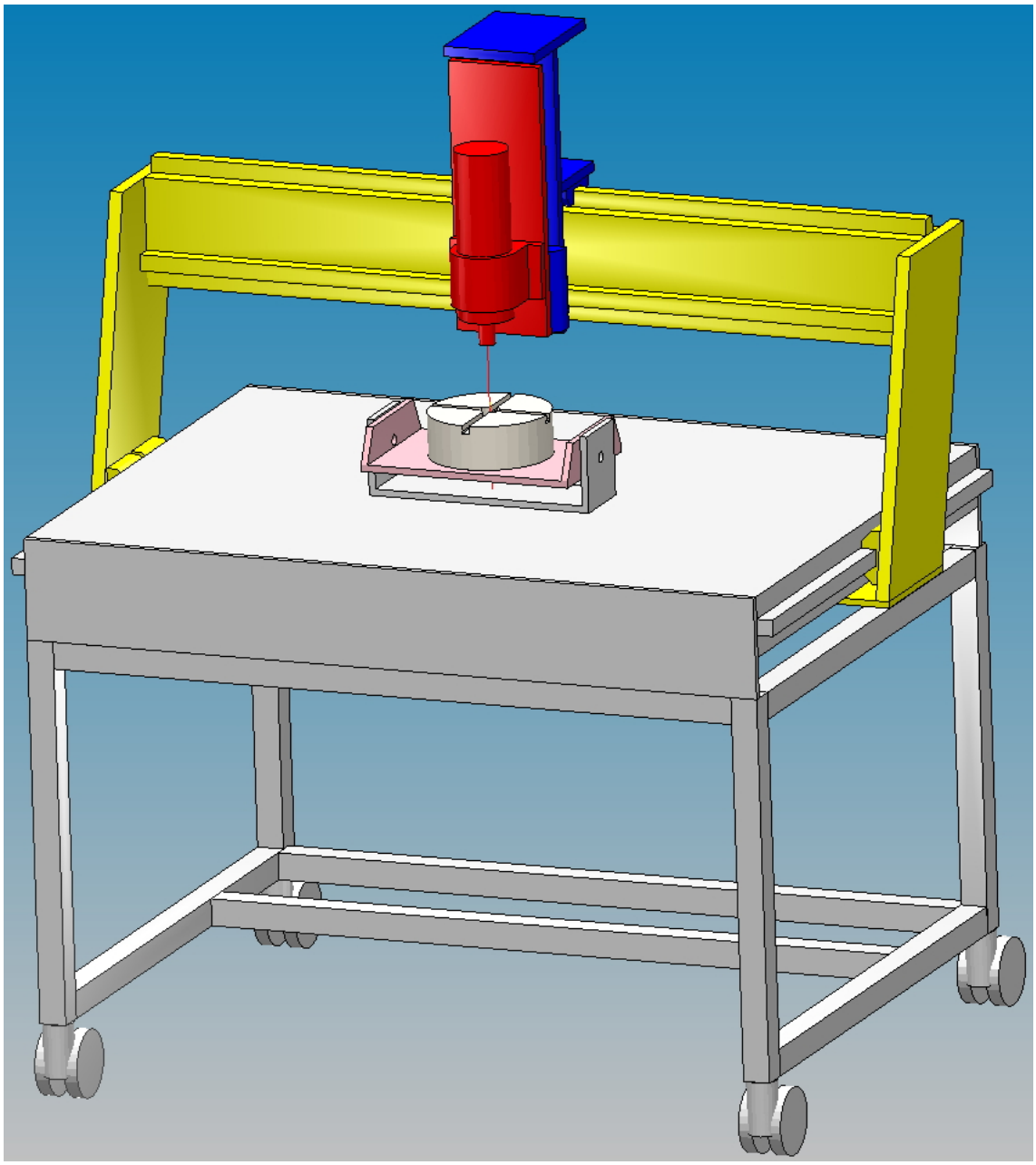
How to import a 3D machine modell into GrblGru

toe

February 18, 2019



Contents

1 Motivation

A special feature of ***GrblGru*** is the possibility to import your own 3D models. These models are then used to graphically simulate the loaded GCode.

This document describes the necessary steps to import an existing 3D model.

2 Can *GrblGru* simulate my machine ?

If you cannot find a suitable model in the list of available machines, you can import your own 3D model. However, the condition for this is that the **type** of the model already exists. The **Type** defines relations of axes to each other. For example, whether the tool is moving towards the part or whether the tool is fixed and the part is moving towards the tool. Is the Z axis moved with X? Does an A-axis rotation affect the B-axis or not?

The following machines are examples of two completely different types.

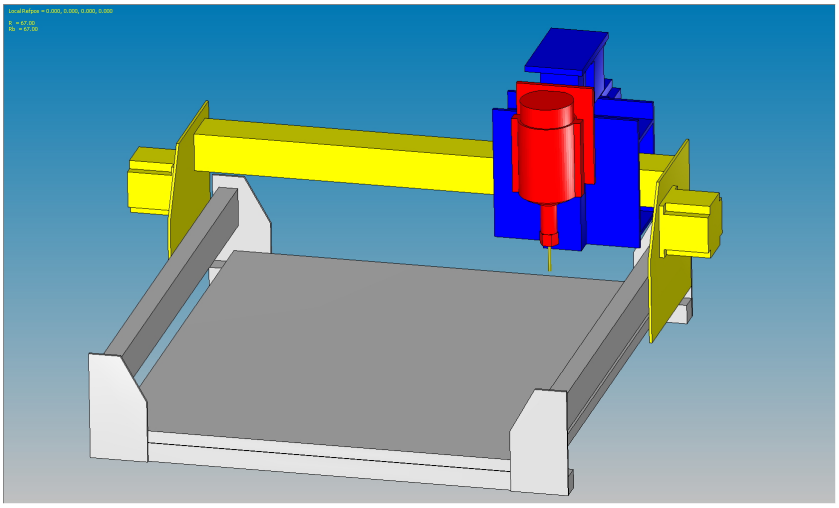


Figure 1: Typ ShapeOko

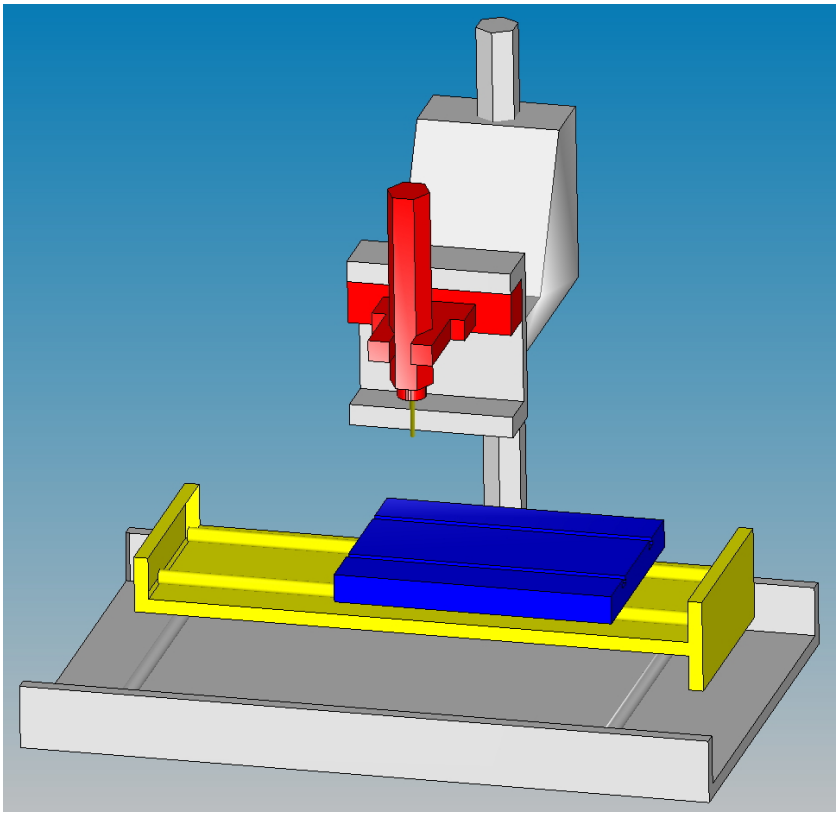


Figure 2: Typ Milly

I recommend to have a look at some of the available models to see the differences. Under the menu item **Extras/Machine Manager** you will find a list of all machines and can view the corresponding type under the entry **Machine type**.

