# Autodesk ® PowerMill ® Robot

## Tool & Spindle calibration

# Autodesk® PowerMill® 2018



## Trademarks



## Disclaimer

# Why to calibrate a spindle?

Robots need to be taught about tools in order to know the tool tip location.

During the teaching procedure, the robot determines where the tool tip center point is, in relation to its 6th axis workplane (in the case where the spindle is mounted on the robot).

This procedure must be repeated for each tool. This means that each tool will contain errors due to the inaccuracy of the teaching process.

Teaching the same tool twice will not give the same result. This is because the process is very visual, so the user will always introduce “human errors”.

Any errors incurred during the teaching stage will be dramatically amplified and will reduce machining accuracy.

The spindle calibration procedure has several key benefits:

- **It helps to improve machining accuracy**
- **It reduces setup times**
- **It removes the need to physically teach each tool**

With this functionality, the robot is closer in behavior to a CNC machine.

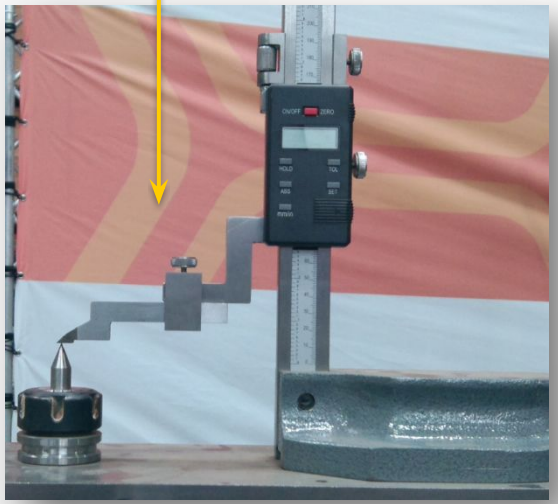
# Objectives

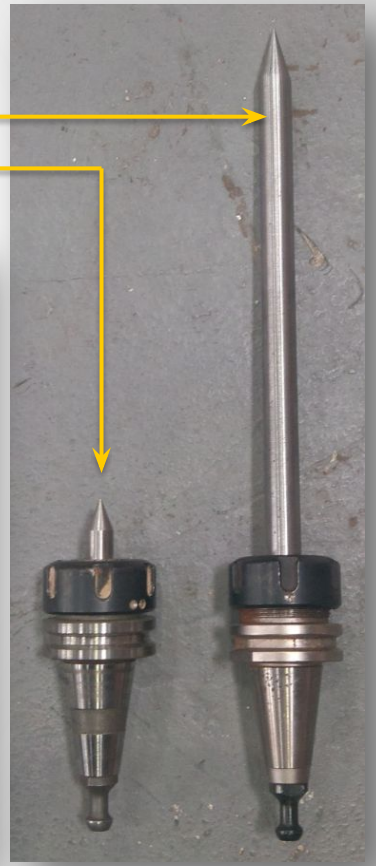
The objective of the spindle calibration procedure is to:

1. Define the spindle center point (XYZ)
2. Define the spindle direction (IJK)

# Requirements to perform a spindle calibration

1. **PowerMill Robot with the robot simulation loaded**
2. **Three probes / spikes**
   - One long probe (spike)
   - One short probe (spike)
   - A third spike (used for teaching)
3. **A tool measuring device**

