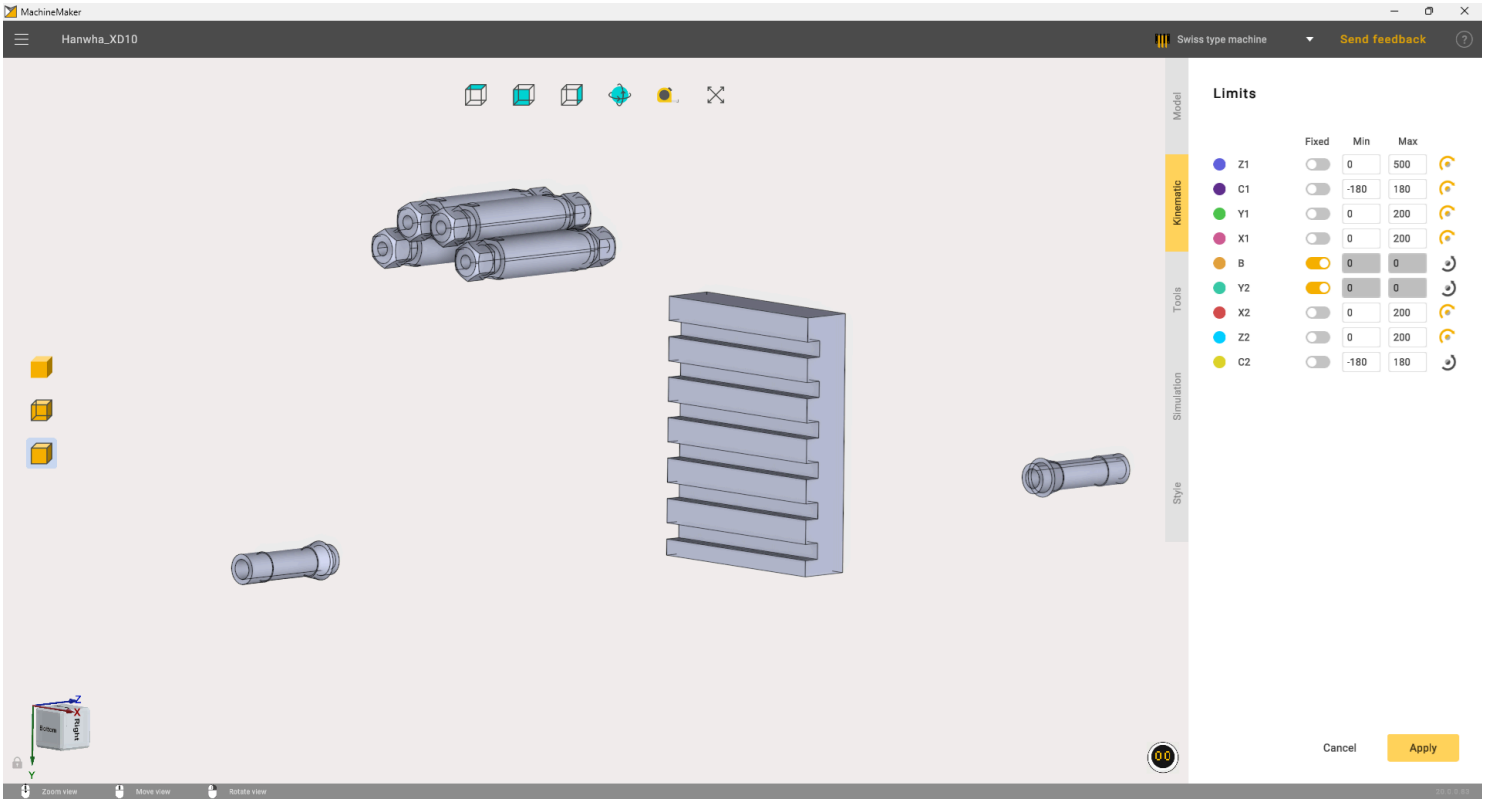
Assign the tool plate to X1 and the four upper cylindrical tool housings to B. Assign the spindle components to the appropriate nodes of the selected template, using its diagram as a guide. The screenshots use the following colors for X1 and B:

Node	Geometry	Color
X1	Tool plate with six slots	Pink
B	Four cylindrical housings of the upper tool group	Orange

Check that every part belongs to the correct group. Do not include holders that will be added separately in the fixed machine geometry. Once the parts are assigned, open the Kinematic tab.

3. Setting axis limits on the Kinematic tab

In the Limits panel, enter the values shown in the screenshot. The Min and Max fields define the travel limits of linear axes and the rotation limits of rotary axes in degrees. Enable Fixed for B and Y2 to lock their movement.