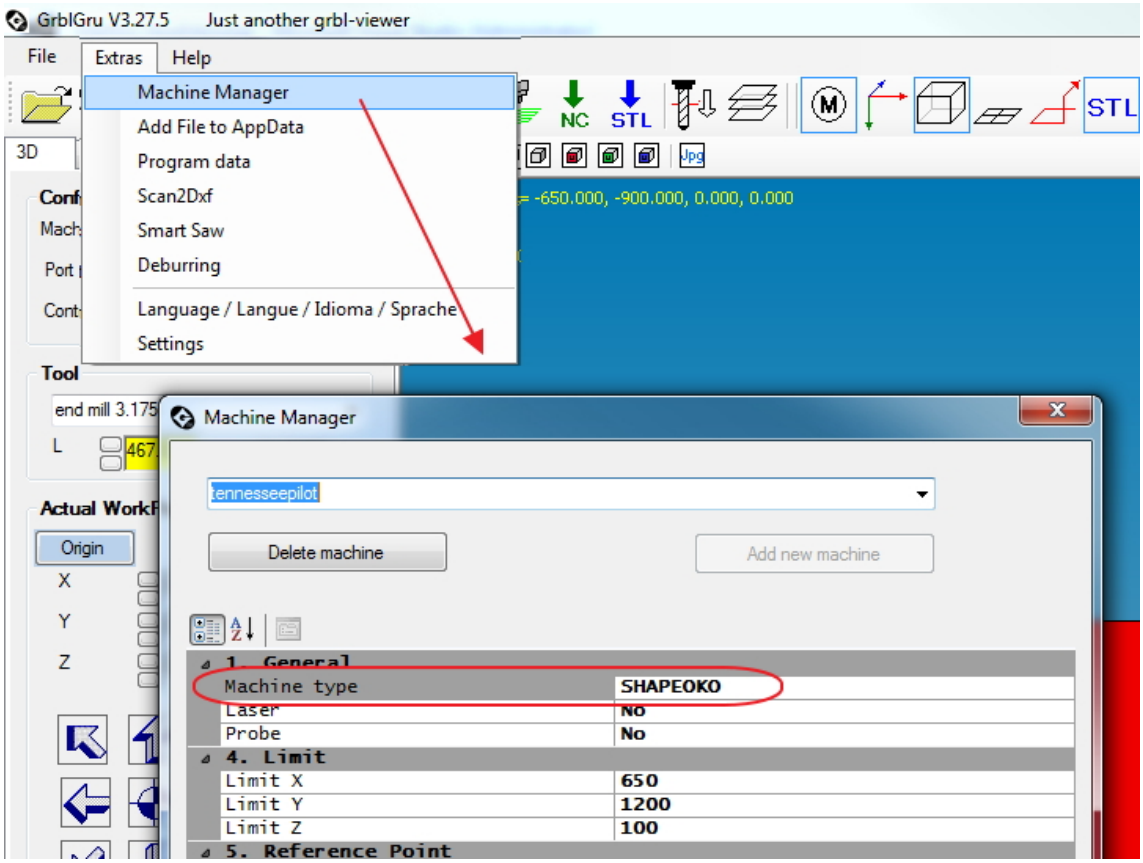


Figure 3: Input **Machine type** in the dialog of machine management

If you need a model whose type is not yet available, please let me know. I will then try to add the appropriate type.

The following machine types have been realized so far:

- SHAPEOKO
- MILLY
- SPRITE
- NONY
- EGGBOT
- PRINTER3D
- SHAPEOKO-AX
- LASER
- FIVE-AXES-1
- FIVE-AXES-2
- FIVE-AXES-3

3 Designing the machine in CAD-Sytem

First of all you have to design the machine in CAD. I do not want to go into this point in more detail, because it is essentially dependent on the CAD system used. I have always used the program CREO to create my previous models. The number of objects is limited and the export is limited to STL and own format, but it is also free of charge.

> http://de.ptc.com/product/creo/elements/direct-modeling/express

For the construction with CREO there is a short video:

> https://youtu.be/v5m8HKOdHG0

The only important thing in the construction is that the machine coordinate system is aligned as follows.

> The X-axis points to the right, Y to the rear, Z to the top. The preferred origin is on the rear right base.

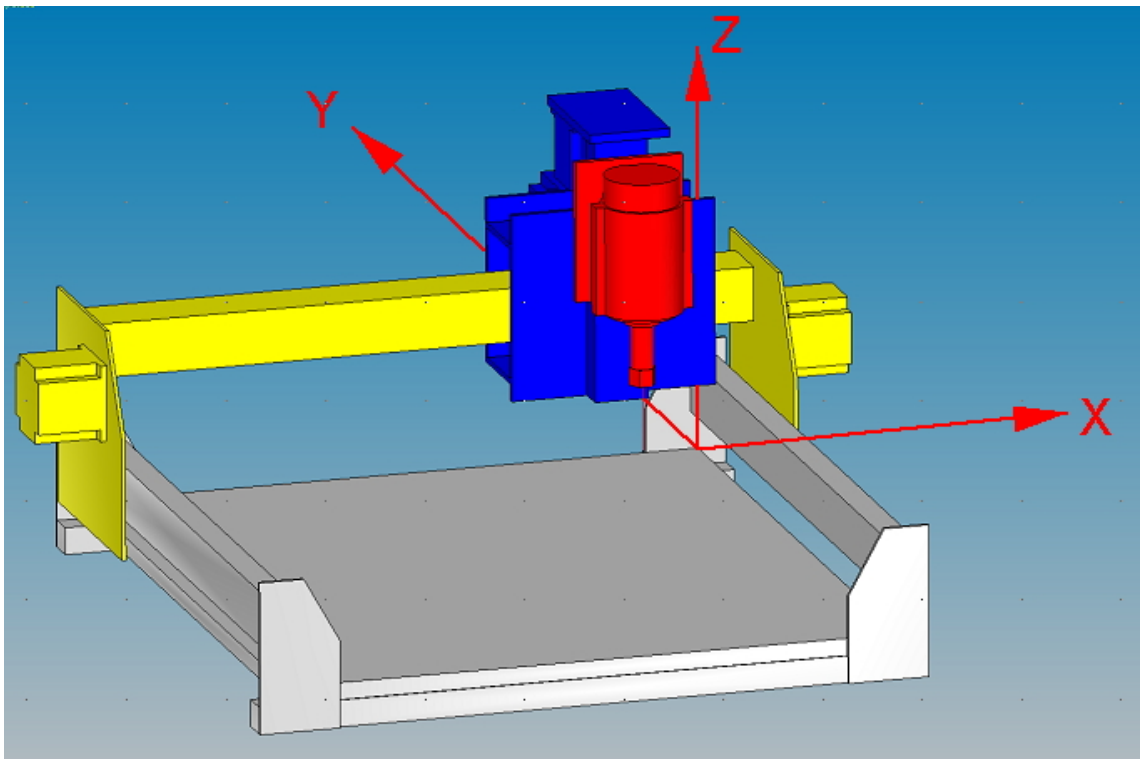


Figure 4: The machine coordinate system

4 Save assemblies as STL

GrblGru can only read 3D data in STL format at the moment. For this purpose, the axis assemblies must be available in this format for the actual import.

After the complete model has been constructed, the assignment of the assemblies to the desired axes and storage in the STL files begins. The following file names are expected:

- **Base+.STL**
  Fix base
- **X+.STL**
  X-axis; linear axis
- **Y+.STL**
  Y-axis; linear axis
- **Z+.STL**
  Z-axis; linear axis
- **A+.STL**
  A-axis; rotation axis
- **B+.STL**
  B-axis; rotation axis

The'+' in the name causes the edges of the respective assembly to be redrawn and can also be omitted. All files are first stored in any directory.

> ***GrblGru*** can only read 3D data in STL format at the moment.

5 Creating a new machine in the machine management

The next step is to first create a new machine. You will find the following dialog in the menu under the item **Extras/Machine Manager**.

The later input of the machine data is made easier by first selecting a machine of the type you want to create in the first line. This means that a lot of data is already preassigned.

Then simply enter the name of your model in the first line and press the button "Add new machine".