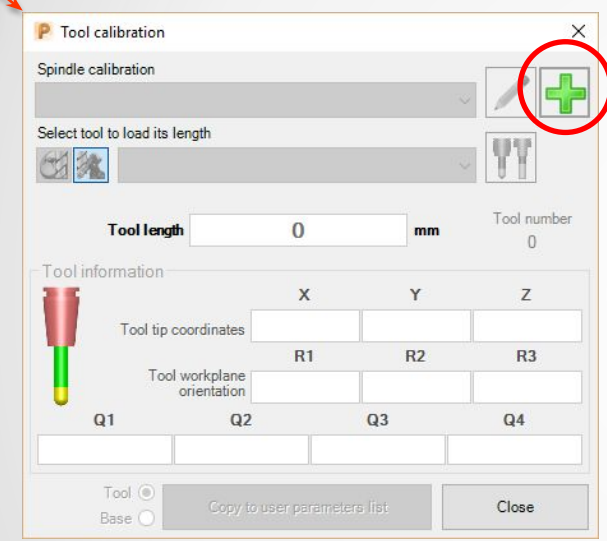


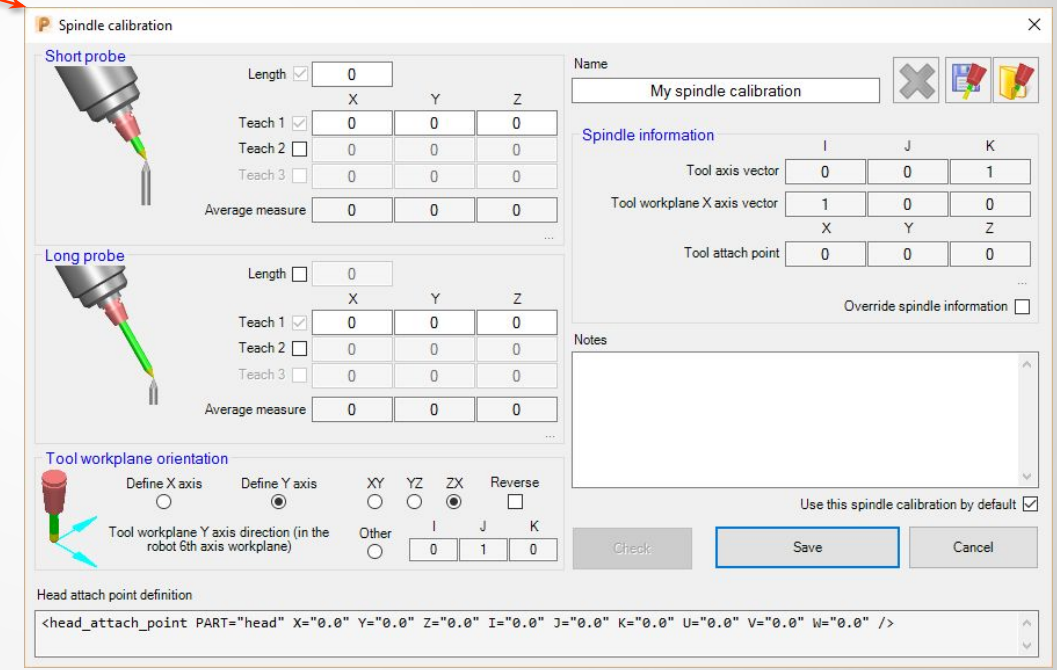


# Step 1: Create a new spindle calibration

From the tool calibration form, create a new spindle calibration.

The spindle calibration data are stored into the RobConfig file of the robot.



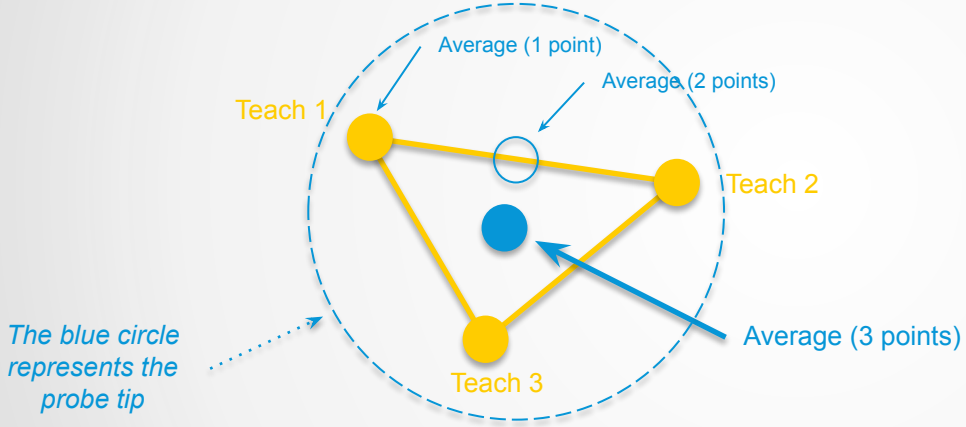



# Step 2: Teach short probe

(Example based on a robot holding the spindle…)

The short probe must be taught as it would be for any other tool that the user wishes to use with the robot (usually using a “4 or 5 points method”). The values we are looking at are the coordinates (XYZ) of the tip of the probe.

Teaching is required at least once but more times will give better accuracy. This is because PowerMill Robot will use their average. The three ‘teach’ method is the best…



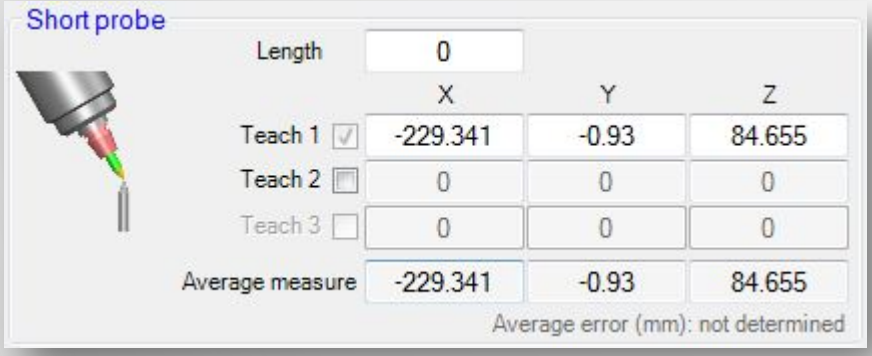

Once taught, the robot can display the X, Y and Z coordinates of the probe tip, in relation to the 6th axis workplane (flange) of the robot *.

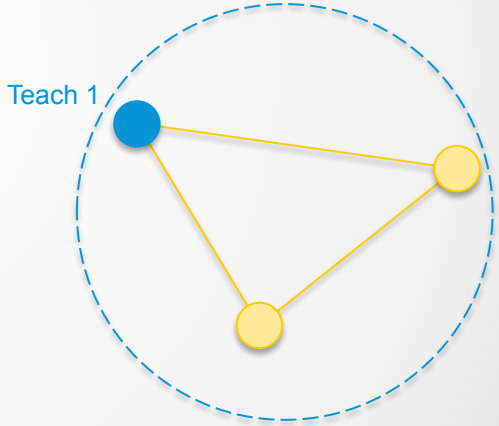
These coordinates will be used by the spindle calibration form.