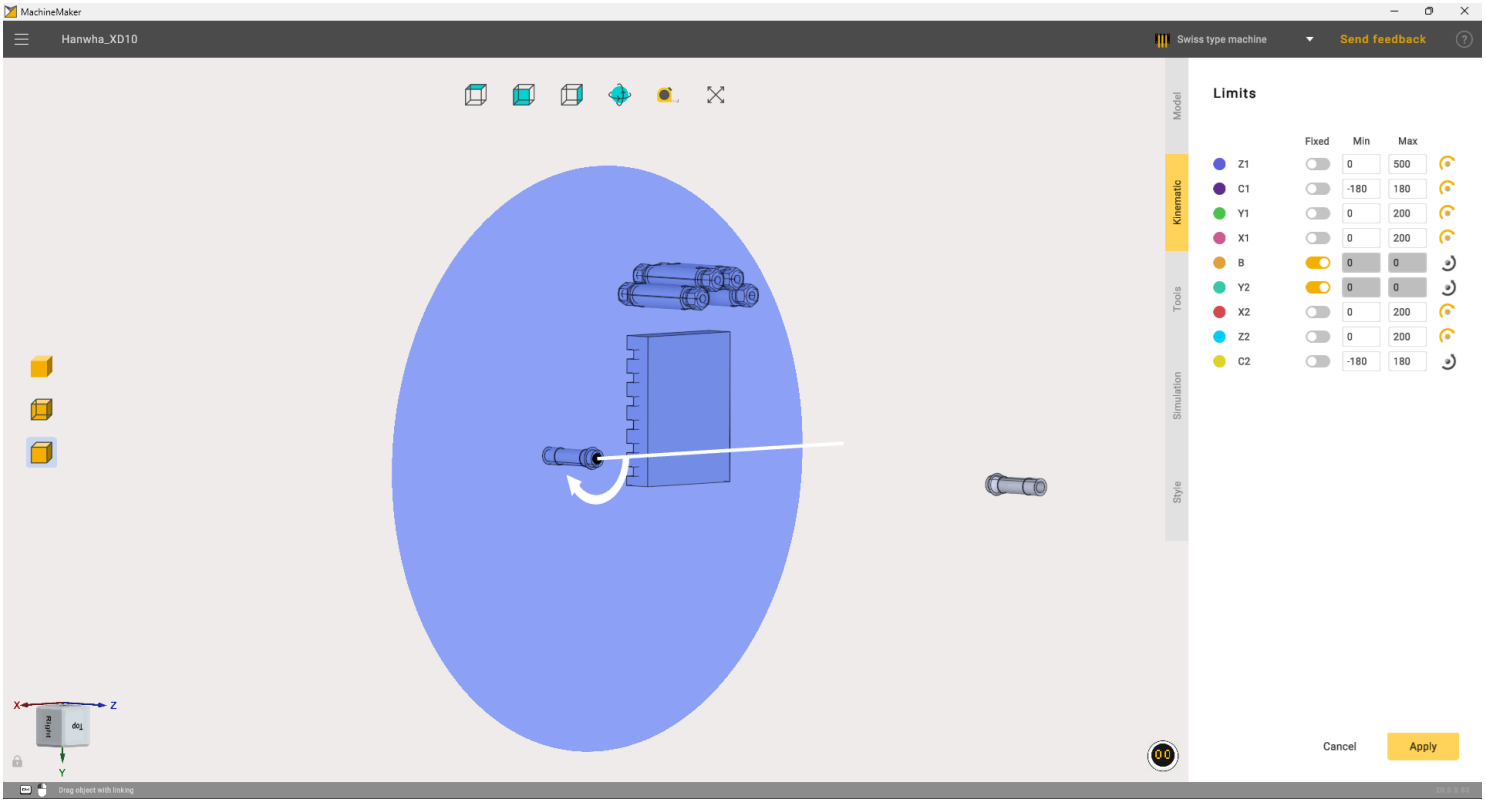


Axis limits for the training configuration. Axes B and Y2 are fixed.

Select each axis in turn and check its movement direction in the viewport. Planes indicate the travel limits of linear axes; a circular indicator shows the rotation of rotary axes.

4. Positioning the C2 axis

Select C2 and align its rotation axis with the centerline of the cylindrical counter-spindle component, as shown below. The center of the indicator must coincide with the center of the hole in the end face. Check the rotation direction using the arrow; if necessary, reverse it with the direction icon to the right of the C2 row.



Positioning C2: the rotation center coincides with the center of the hole, and the axis runs along the counter spindle.

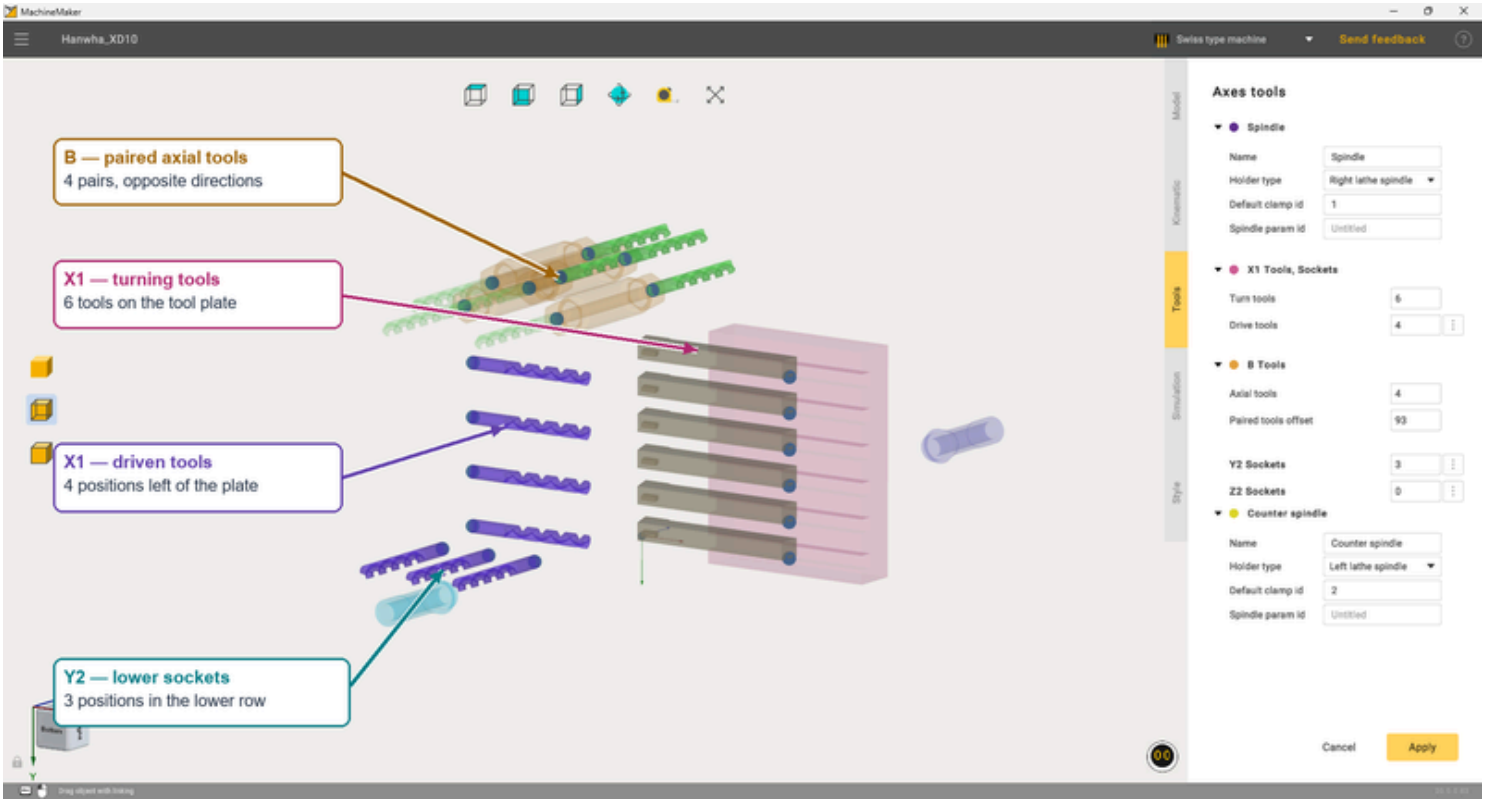
This image illustrates the position of C2. Use the screenshot in the previous step for the numerical limits of all axes.

5. Positioning tools and sockets

Open the Tools tab. In the Axes tools panel, expand the relevant groups and set the number of positions:

Group	Setting	Value
X1 tools and sockets	Turn tools	6
X1 tools and sockets	Drive tools	4
B tools	Axial tools	4
B tools	Paired tools offset	93
Y2 sockets	Count	3
Z2 sockets	Count	0

Position the tools and sockets as shown in the image. Select each position in the viewport and adjust its location and orientation using the Move and Rotate fields and geometry snapping.



Tool group layout: X1 turning tools, X1 driven-tool positions, B paired axial tools, and the lower Y2 sockets.

X1 turning tools. Place six turning tools in the slots of the tool plate on the right. The tool shanks must be parallel, with one in each slot.

X1 driven-tool positions. The four purple tool symbols form a vertical row just to the left of the turning tools. Holders will be attached to these positions later.

B paired tools. The upper group contains four axial positions. Align them with the holes in the cylindrical housings. The paired tools point in opposite directions; set the distance between them using Paired tools offset = 93.

Y2 sockets. The three lower positions form a separate row. Position them relative to the lower spindle component, as shown in the image.