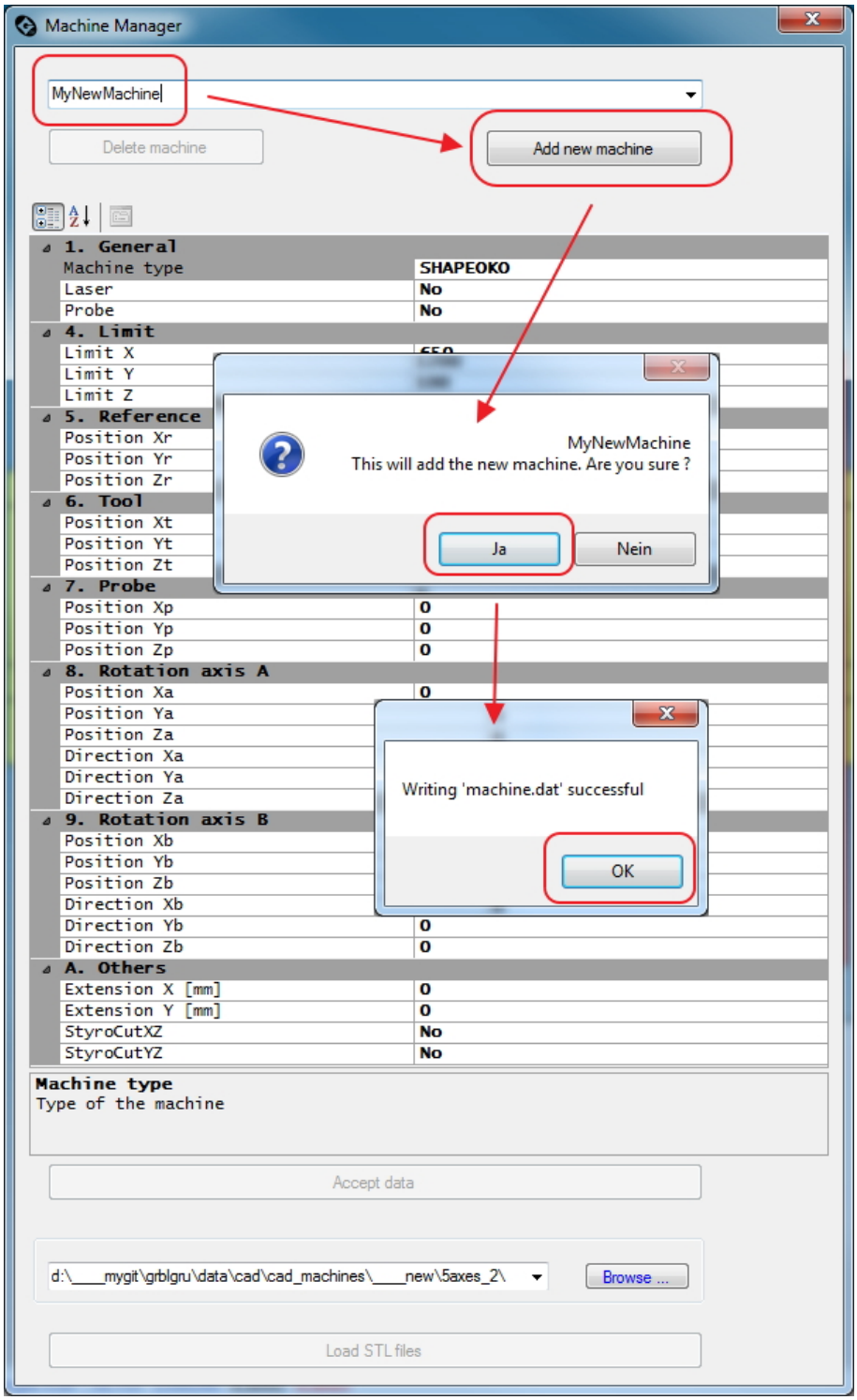


Figure 5: Machine Manager dialog

6 Import STL files

After you have created all STL files and created the new machine, you can now load the files in the machine management. Select the directory with the STLs via the 'Browse' button and confirm the queries.

> Please DO NOT enter the path manually. That doesn't work !

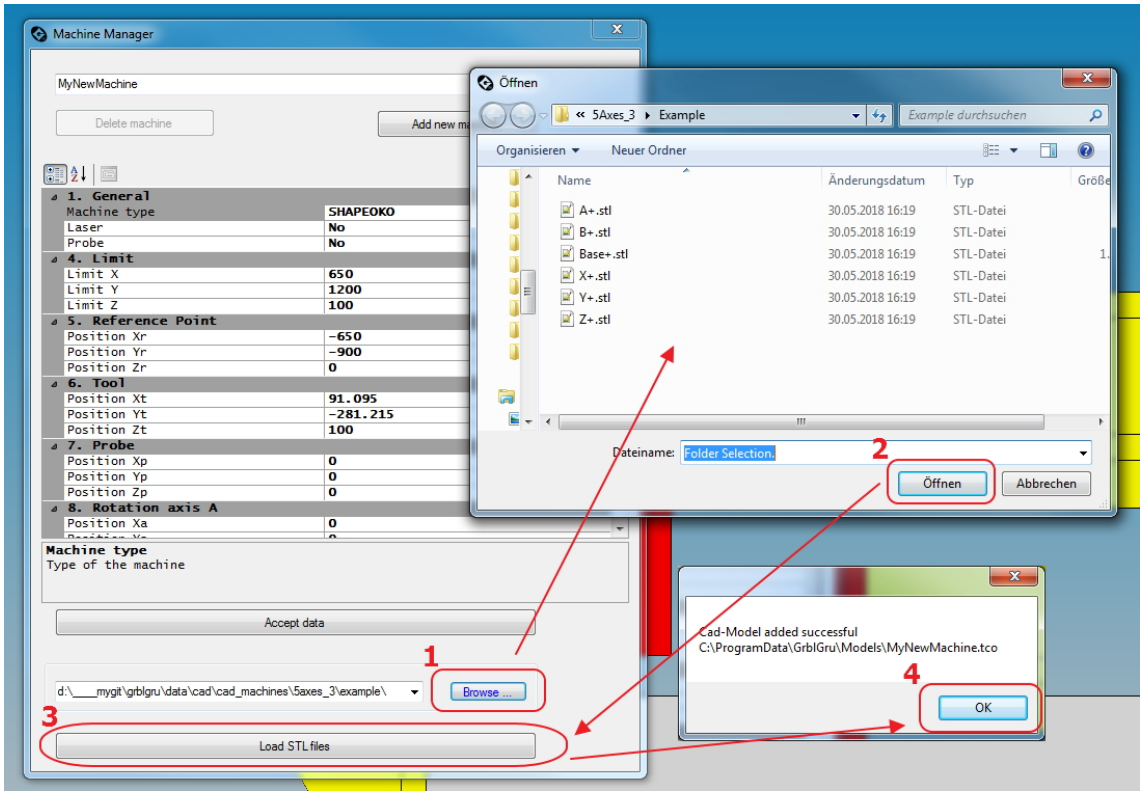


Figure 6: Import of STL files in machine management

7 Determining control values

The machine can now be selected and displayed in the program.

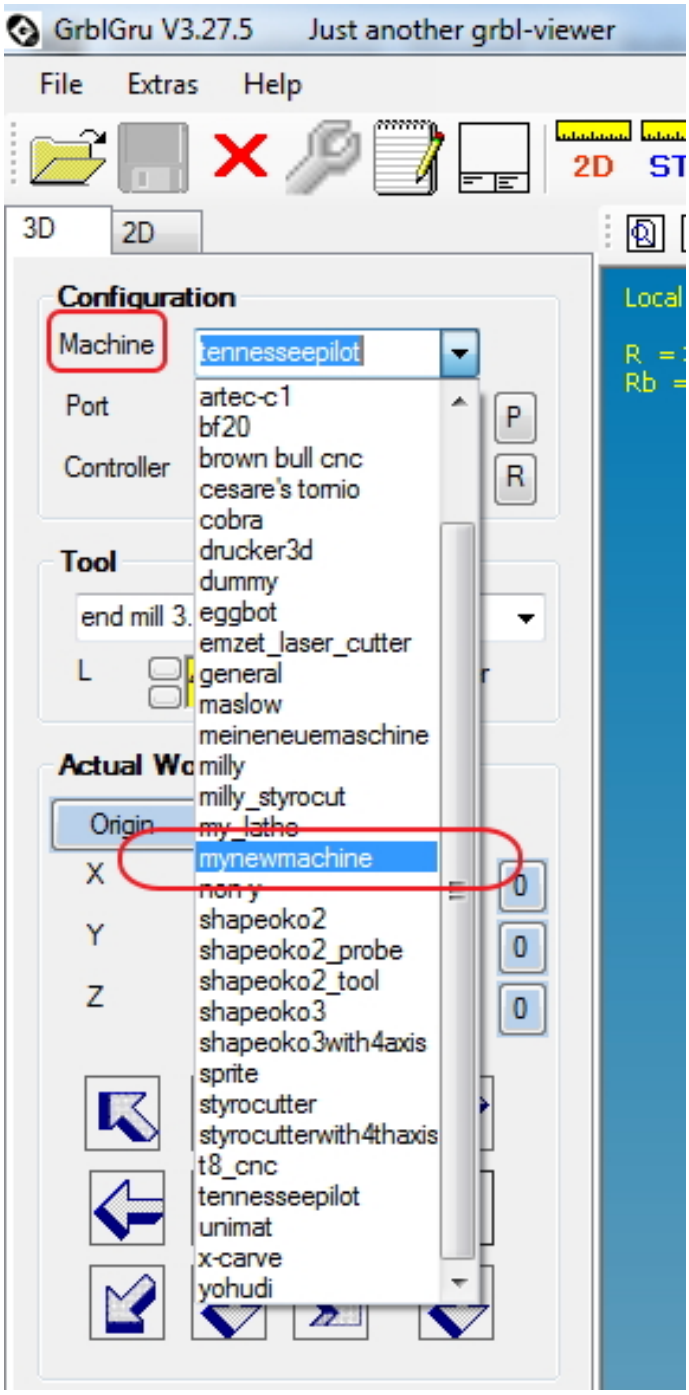


Figure 7: List of available machines with the new entry

7.1 Tool Position

However, it is noticeable that the tool may not yet be displayed in the correct position. This requires ***GrblGru*** the coordinate of the tool origin in the machine coordinate system.

