Application Note A157: PCS and SMART Move for speed, accuracy and ease of use

Form Talysurf® PGI **NOVUS** and **Metrology 4.0** software

Simple measurement of complex parts

James Porter, Applications Engineer

For the first time, the stylus tip is fully positionable around the sample, using Taylor Hobson's unique SMART Move and Part Co-ordinate System (PCS).

Introduction to co-ordinate systems

There are significant advantages of the Form Talysurf® PGI NOVUS part co-ordinate system over a traditional instrument-based co-ordinate system.

Traditionally, profilometers use a co-ordinate system based around the instrument axes. In Metrology 4.0 this is called the Instrument Co-ordinate System (ICS). Here, X, Y, and Z refer to the machine's axes. X is the traverse unit and runs from left to right, the linear Y stage is typically mounted orthogonally and runs from front to back. A vertical columns provides the Z axis and runs up and down. This co-ordinate system represents 3D movement around the working area. It is useful for a wide range of applications and all axes can be controlled very precisely (Figure 1).

However, many applications require a different approach where an ICS alone would have limitations. The Form Talysurf® PGI NOVUS Part Co-ordinate System (PCS) provides the basis for constructing a new co-ordinate system that is built around a part's alignment, orientation and origin. This allows precise and rapid movement around the part with respect to the design profile with respect to the design.

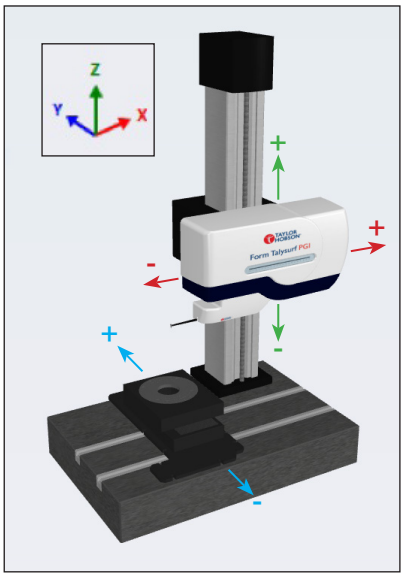

Figure 1 - Instrument co-ordinate system (ICS) of the Form Talysurf® PGI NOVUS

Part Co-ordinate System (PCS)

What is PCS?

The part co-ordinate system concept makes the measurement of a component much easier to visualise and understand. It gives a local frame of reference to which the locations of features are defined. When a technical drawing is created, the dimensions and features are defined from a common reference point (origin) and associated axes.

The PCS co-ordinate system takes this concept and allows the measurement of the part to be conducted using the reference point and axes.

When it comes to the measurement of the component, the part's reference point and axis are set as the new PCS origin. This then allows the Metrology 4.0 software to position the stylus tip on any desired feature with exceptional accuracy.

Figure 2 shows a part measurement with a PCS origin attached to it. The part co-ordinate system is denoted by the blue, green and red arrows. Once the origin has been set, the co-ordinate system is maintained even with rotation of the rotary stages (Figure 2). After rotation, any subsequent measurement will maintain its relationship with the PCS of the previous measurement.

Metrology 4.0®
SMART SOFTWARE

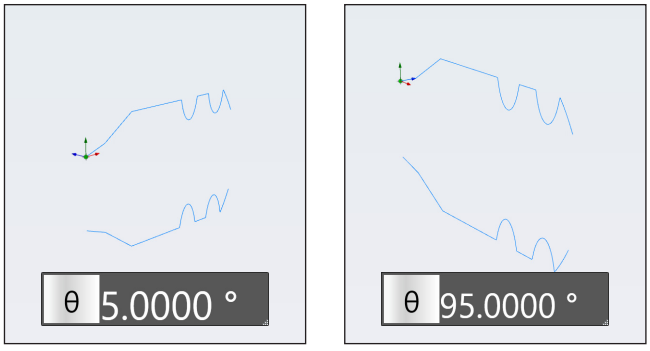

Figure 2 - Example showing how the PCS co-ordinate system is maintained after rotating the part through 90°

How does PCS work?

Form Talysurf® PGI NOVUS and Metrology 4.0's ability to position the stylus tip accurately, means that PCS is extremely useful for demanding measurement requirements. The Form Talysurf® PGI NOVUS can automatically control the position of the stylus through the gauge range (20 mm using a 100 mm long stylus). As the stylus tip moves through an arc, it is important to know where the tip is at any time. This means it is necessary for the movement of a particular stylus to be known. Software intelligence is used to plot the path of the arc and knows beforehand where the tip will be (Figure 3).

The length of the stylus and its shank length can be used to predict the path of the stylus. Metrology 4.0 takes this one step further, utilising the gauge calibration to determine the precise path of the stylus as it moves through the range. This further increases the accuracy of movements and allows the exact position of the stylus tip to be predicted.