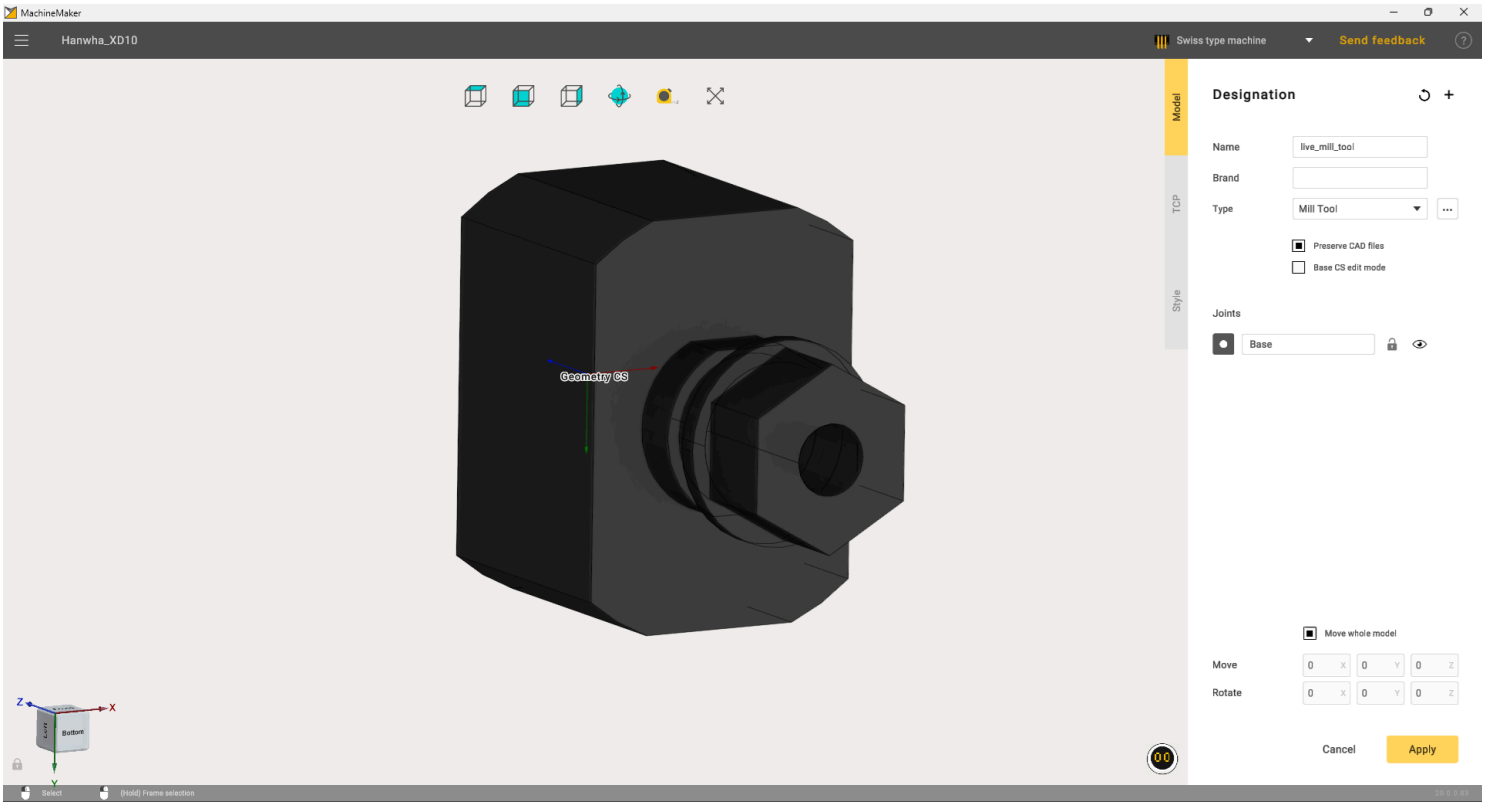
For the spindle groups, use the settings shown in the screenshot:

Setting	Main spindle	Counter spindle
Name	Spindle	Counter spindle
Holder type	Right lathe spindle	Left lathe spindle
Default clamp ID	1	2

Check the group positions from several viewing angles and click Apply.

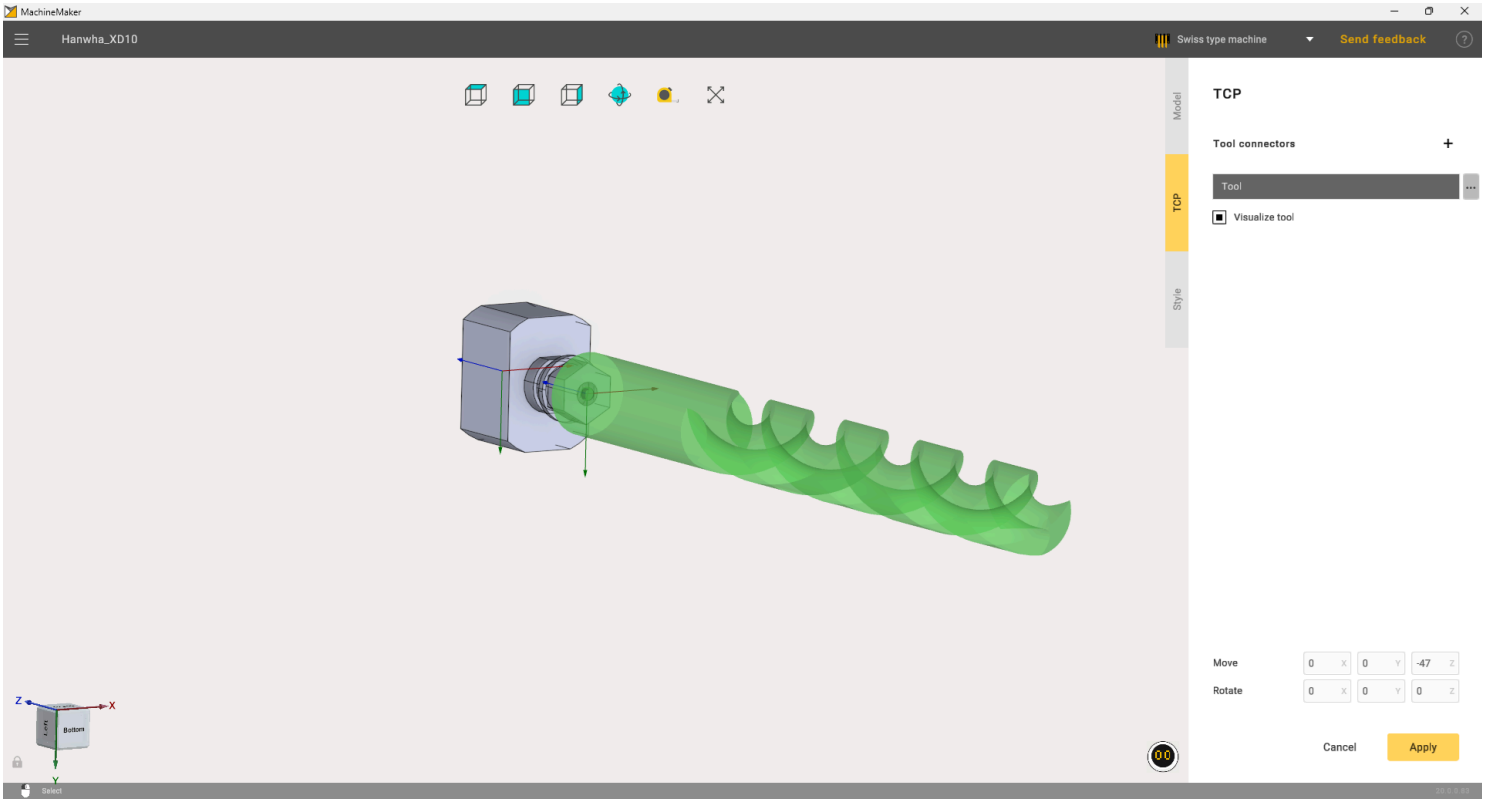
6. Adding the first tool with a holder

7. In the main window, click Add Mechanism and add `live_mill_tool.SLDPRT` as a tool.
8. On the Model tab, enter the name live_mill_tool and select the Mill Tool type. Assign the holder geometry to the Base node. Keep Preserve CAD files enabled.
9. Check the orientation of the model and its coordinate system. In the screenshot, all model translation and rotation values are zero.