These coordinates must be taken from the model in the CAD system. In the CREO program there is a command 'Measure 3D point' which returns the desired values. To determine the exact center of a circle, for example, certain CAD activities such as creating a working plane and drawing guides are also required. How you can do this with your CAD system can be found in the corresponding documentation.

In fact, you need the X,Y and Z components of the tool origin to be able to enter them in the machine management dialog.

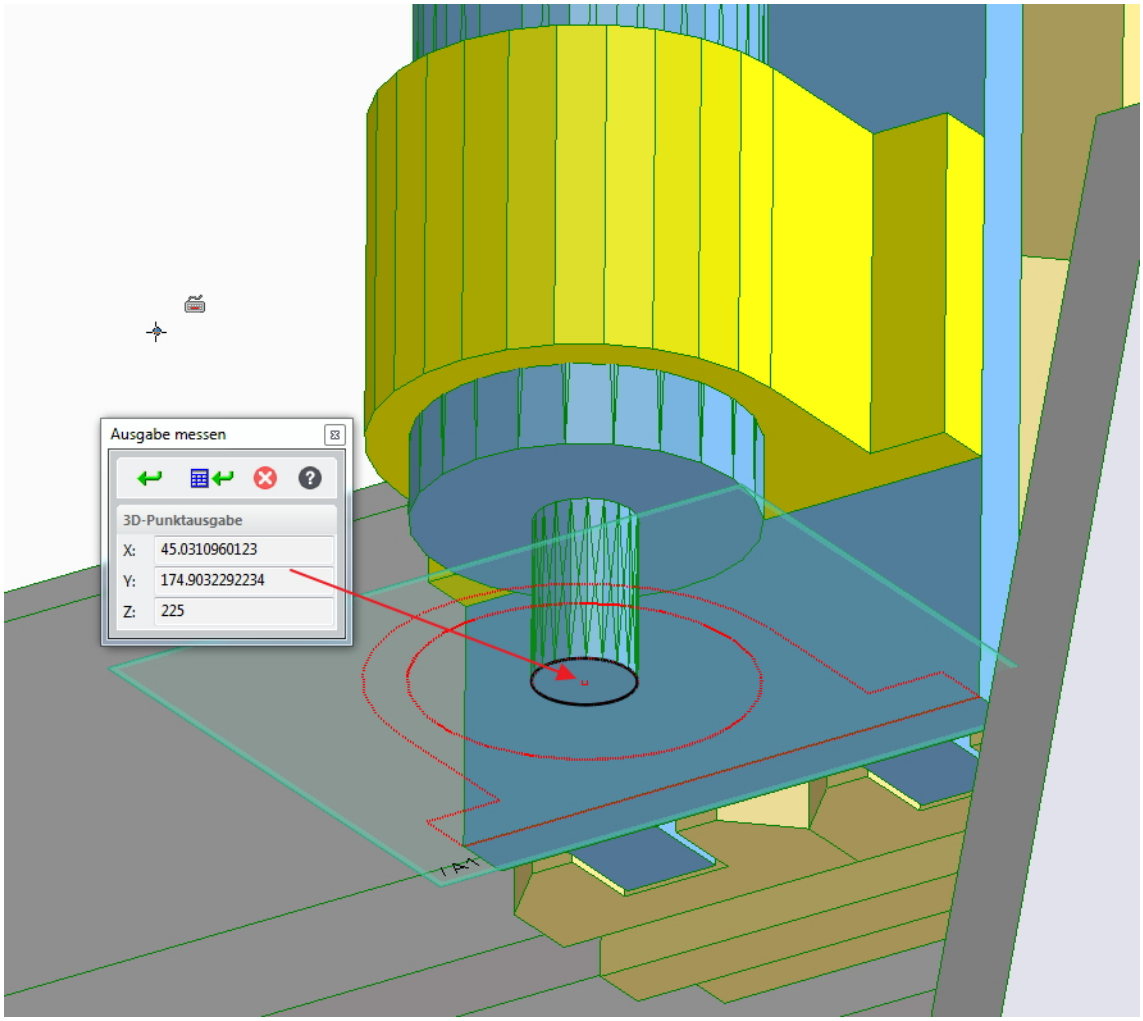


Figure 8: Measurement of tool origin

The X,Y and Z components of the coordinate are then entered in the dialog of the machine management in Chapter 6 Tool.

> Attention !
> Don't forget to press the button 'Accept data' after the input.

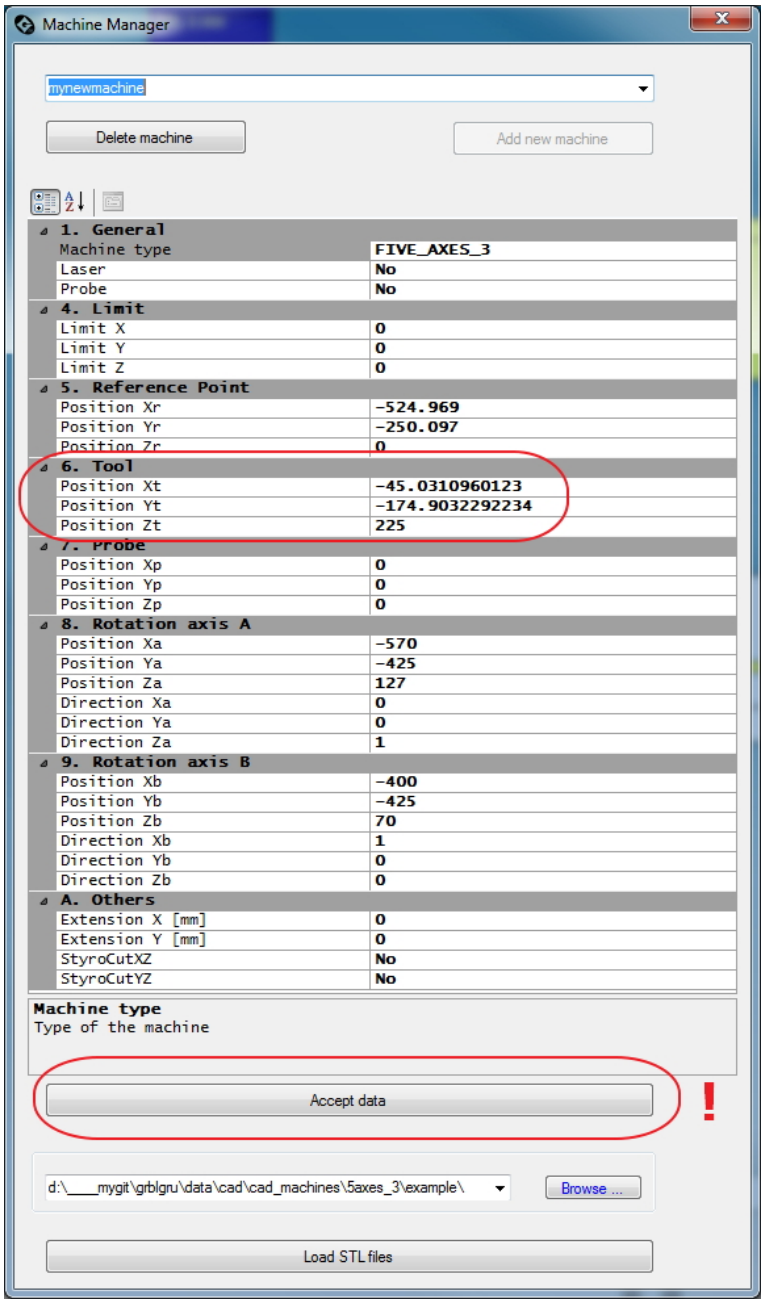


Figure 9: Entering the origin tool.

7.2 Rotary axes: Position and direction

For purely pragmatic reasons, the designations of the two rotary axes A and B do not correspond to the basic rules for axis designations. This is the reason why in the following example the rotary axis, which rotates around the Z axis, does not bear the name C, but can be called A or B.

For ***GrblGru*** to handle the rotary axes correctly, a point on the rotary axis and the direction of the axis are required. To measure a point on the rotary axis, proceed in the same way as the tool origin. The direction can usually be determined without measurement, because it usually runs in X, Y or Z direction. In the example 'chuck' it points upwards, i.e. in the Z-direction. Therefore, in this case, we enter 0, 0, 1. Entering the direction always refers to the initial position of the model. The way it was constructed and drawn.