** If the part is held by the robot (the spindle is on the table), the X,Y and Z coordinates of the probe tip teach are displayed, on the teach pendant, in relation to the robot world workplane.*

# Step 2: Teach short probe. Measure 1/3

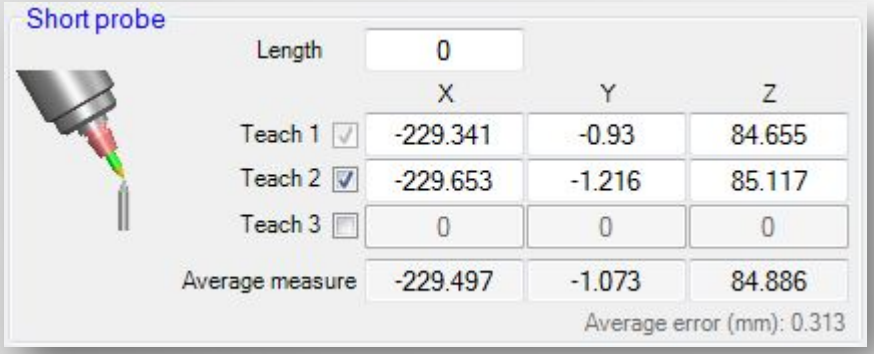
The first ‘teach’ gives the values below:

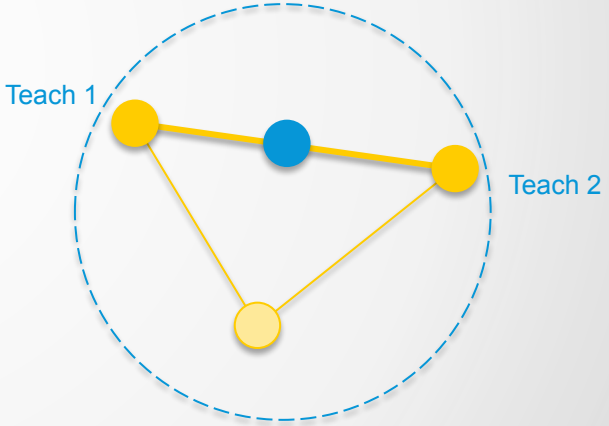


# Step 2: Teach short probe. Measure 2/3

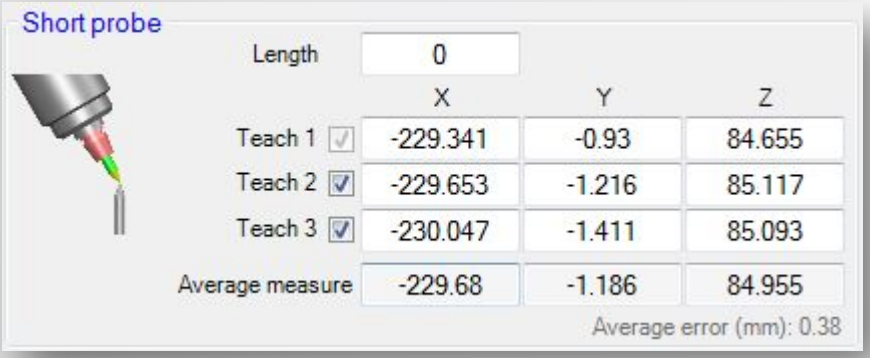
And for the second ‘teach’:

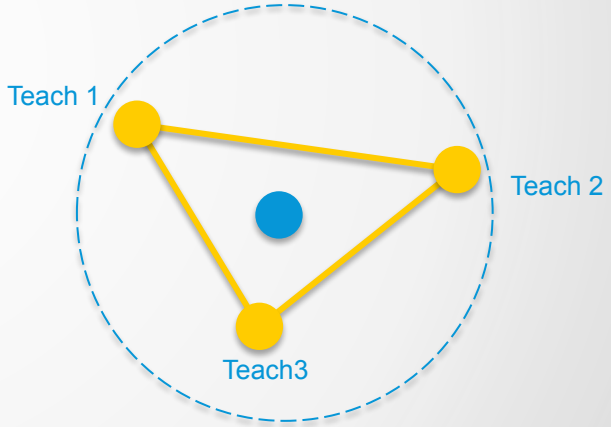


# Step 2: Teach short probe. Measure 3/3

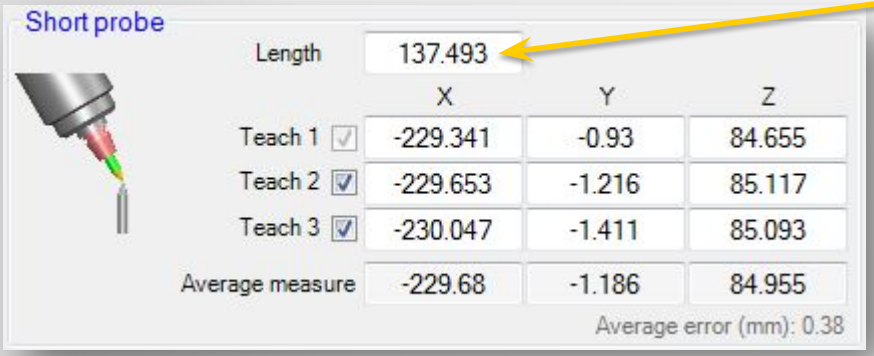
Finally for the third ‘teach’:



# Step 3: Measure short probe length

The short probe length is then measured with the tool measuring device. The value can then be entered into the calibration form:

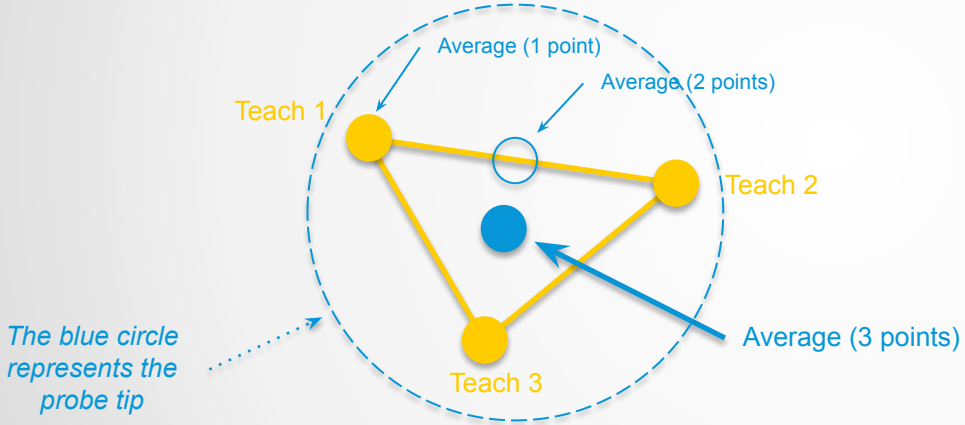




Reference surface

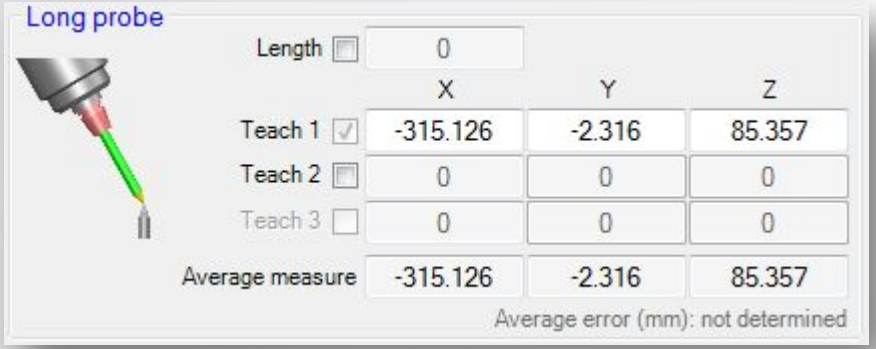
# Step 4: Measure long probe

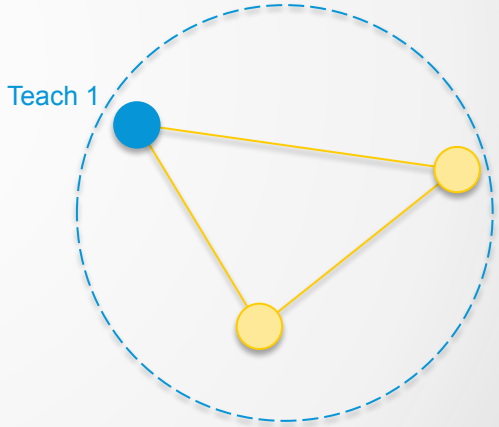
The short probe method is repeated with the long probe…




# Step 4: Teach long probe. Measure 1/3

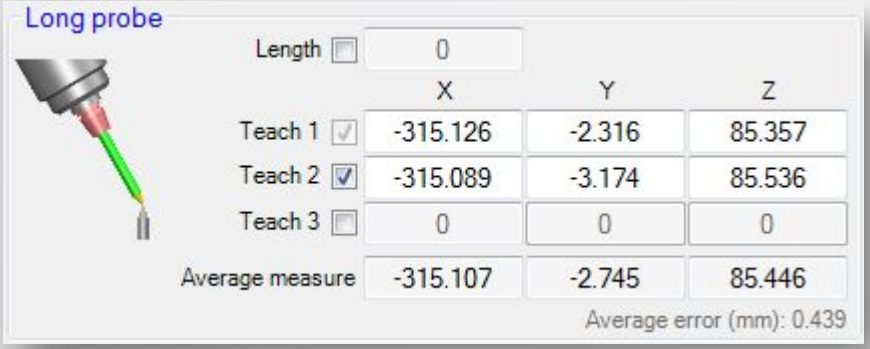
The first ‘teach’ gives the values below:

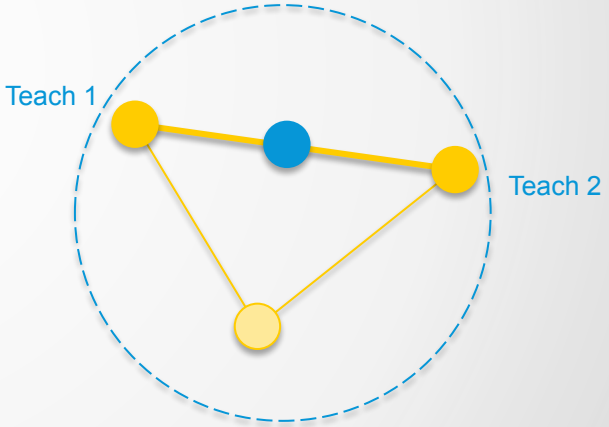


# Step 4: Teach long probe. Measure 2/3

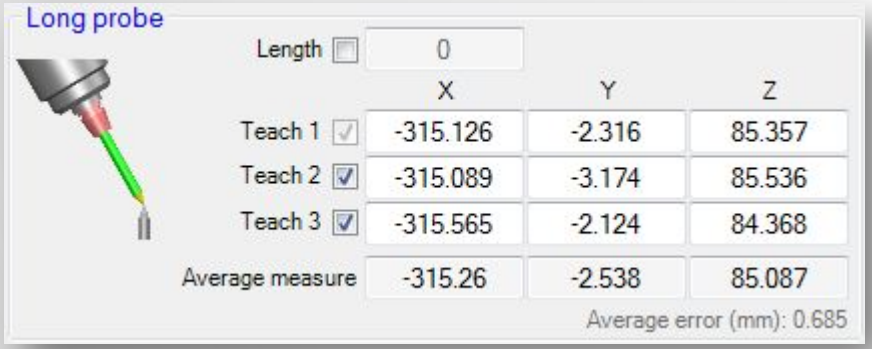
And for the second ‘teach’:

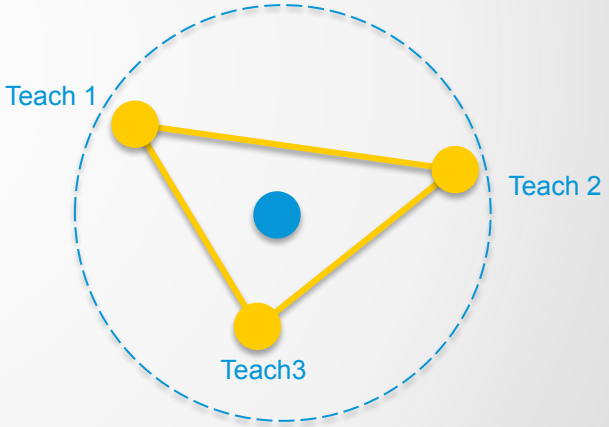


# Step 4: Teach long probe. Measure 3/3

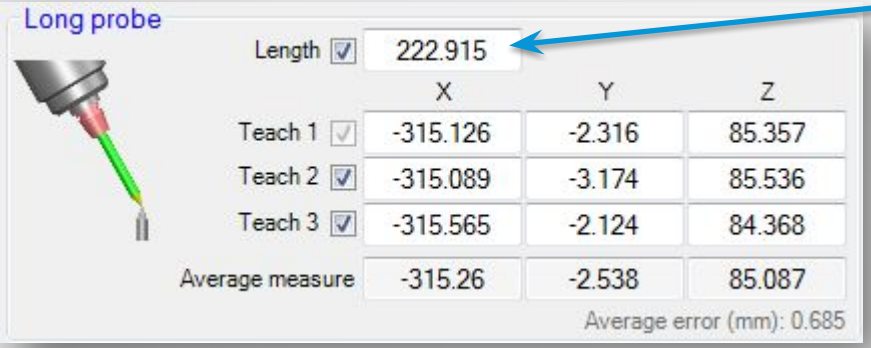
Finally for the third ‘teach’:



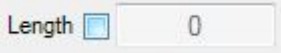
# Step 5: Measure long probe length

Optionally, the long probe length can be measured with the tool measuring device. The value can then be entered into the calibration form:





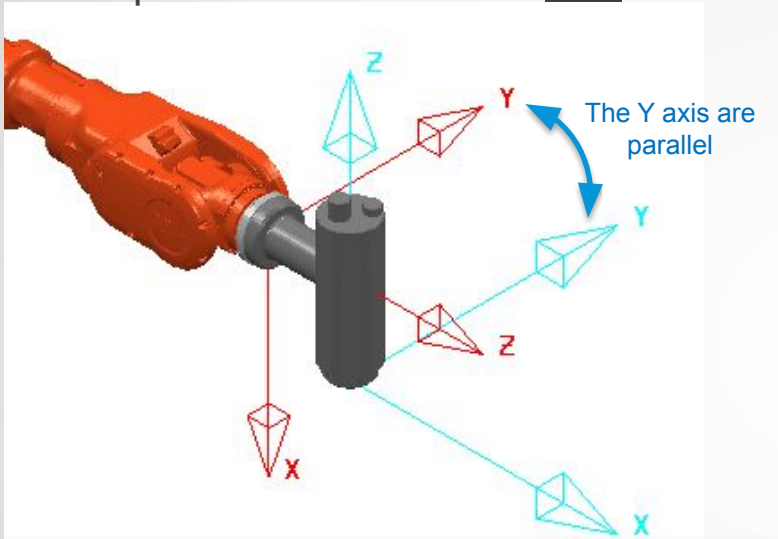
If this is not used, the “Length” field must remain unchecked!

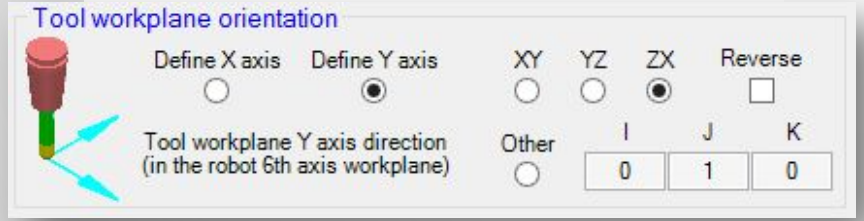


# Step 6: Define tool workplane orientation

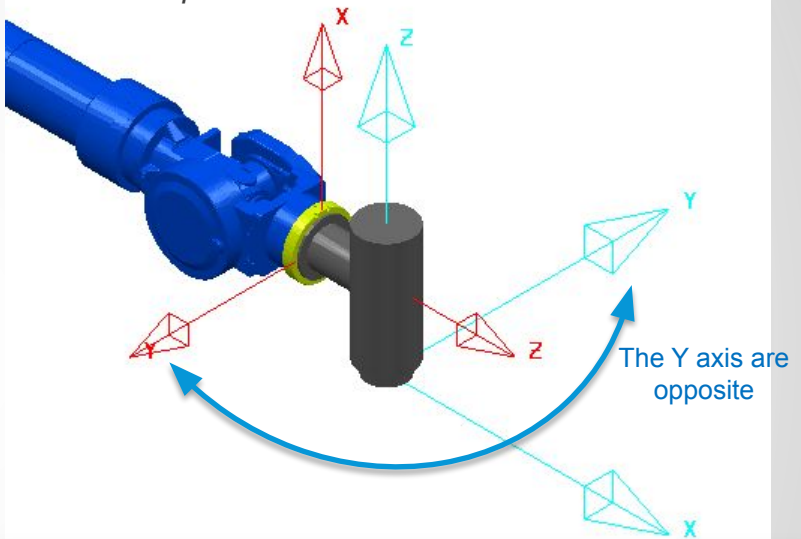
It is necessary to define the X or Y axis direction of the required tool workplane, in reference to the 6th axis workplane of the robot.