Adding the first tool: select the milling tool type and assign the holder geometry to Base.

10. Open the TCP tab and select the Tool connector.
11. Place the connector at the center of the holder's clamping hole. For this model, set translation to X = 0, Y = 0, Z = −47 and rotation to X = 0°, Y = 0°, Z = 0°.
12. Enable Visualize tool. The tool symbol must extend from the hole along the clamping axis, as shown in the image.
13. Click Apply. The new tool is now available for attachment to the machine sockets.



First tool TCP: translation Z = −47, zero rotation about all axes, and tool visibility enabled.

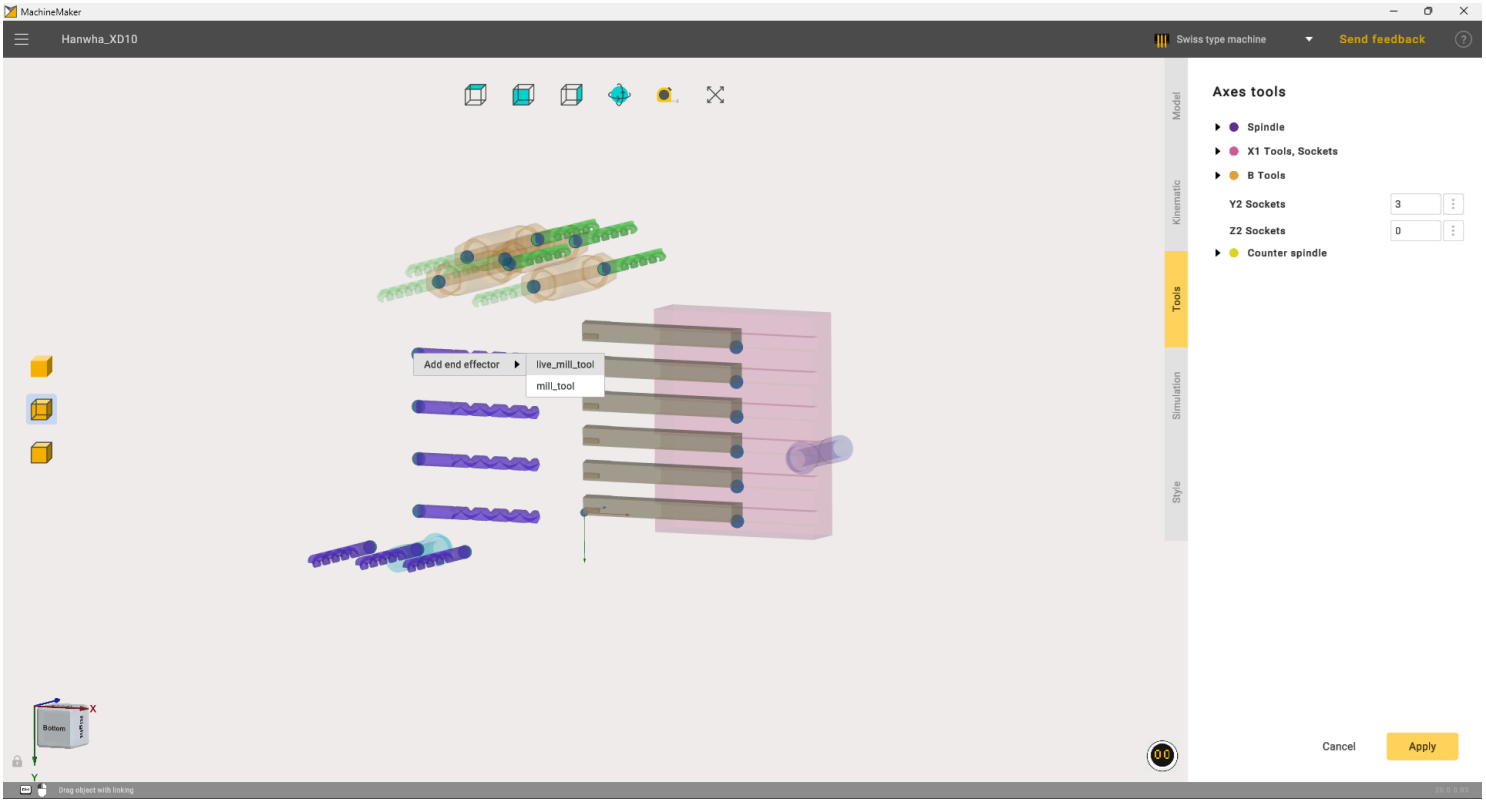
7. Adding the second tool

Similarly, use Add Mechanism to import `mill_tool.SLDPRT`. Enter the name mill_tool, select the Mill Tool type and assign the geometry to the Base node.

On the TCP tab, position the connector at the center of the hole. The second model in the source video uses translation X = 0, Y = 0, Z = −34 and zero rotation about all axes. Enable tool visibility, check the tool direction and click Apply.

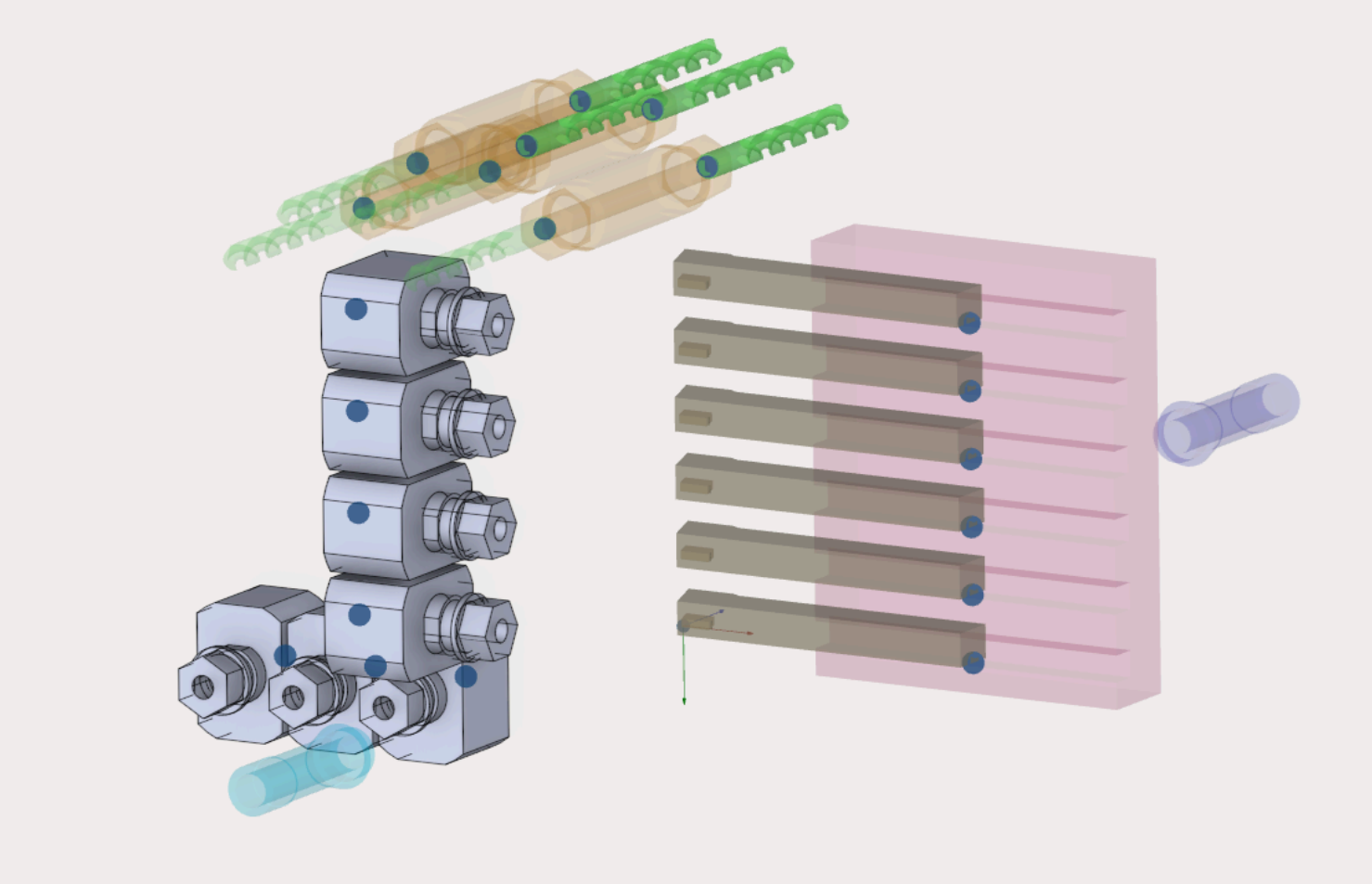
8. Attaching tools to the machine sockets