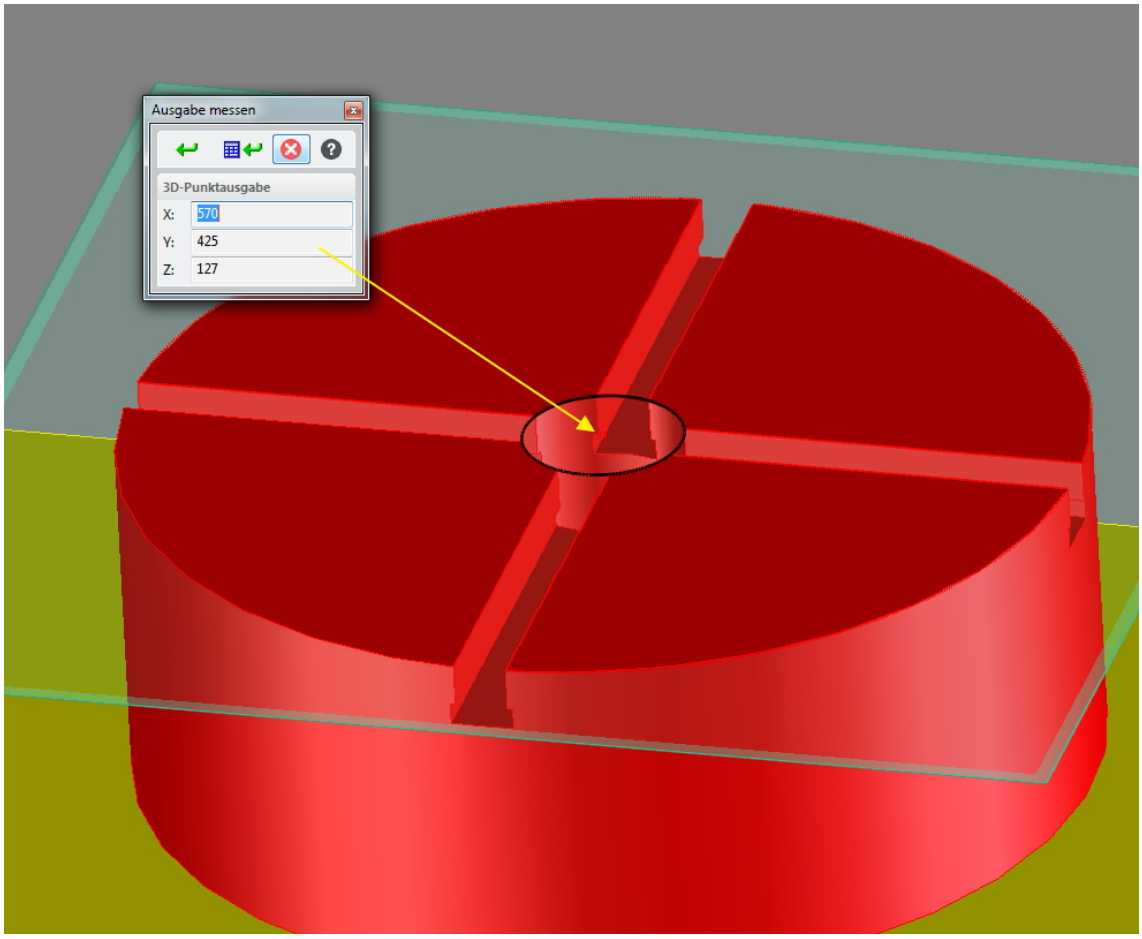


Figure 10: Measurement of a point on the A axis

The position and direction of the A axis are entered in the dialog of the machine management in Chapter 8.

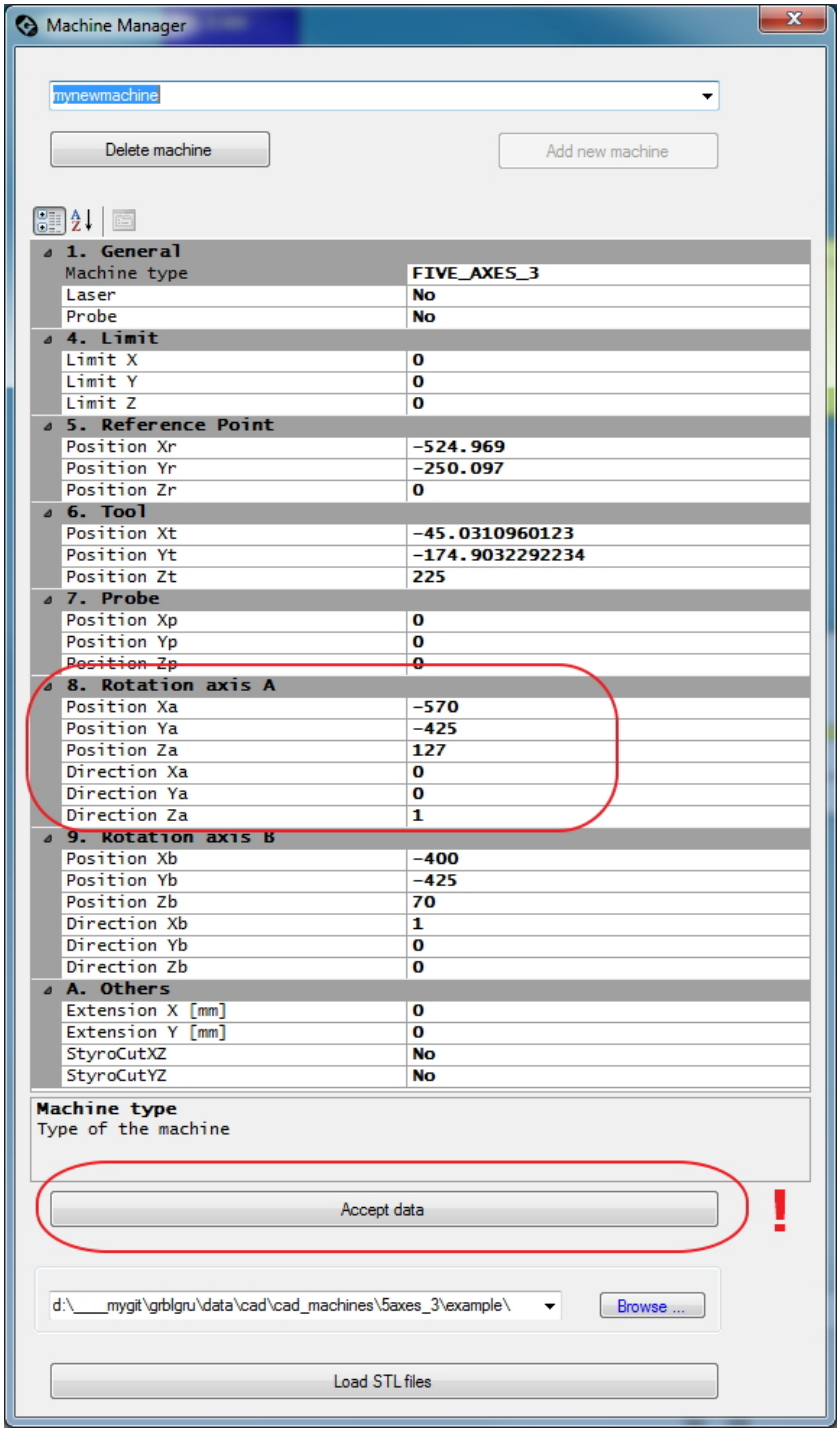


Figure 11: Entering the position and direction of the A axis

For the sake of completeness the same story with the B-axis. The direction is the X-direction, i.e. 1,0,0