The gauge can be controlled in both Normal and Reverse bias, allowing both upper and lower surfaces to be measured and related to each other. The co-ordinates of the current (upper or lower) tip position are displayed and updated live at all times. As the software knows the current position of the tip, it is able to move to any location around the sample being measured.

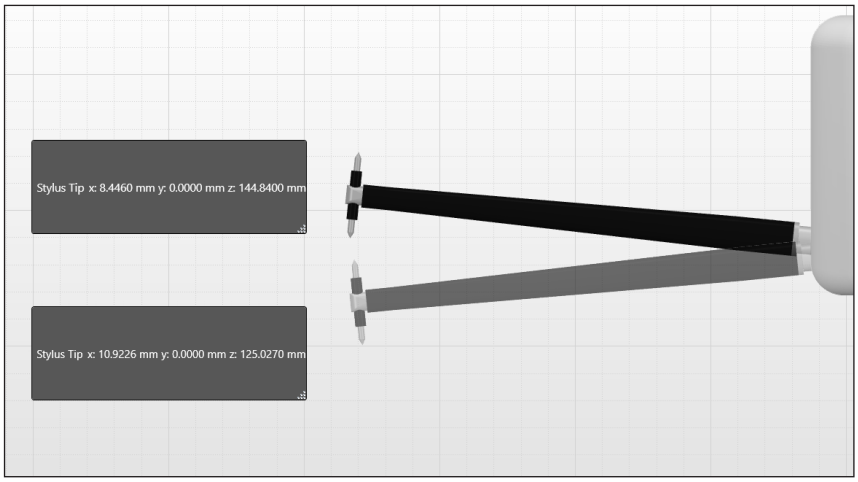

Figure 3 - Example showing that the stylus tip position is always known throughout the gauge range. This means that the tip can be precisely positioned where required.

SMART Move

SMART move is very useful for providing easy access to complex features, or inside bores, for example. It removes all operator guess work and gives confidence to the operator.

The PCS co-ordinate system relies on the powerful ability of precise stylus tip control. This allows the stylus to move in and around the part with extraordinary accuracy. Multiple PCS points can be created which will have specific X, Y, Z co-ordinates that are relative to the current PCS origin. SMART move is very useful when measuring inside bores as it removes all operator guess work.

Once a PCS point is made, the stylus tip can then be precisely positioned or lowered onto it. There are multiple ways of creating PCS points for use with SMART Move. Two methods are detailed below.

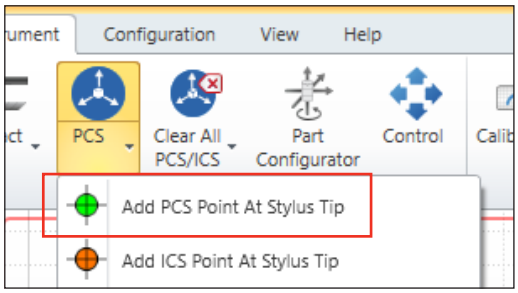

Figure 4 - Option to create a point from the stylus tip position.

1. Create a point at stylus tip

A PCS point can easily be created from the current position of the stylus (Figure 4). This can be an effective way of setting the origin of a component. For example, the user could use the automatic cresting functionality to find the top point of a part. Once the crest has been found, the stylus tip can automatically move to that position and a PCS point can be set.

2. Add datum point from analysis

A PCS point can be automatically set from a measurement. This is invaluable when measuring hard to find features. For example, when measuring the small land area on a threaded part or when measuring in an internal bore that cannot be seen by the operator. This is done by taking a measurement and using the contour analysis to find a point of interest.

Example - Using PCS points and SMART Move on a threaded part

Taking the example of a threaded part, it is often required to align on the thread itself. To do this the stylus tip needs to be required to be on the top of the thread. This then allows the use of the Cylinder Alignment function to align the part (for more information, please see the Technical Note on Cylinder Alignment).

The thread adds complexity as the start point is changed with radial orientation. Using contour, it is possible to find the start position of the thread in any part orientation and then feed the exact position back as a PCS point for SMART Move to be used.