14. Open the settings of the `Hanwha_XD10` mechanism and select the Tools tab.
15. Right-click the required tool position or its attachment point.
16. In the context menu, select Add end effector, then live_mill_tool or mill_tool.



Attaching a tool to a socket using Add end effector in the context menu.

17. Repeat for the other positions. Fill the four positions in the vertical group and the three lower sockets with suitable tools and holders.
18. Check the seating and orientation of every holder. Once all positions are filled, the configuration should look like the image below. Click Apply.



Completed socket setup: four holders in the vertical group and three holders in the lower row.

9. Checking the simulation and saving the project

Switch to MachineMaker simulation mode and check the movement of all machine components. Change the positions of the available axes in turn: Z1, Y1, X1, X2, Z2, then check the rotation of C1 and C2.

Make sure that the components move in the correct directions and stay within the configured limits, and that the holders and tools move with their assigned nodes. The counter spindle must rotate about the configured C2 axis. Axes B and Y2 must remain stationary in this configuration.

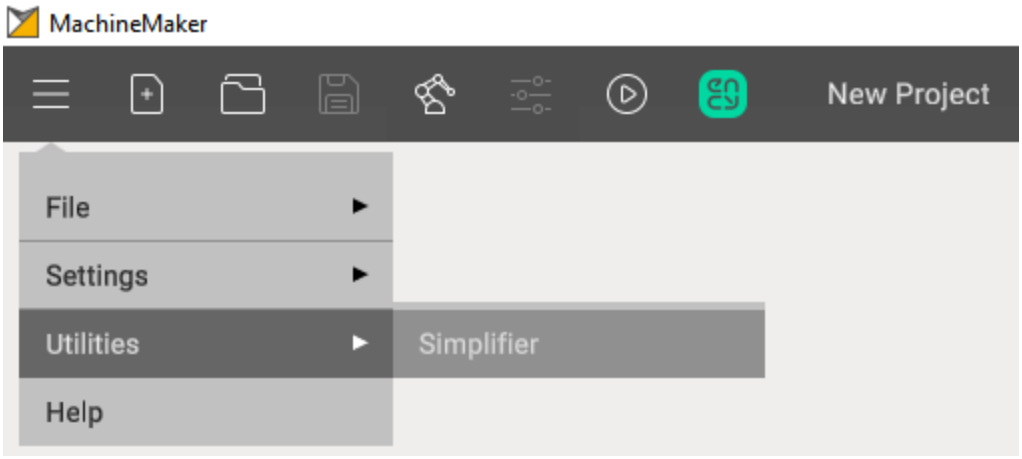
If any movement is incorrect, return to the part assignments, axis settings or tool positions and correct the relevant parameter. Repeat the check after making changes.

Exit simulation mode and save the machine project using the save command on the top toolbar. The Hanwha XD10 configuration is ready for further use in the CAM system.