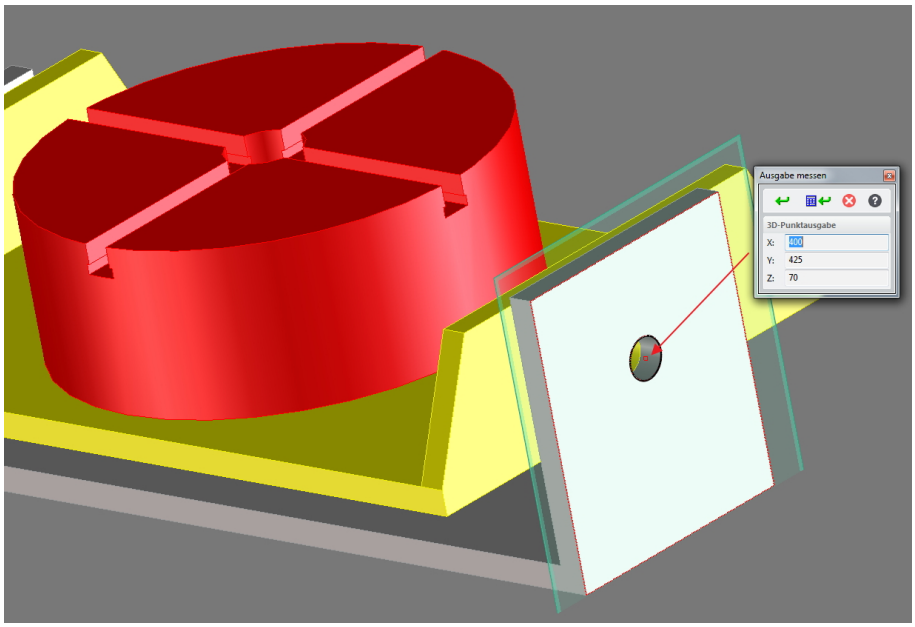


Figure 12: Measurement of a point on the B axis

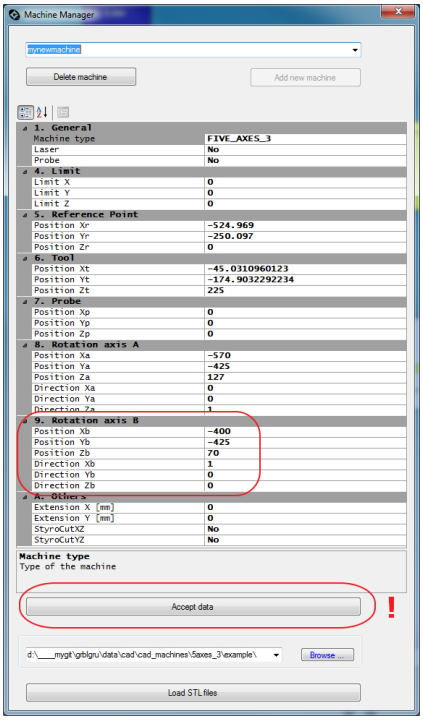


Figure 13: Entering the position and direction of the B axis

8 Entering the reference position

In chapter 3 you can specify the position of a reference point to which the model will be positioned by pressing the toolbar button.  In combination with rotary axes, it has proven helpful to place the reference point in the center of the A axis.

The position of the X and Y components can be calculated simply by subtracting the A-axis position and the tool position. Z stays at 0.

$$X_r = X_a - X_t \tag{1}$$
$$Y_r = Y_a - Y_t \tag{2}$$
$$Z_r = 0 \tag{3}$$
$$\tag{4}$$
$$X_r = -570 - (-45.031) = -524.969 \tag{5}$$
$$Y_r = -425 - (-174.903) = -250.097 \tag{6}$$
$$Z_r = 0 \tag{7}$$

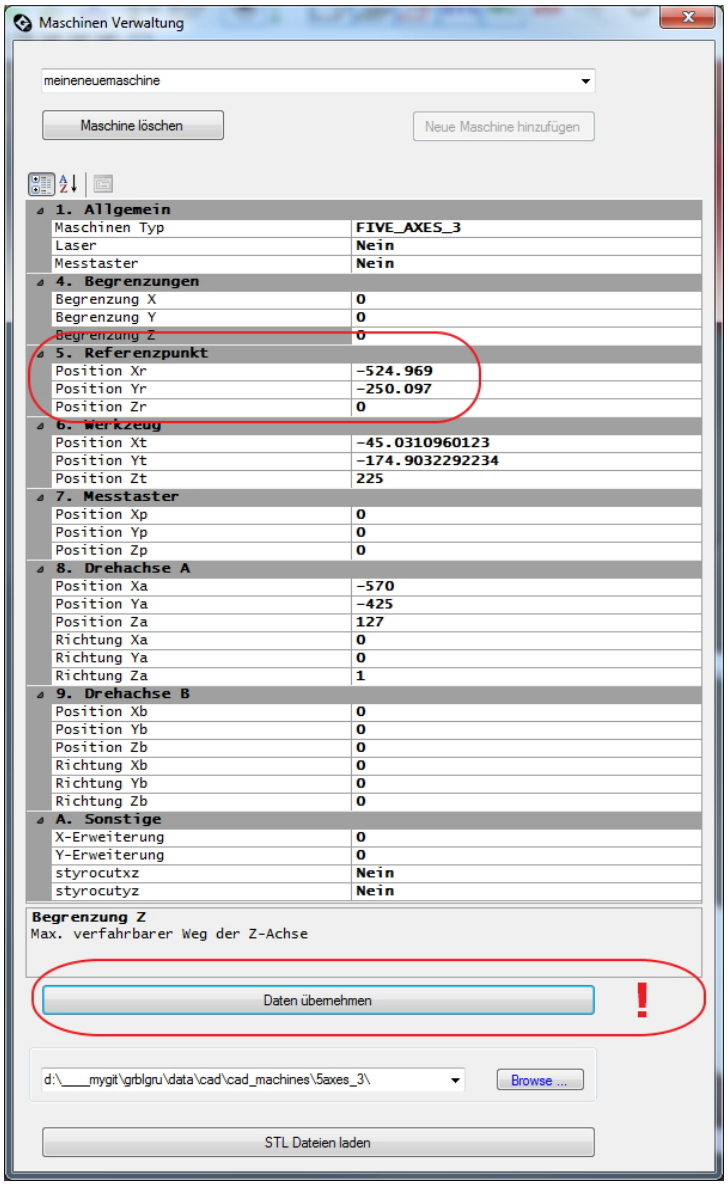


Figure 14: Entering the position of the reference point

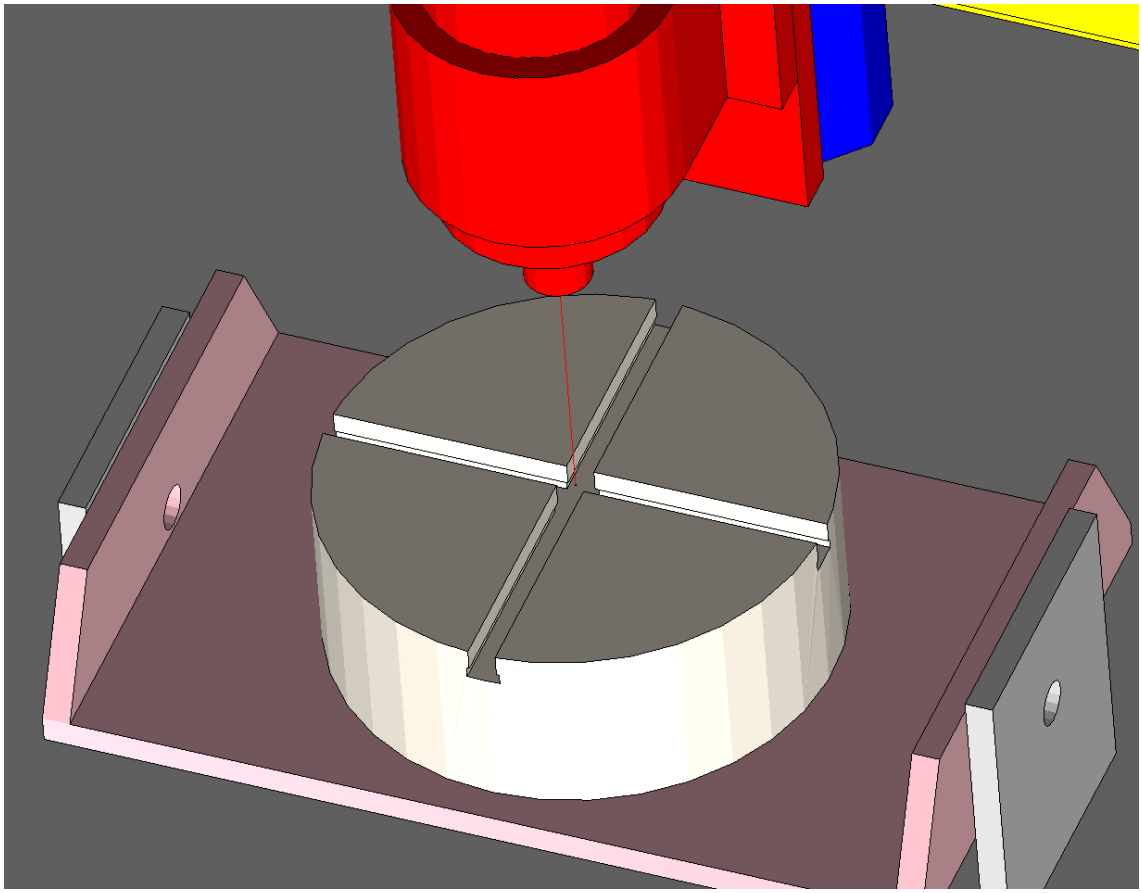


Figure 15: Reference point = center A-axis

9 Limits (limit switches)

If you want, you can enter the axis limits in chapter 4. If 'check limits' is switched on in the settings, the axes stop in manual mode when the end position is reached.