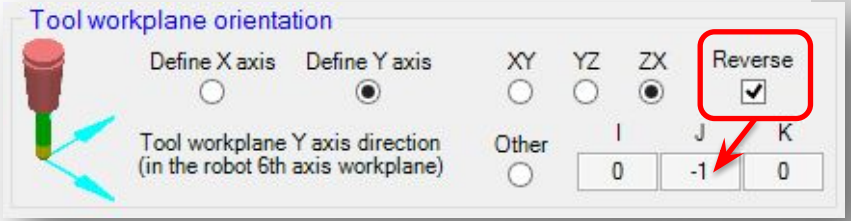
*Note: The orientation of the 6th axis workplane varies between robot manufacturers!*



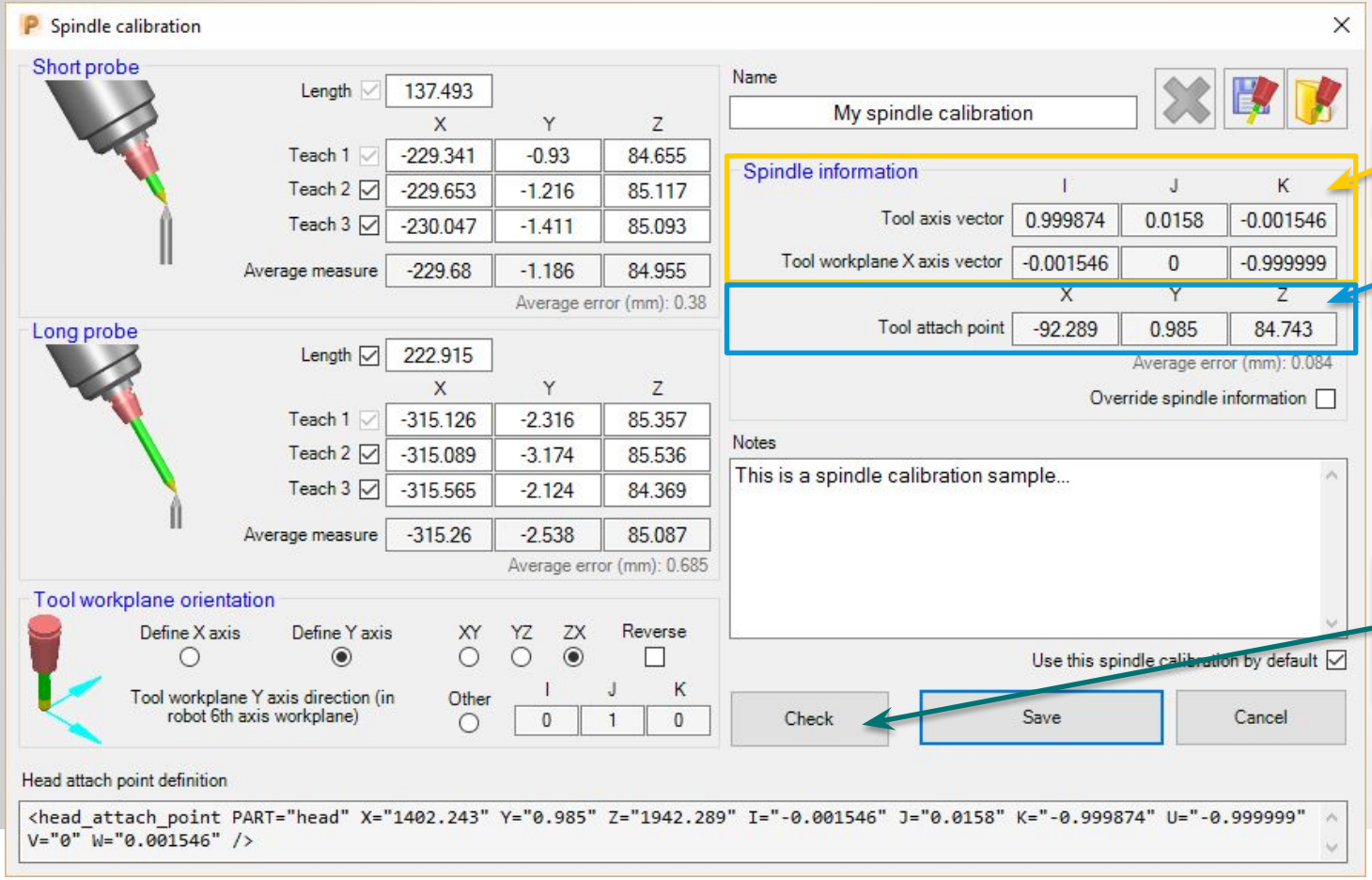

*This is generally used for KUKA, ABB, COMAU…*




*This is generally used for FANUC, MOTOMAN…*

# Spindle information…




Spindle direction (tool workplane)