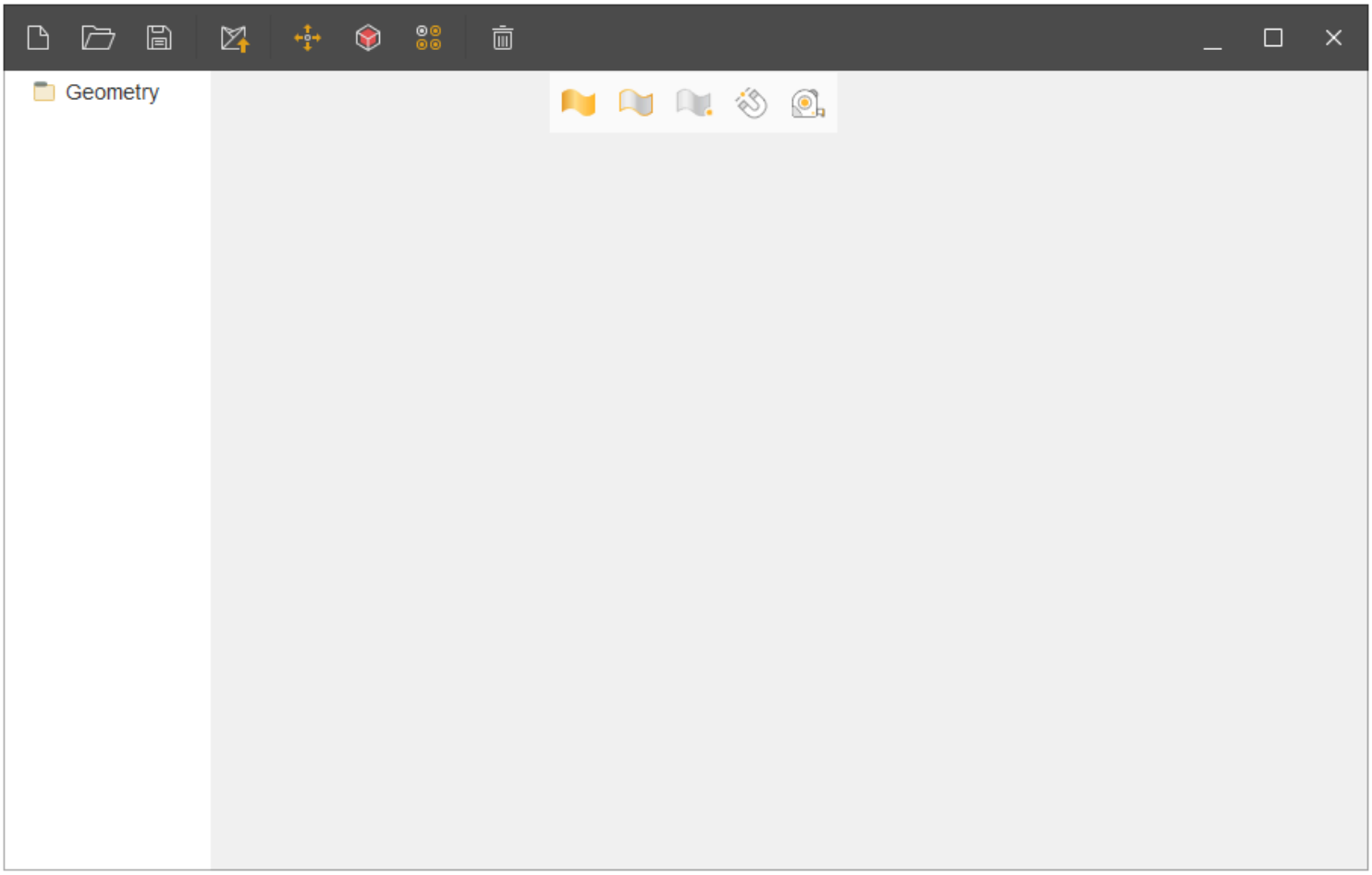
Simplifier

Simplifier in MachineMaker is intended to simplify complex 3D models. This may include eliminating redundant parts, merging surfaces, optimizing model structure, and other complexity reduction techniques.

To open it you need to click on the drop-down menu and select Simplifier in the utilities menu.



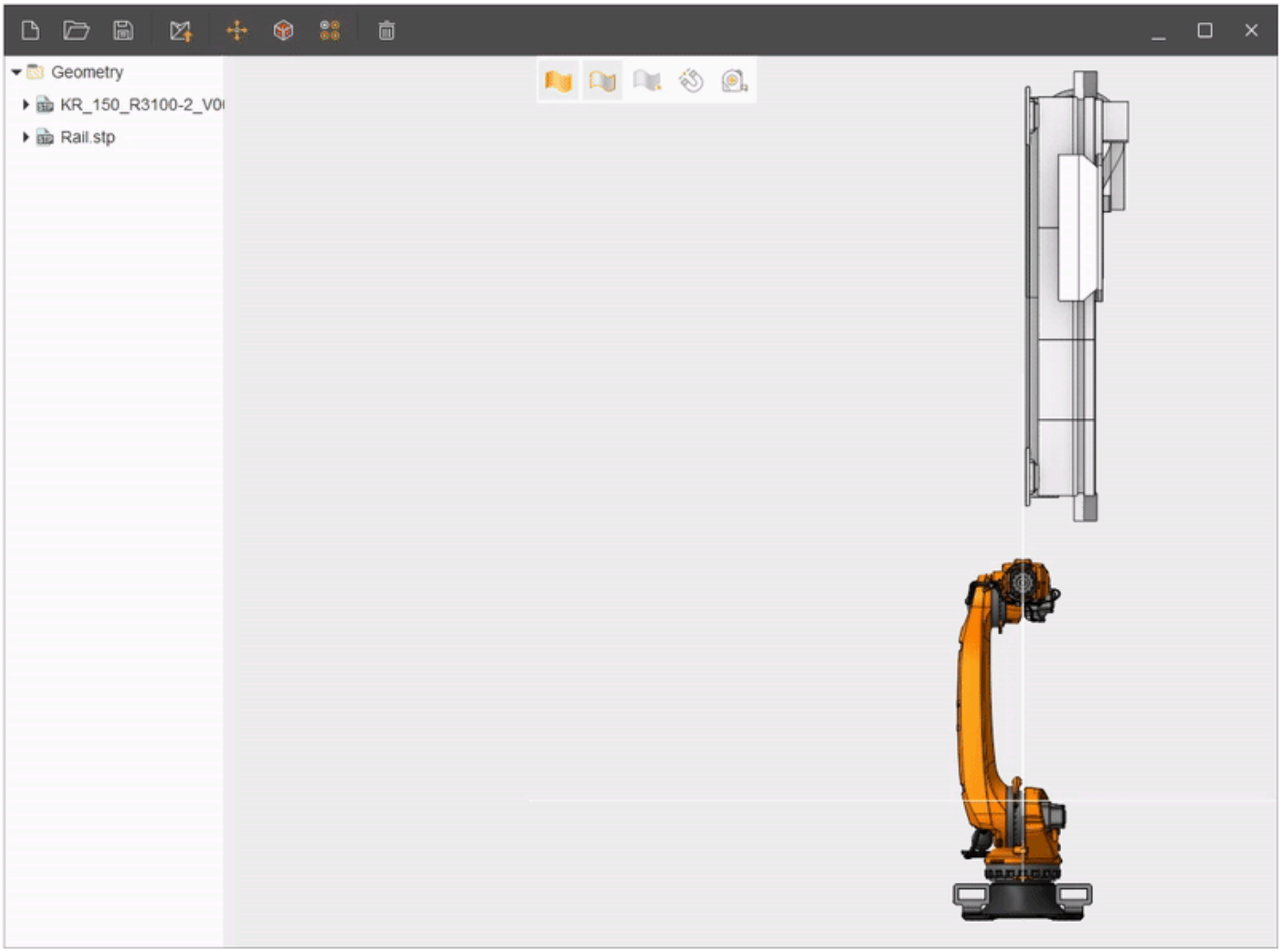
The main menu of this utility looks like this:



The main window comprises the following sections:

1. New project.
2. Import.
3. Save as.
4. Send to MachineMaker.
5. Transformation geometry.
6. Simplify geometry.
7. Find similar nodes.
8. Delete.