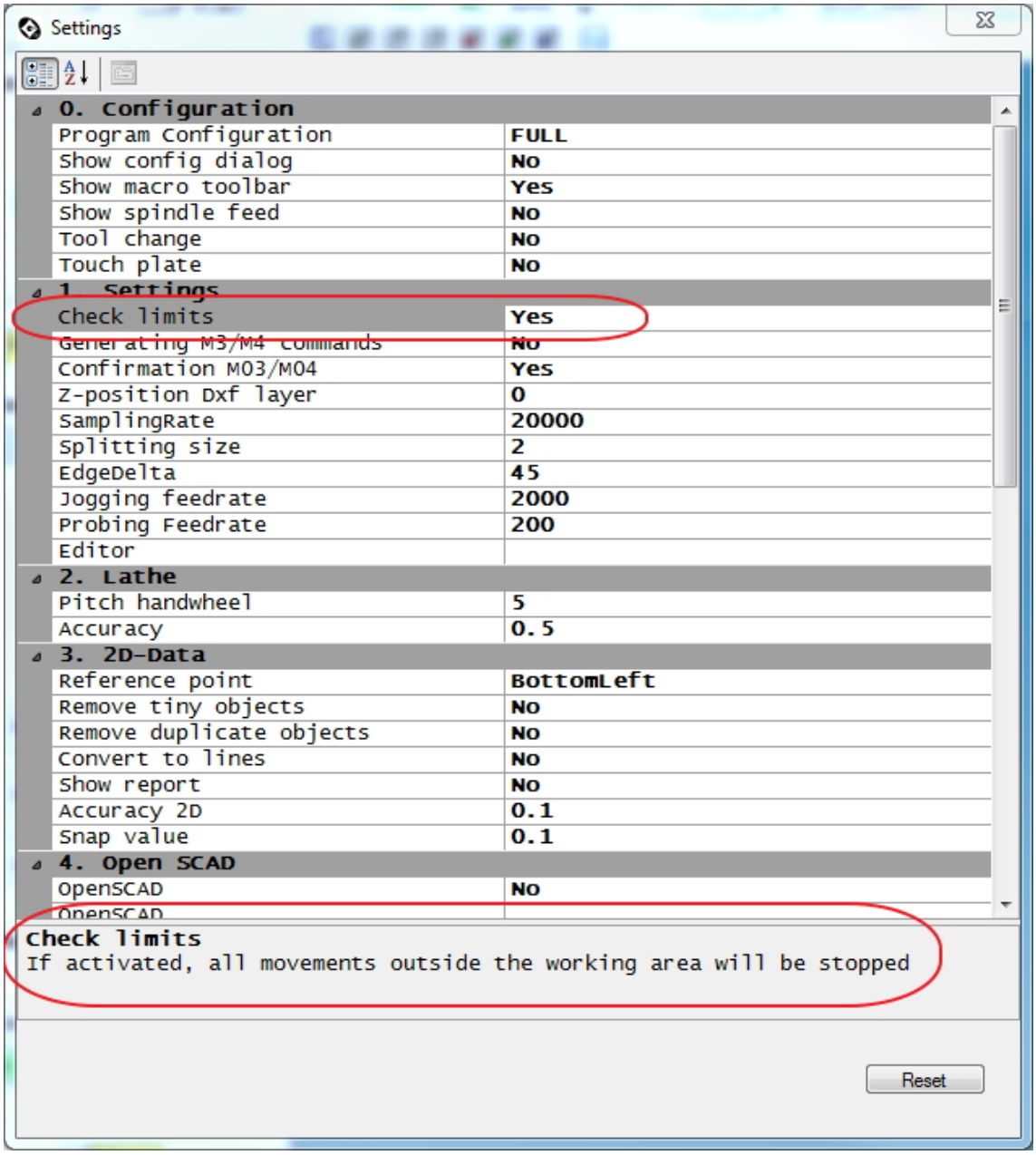


Figure 16: Dialog Settings

10 Remaining settings

Please make sure that you have not set one of the option buttons by mistake. These are only intended for special machines and can considerably influence the machine function.

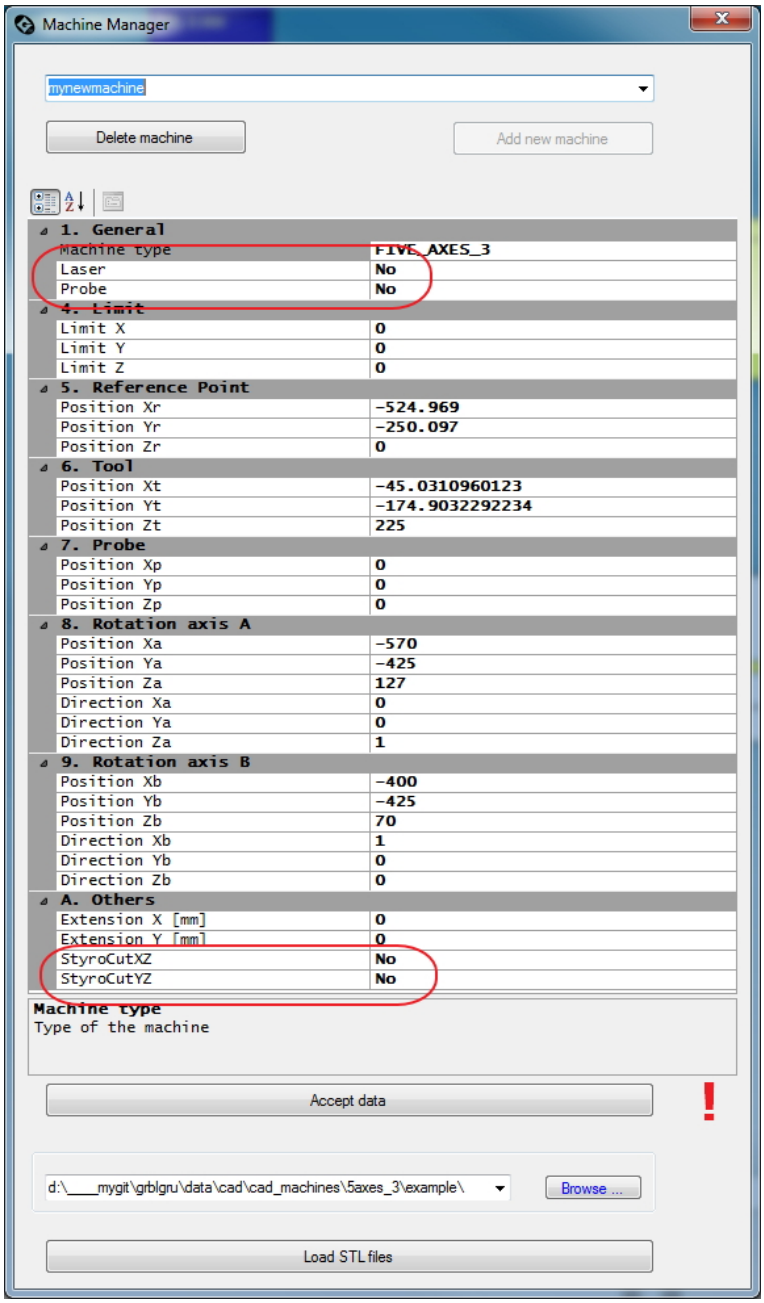


Figure 17: Normal position of the option switches = NO

11 Special features for lathes

In principle, the creation of lathe 3D models works exactly like that of milling. However, there are some additions that I would like to go into in more detail here.