1. Finding start position using contour and PCS.

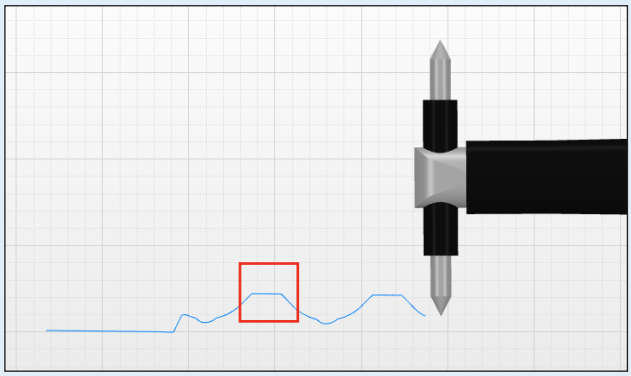

Figure 5.1 - An initial measurement to locate the start of the thread

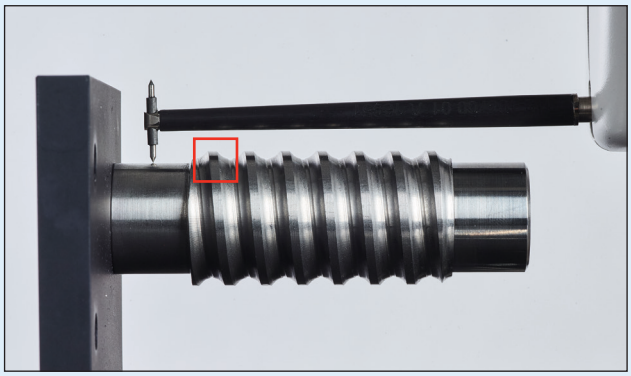

Figure 5.2 - The stylus is required to be positioned on the first lead (highlighted)

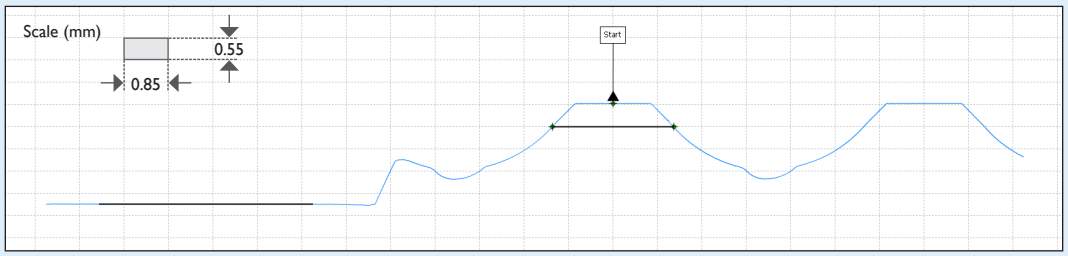

Figure 5.3 - An advanced contour analysis is automatically applied to create a datum point at the start of the thread

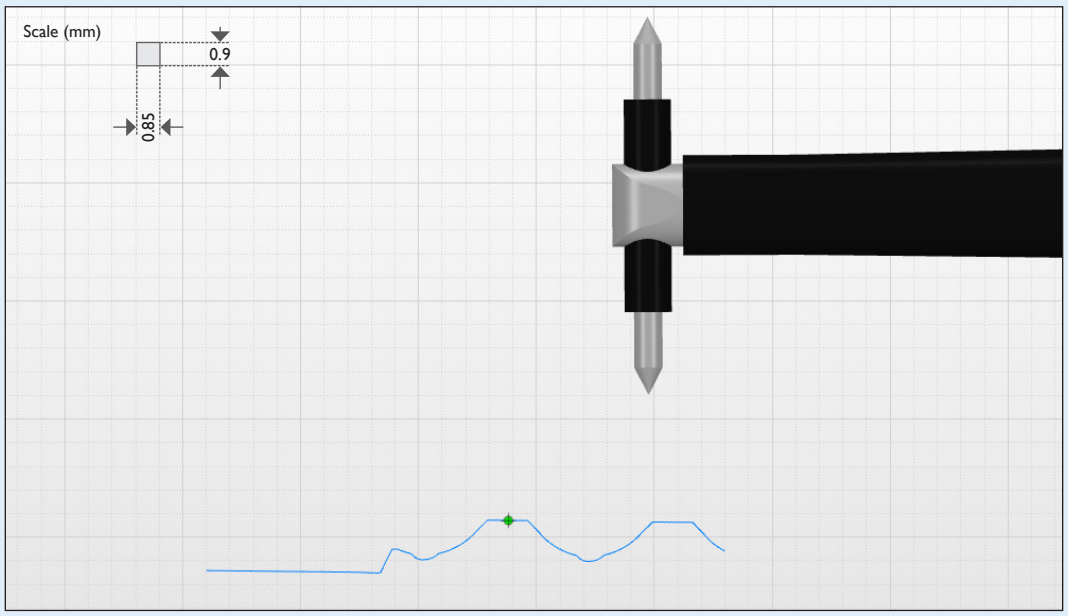

Figure 5.4 - The datum point can then be added as a PCS co-ordinate

2. Moving to start position using SMART Move.

The pre-flight path plots the exact route the stylus tip will travel. This allows precise control when measuring small, intricate areas and helps to avoid obstructions. Once the stylus tip has been placed onto the top of the thread, the part can be correctly aligned.