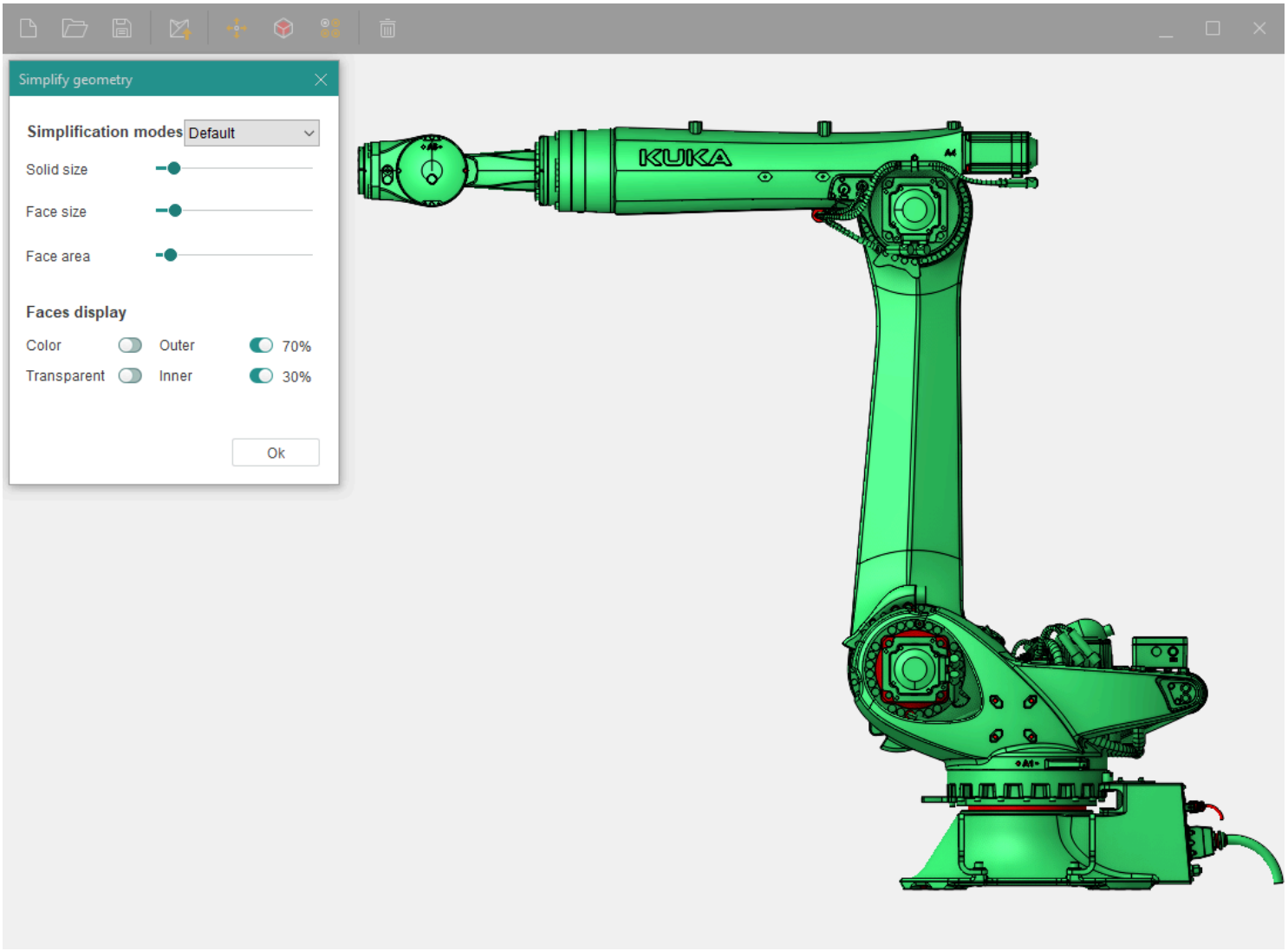
Transformation geometry is needed to move objects and has identical functions as in CAM system.



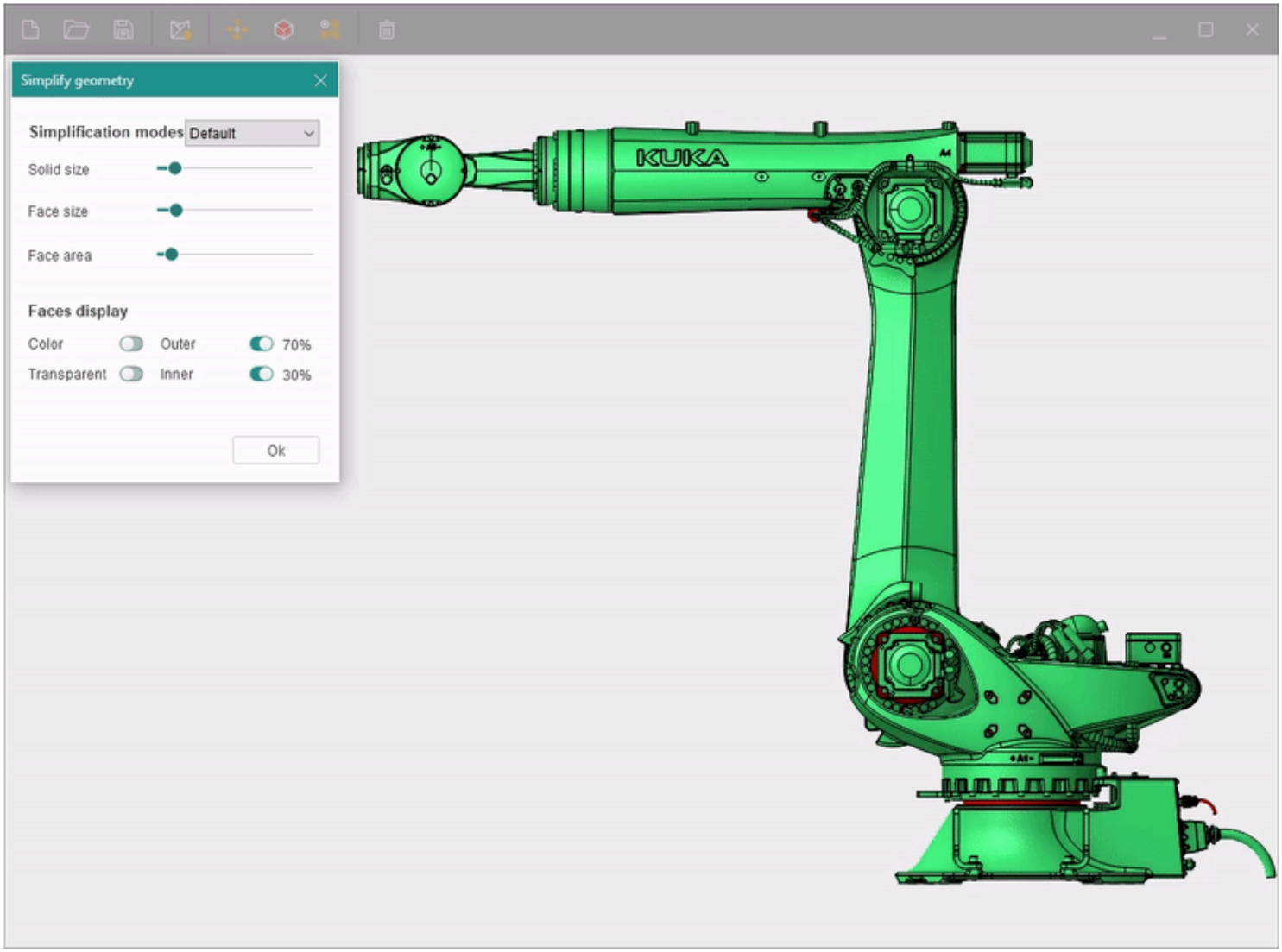
Simplify geometry - This is one of the main functions of this utility. Here you can select different modes of model simplification. There are 4 templates:

1. Default - a mode that removes small objects from the model.
2. Middle - a mode that removes most of the objects from the surface of the model.
3. Maximum - a mode that removes everything except large parts of the model.
4. Custom - a mode in which you manually edit the surface of your model using sliders.

The Kuka KR 120 R3100-2 robot model will be used for the illustrative test.