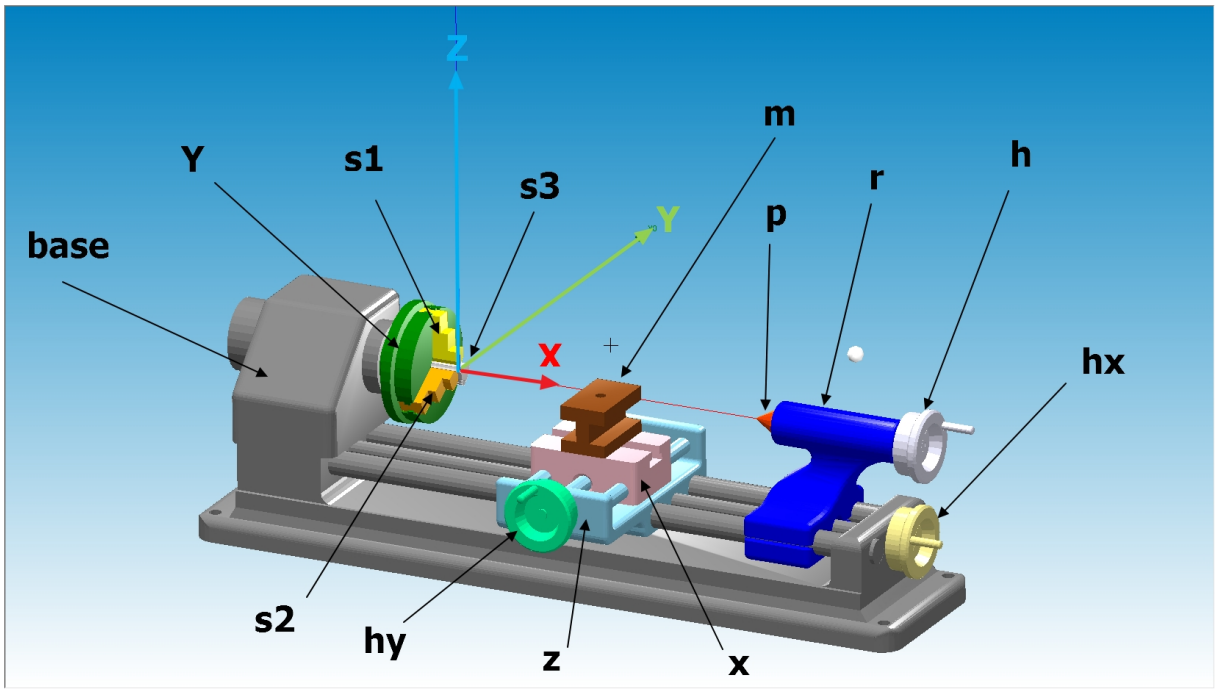


Figure 18: The lathe components

First of all, the 3D model MUST be drawn in the following coordinate system:

- The origin lies in the center of the chuck. If this is not taken into account, the chuck will not rotate in the right way.
- The chuck is stored as **y+.stl**.
- The blade holder m should be positioned in such a way that the front edge comes to Y= 0. It is stored as **m+.stl**.
- The chuck must be drawn in such a way that one jaw is perpendicular to the top.
- The vertical jaw must be saved as **s1+.stl**. Then the other two jaws follow with view on the chuck counter-clockwise.
- The handwheels are stored as **h+.stl**, **hx+.stl** and **hy+.stl**.
- The tailstock is stored as **r+.stl** and the tailstock quill as **p+.stl**.
- Tool changer are stored as **m+.stl** like a normal blade holder.

For machines that have a tool changer and/or are moving from the rear, additional entries are required on the setting page and in the machine manager.

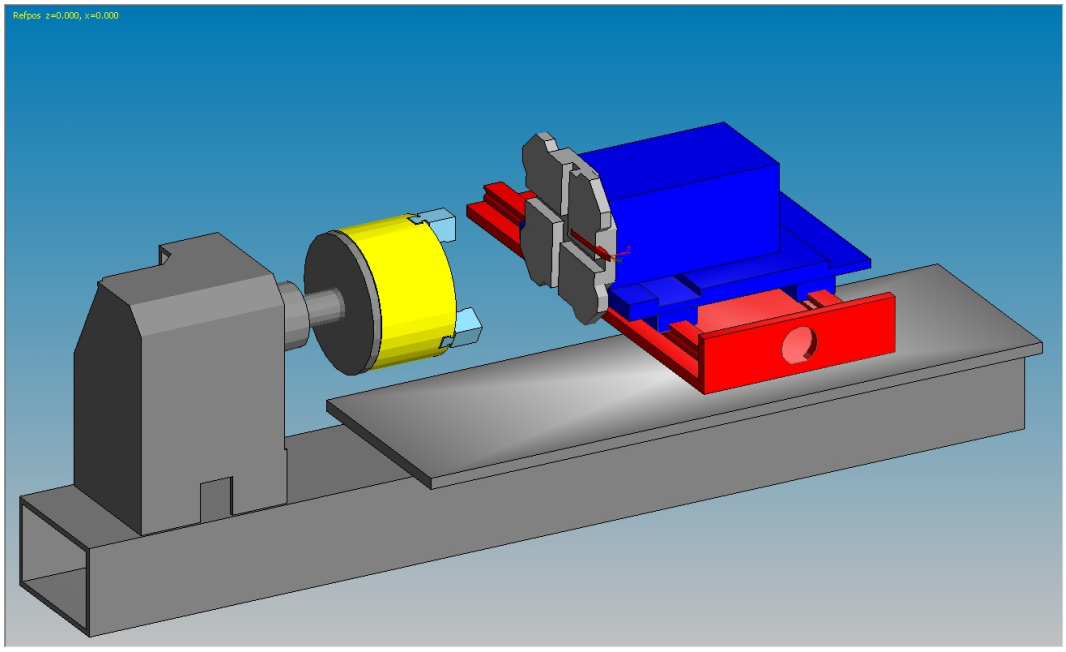


Figure 19: Lathe with tool changer and moving from the rear side

Jogging feedrate	2000
Probing Feedrate	200
Editor	
2. Lathe	
Pitch handwheel	5
Accuracy	0.5
Tool changer	Yes
Tool on opposite side	Yes
3. 2D-Data	
Remove tiny objects	No
Remove duplicate objects	No
Convert to lines	No
Show report	No
Accuracy 2D	0.1
Snap value	0.1
4. Open SCAD	
OpenSCAD	No
OpenSCAD Exe	C:\Program Files\Ope
5. Colors	
Background Bottom	192, 192, 192

Tool changer
Set to "Yes" if a tool changer is available

Figure 20: Parameters on the setting page

In order for the tool changer to rotate correctly, the coordinate of the center point must be entered in the machine manager.

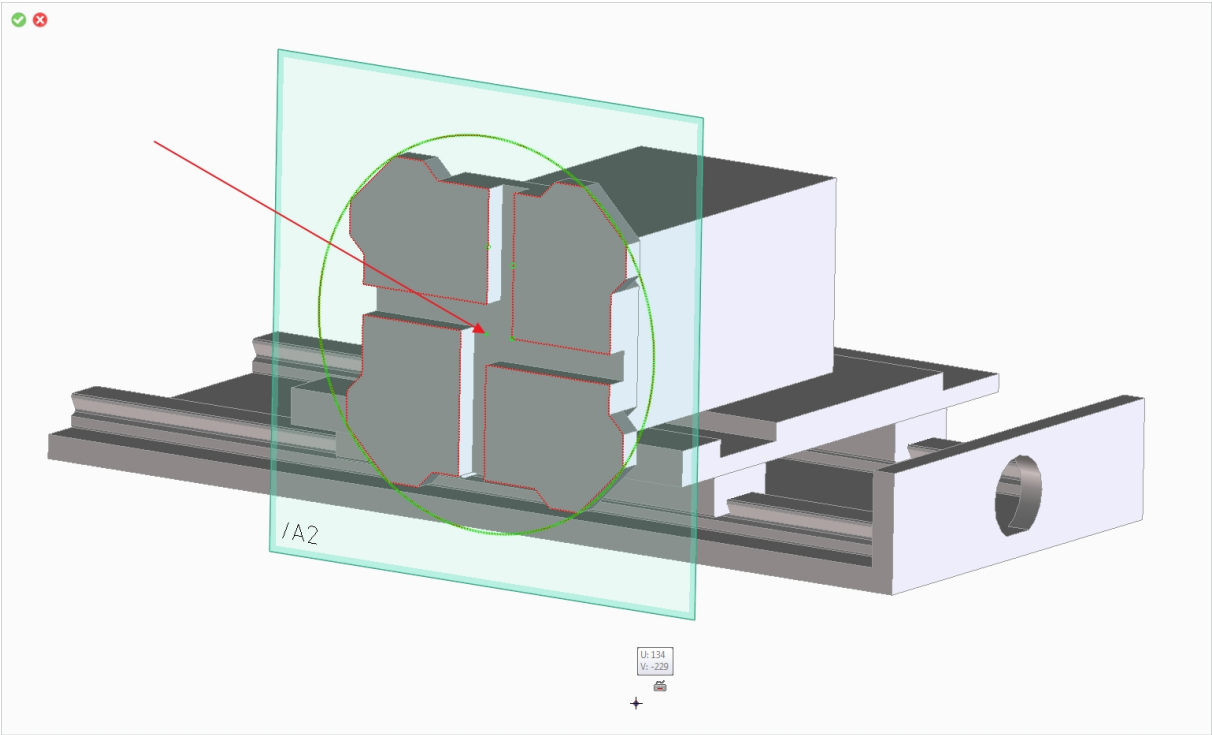


Figure 21: Center of rotation of the tool changer

Position Zp	0
8. Rotation axis A	
Position Xa	0
Position Ya	0
Position Za	0
Direction Xa	0
Direction Ya	0
Direction Za	0
9. Rotation axis B	
Position Xb	232.494
Position Yb	76.2
Position Zb	-10.743
Direction Xb	0
Direction Yb	0
Direction Zb	0

Figure 22: Center of rotation of the tool changer in the machine manager