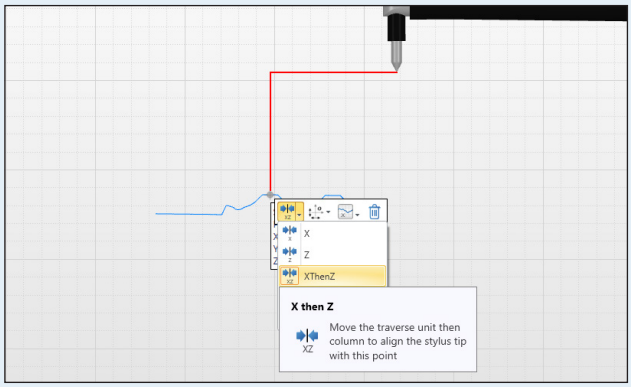

Figure 9 - Shows the flight path of the stylus when moving around the part

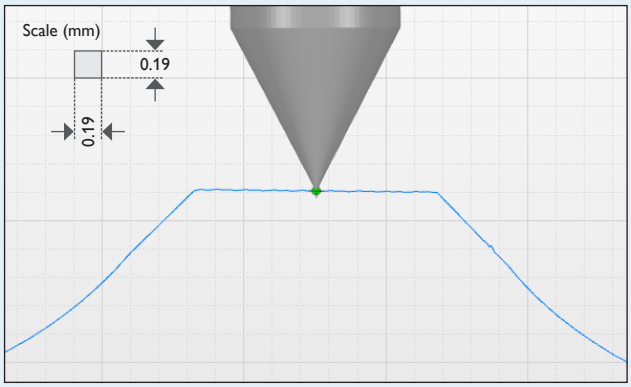

Figure 10 - The stylus tip is now located on part

Measure from point

PCS points become even more powerful when using them to define measurement areas. It is possible to measure from one point to another instead of having to input a measurement length. This becomes very useful when measuring parts with only a small amount of land or where there are big drop offs which could damage styli.

The instrument view also shows the available gauge range of the stylus and the path the stylus would need to travel in order to reach the first point. This function makes the measurement process remarkably easy.

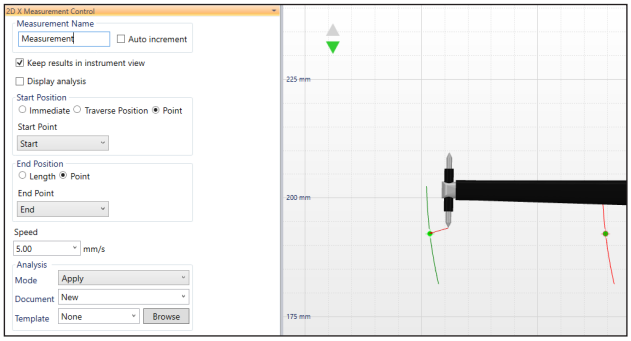

Figure 11 - Measurements from one PCS point to the next show the available gauge range of the stylus and path of the stylus tip (green and red arcs)

Summary

Form Talysurf® PGI NOVUS and Metrology 4.0's unique functionality allows any component to be measured with the highest confidence using PCS and SMART Move. For the first time, the stylus tip is now fully positionable around the sample, leading to faster programming, less accidental collisions and greater efficiency.

Taylor Hobson UK
Tel: +44 (0)116 276 3771
taylor-hobson.sales@ametek.com

Taylor Hobson France
Tel: +33 130 68 89 30
taylor-hobson.france@ametek.com

Taylor Hobson Germany
Tel: +49 6150 543 0
taylor-hobson.germany@ametek.com

Taylor Hobson Italy
Tel: +39 02 946 93401
taylor-hobson.italy@ametek.com

Taylor Hobson India
Tel: +91 80 6782 3346
taylor-hobson.india@ametek.com

Taylor Hobson China
taylor-hobson-china.sales@ametek.com
Shanghai Office
Tel: +86 21 5868 5111-110
Beijing Office
Tel: +86 10 8526 2111
Chengdu Office
Tel: +86 28 8675 8111
Guangzhou Office
Tel: +86 20 8363 4768

Taylor Hobson Japan
Tel: +81 34400 2400
taylor-hobson.japan@ametek.com

Taylor Hobson Korea
Tel: +82 31 888 5255
taylor-hobson.korea@ametek.com

Taylor Hobson Singapore
Tel: +65 6484 2388 Ext 120
taylor-hobson.singapore@ametek.com

Taylor Hobson Thailand
Tel: +66 2 0127500 Ext 505
taylor-hobson.thailand@ametek.com

Taylor Hobson Taiwan
Tel: +886 3 575 0099 Ext 301
taylor-hobson.taiwan@ametek.com

Taylor Hobson Mexico
Tel: +52 442 426 4480
taylor-hobson.mexico@ametek.com

Taylor Hobson USA
Tel: +1 630 621 3099
taylor-hobson.usa@ametek.com