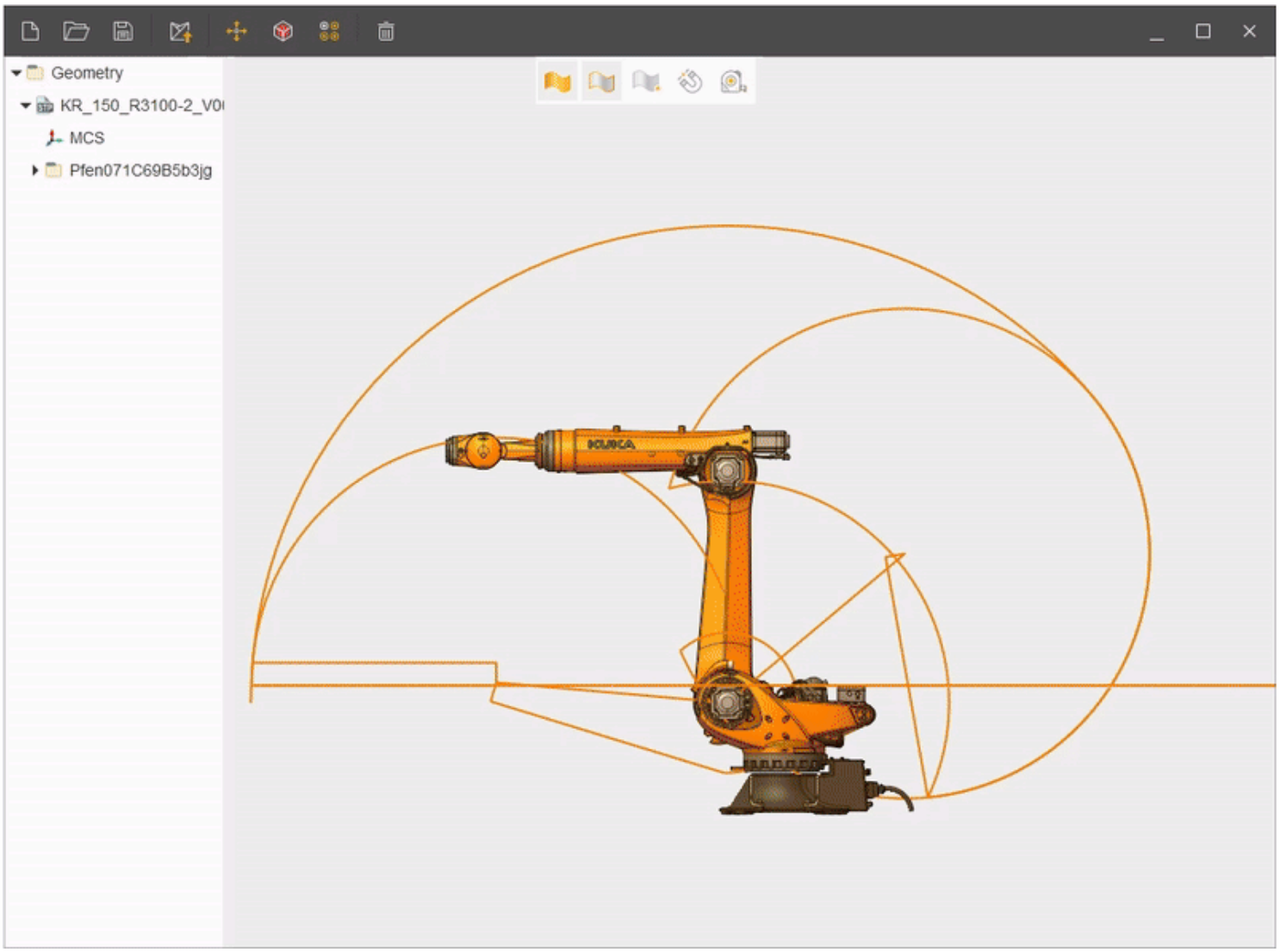


Before removing unnecessary objects from the robot, you can use the faces display function, where you can see in advance which objects will be removed (marked in red).

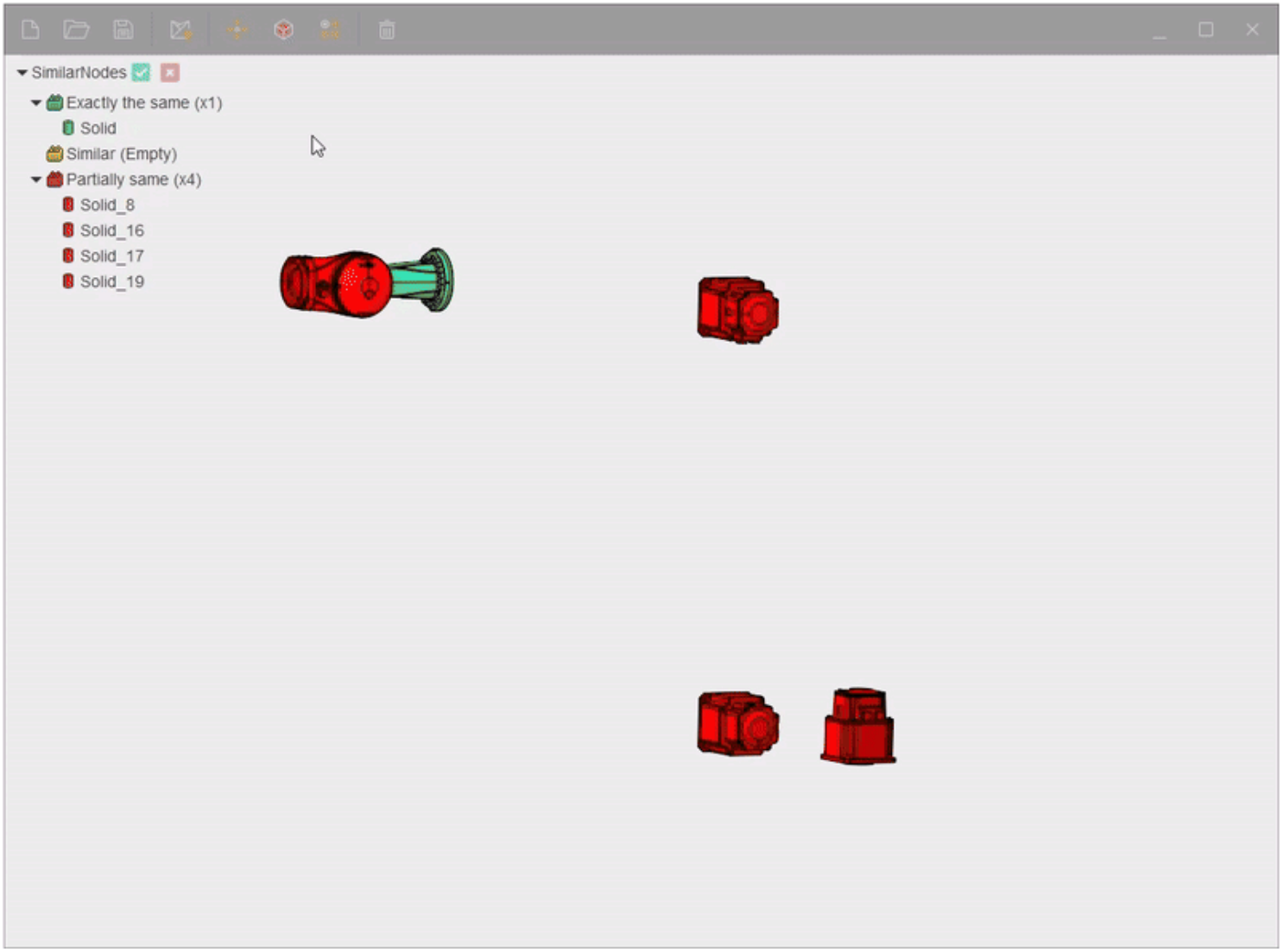


Simplifier also has a Find similar nodes function. It is used to search for similar parts in your model, then it sorts them in a list by different nodes such as:

- Exactly the same
- Similar
- Partially same



If necessary, you can delete nodes using the Delete button.


SimilarNodes
Exactly the same (x1)
Solid
Similar (Empty)
Partially same (x4)
Solid_8
Solid_16
Solid_17
Solid_19