Spindle center point

Create the “spindle workplane” measured for checking

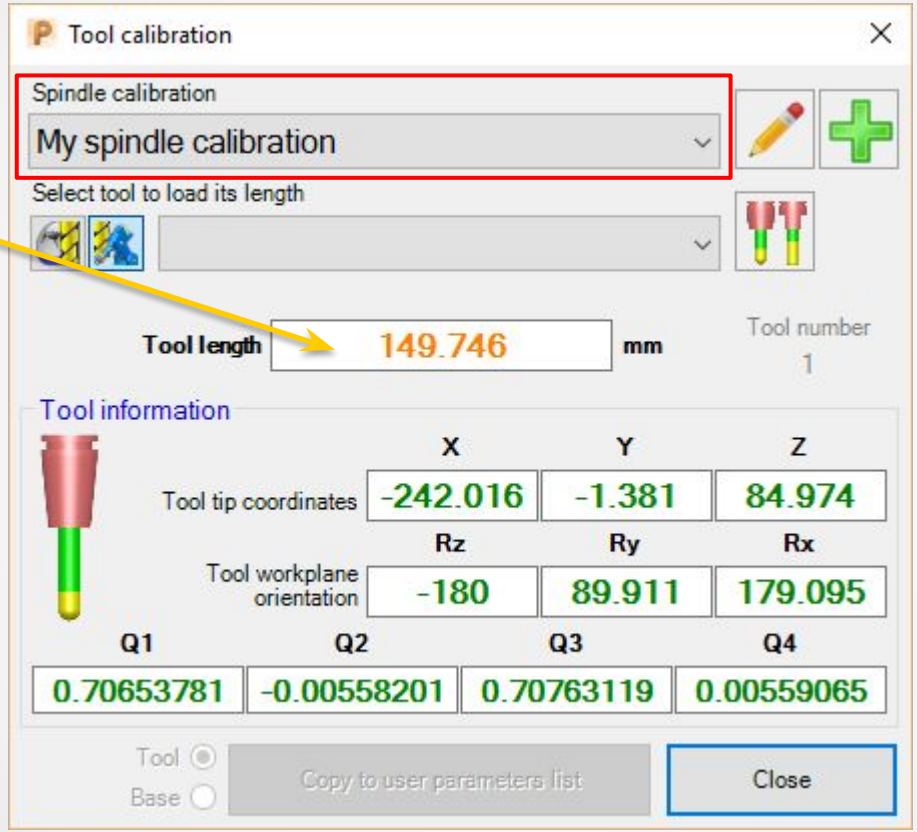
# Step 7: Measure cutting tool length

The cutting tool length is measured in the same way as the probes…




Reference surface

# Tool information is displayed


This information should go in the robot controller or in the robot program.

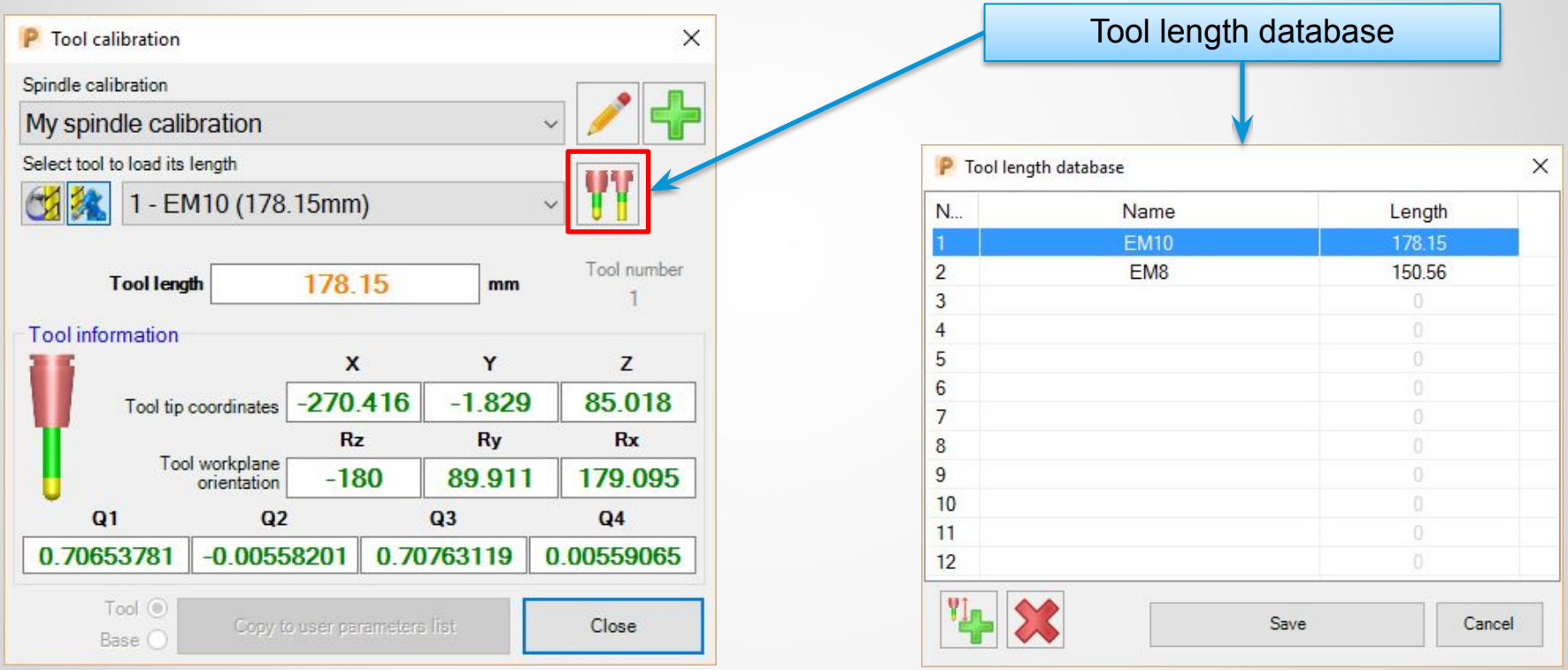
*In this case the tool length was 149.746 mm*

The coordinates are referring to the robot 6th axis workplane (flange) as the spindle is mounted on the robot (for this example)

*Values are displayed in the robot manufacturer specific convention (Euler/Quaternion/…)*

# Tool length database

Tool length can be stored in the tool length database as described below:

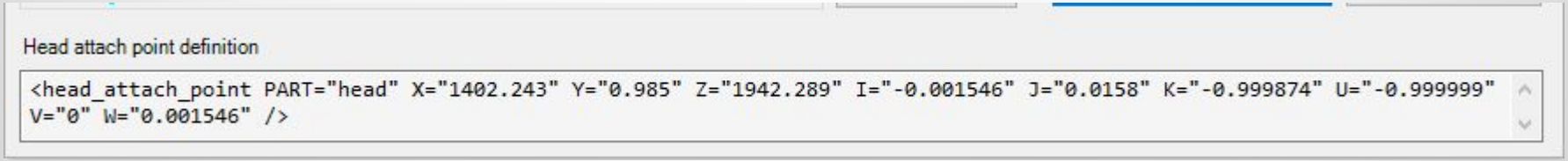


# Step 8: Update CAD & simulation

- For the most accurate simulation the .mtd file can be updated to reflect the 'actual' *head_attach_point* values, derived from the spindle calibration form.

- In some cases it may be advisable to adapt the CAD data of the robot simulation.

```
<head_attach_point PART="head" X="..." Y="..." Z="..." I="..." J="..." K="..." U="..." V="..." W="..."
                                                                                                    />
```

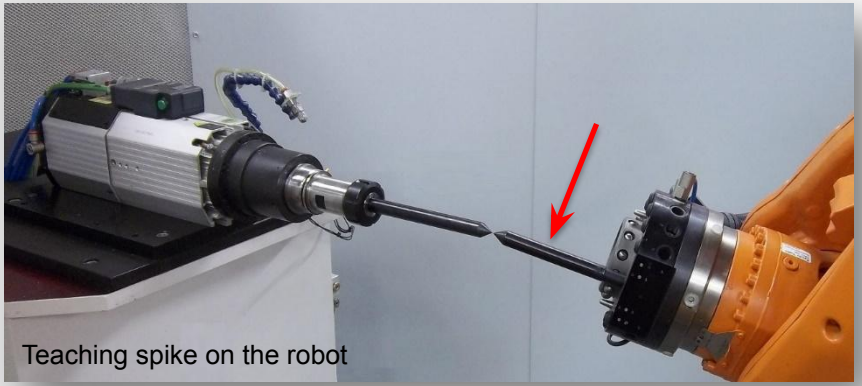


# Autodesk ® PowerMill ® Robot

## Part on robot / External static spindle

# Part-on-robot / External static spindle

**Step 1**: Teach the spike on the robot like a standard tool, against a fixed spike (usually using a “4 or 5 points method”)



Teaching spike on the robot

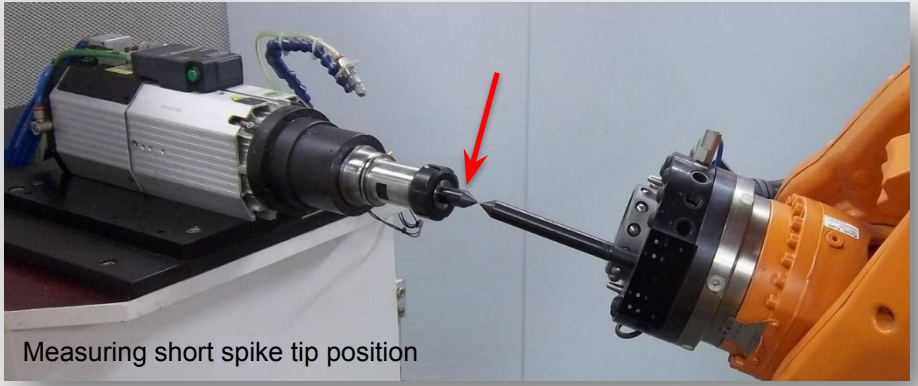
This will give the position of the robot spike tip from the robot flange (6th axis) workplane and allow to jog the robot around the robot spike tip.

The robot teach pendant can usually show the position of the tooltip from the robot world workplane and this is what we will use next.

**Step 2**: Switch the teach pendant display to show tooltip coordinate from **robot world workplane**

# Part-on-robot / External static spindle

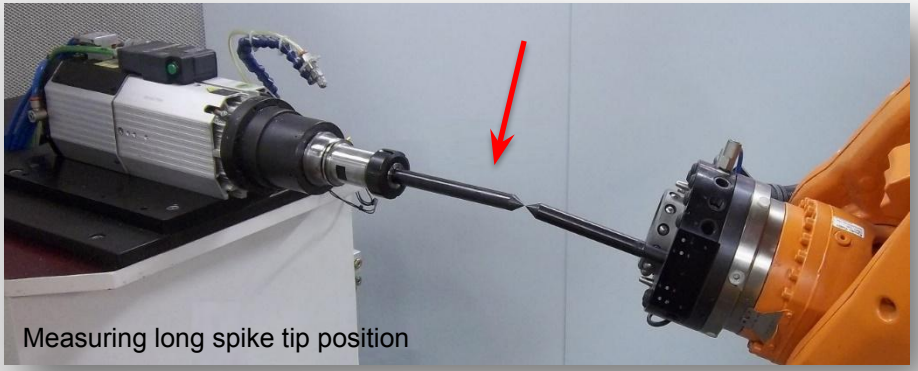
## Step 3: Measure the short spike tip position



Measuring short spike tip position

Moving the previously taught robot spike tip against the short probe tip will show, on the robot teach pendant, the position of the short spike tip from the robot world workplane.
These are the XYZ coordinates to use in the spindle calibration form.

## Step 4: Measure the long spike tip position



Measuring long spike tip position

The same as above needs to be done with the long probe... and the coordinate from the world workplane needs to be entered in the spindle calibration form.

The short and long spike as well as the cutting tools are measured in the usual way (as described earlier).

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