IBS Precision Engineering

TRISKELION

ULTRA PRECISION TACTILE PROBE SYSTEM

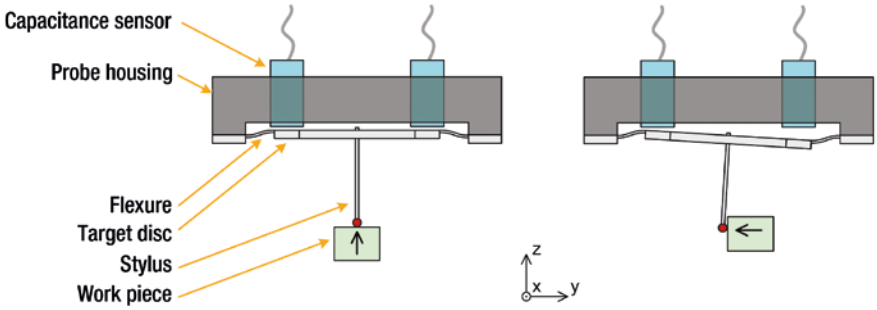
INTRODUCTION

IBS Precision Engineering has developed a 3D ultra-precision touch probe system with a very high accuracy, the Triskelion probe. This probe system is suitable for point measurements as well as scanning. Its excellent measuring uncertainty and full 3D measurement capabilities make this probe suitable for ultra-precision 3D metrology. Possible applications include ultra-precision (micro-/nano-) CMMs as well as on-machine metrology on machine tools.

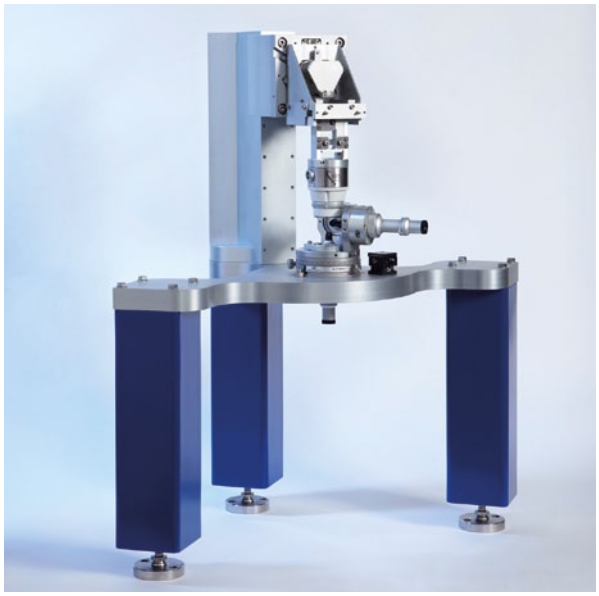
PROBE CONCEPT

A schematic representation of the probe concept is shown below. The stylus is elastically suspended by means of flexures. The stylus is attached to these flexures via a rigid body; this body contains target discs which serve as measurement targets for the capacitance sensors. During deflection of the probe tip, the capacitance sensors measure the displacements of these target discs; from the 3 measurement signals the displacement of the probe tip can thus be determined.

Schematic representation of probe concept



The image shows the working principle of the probe system for deflection of the probe tip in vertical and sideways direction. Note that this is a 2D simplification; the actual design features three flexures and three capacitance sensors, allowing deflection in full 3D, while the deflection of the tip is also measured in x-, y- and z-direction. The suspension of the stylus is realized by means of a monolithic metal suspension foil. This foil contains both the flexures and the three-legged body which connects the flexures to the stylus. The thickness of the flexures is reduced to achieve the desired (low) stiffness of the suspension and to ensure that elastic deformation takes place in the flexures and not in the three-legged body or in the stylus. At the end of each flexure, circular target discs serve as the targets for the three capacitance sensors.



DESIGN FEATURES

LOW CONTACT FORCE

Contact force between probe tip and work piece surface must remain low to prevent the risk of damaging the surface. For the probe design shown on the previous page this contact force is typically 0,07 mN. Other than the 'static' contact force, the impact of the probe tip colliding with the work piece can also cause surface damage. A very efficient way to reduce the collision force is to minimize the suspended mass of the system as implemented in the Triskelion probe.

3D SCANNING UP TO 90 DEGREES

The Triskelion probe is designed for a full 3D measurement independent of the local angle of the probe with respect to the surface. Measurements up to 90 degrees can be performed without losing accuracy. All these measurements are done continuously with data rates up to 10 kHz. Triskelion probes can measure any surface with nanometer precision whether it is a ultra precision sphere, a complex freeform or even a discontinue surface.

LARGE MEASUREMENT RANGE

The measurement range of the probe system is a critical parameter for the control of the CMM: after a probe trigger has been detected, the CMM axes should reach a standstill within the measuring range of the probe system. If this is the case, simply adding the measured probe deflection to the position measurements from the machine axes will yield the measurement point coordinates. The measurement range of all Triskelion probe systems is ± 10 µm in all directions.

STABILITY

The long-term stability of the probe system has been optimized by applying low-expansion materials. The complete probe body and the elastic suspension are made from invar®. The stylus is made from tungsten carbide. In addition, the probe system is assembled from only a minimum number of parts, without adhesives or other potentially unstable assembly techniques.

PICTURE EXPLANATION :

1. Standard probe
2. Micro-tip probe
3. High aspect ratio probe

PROBE TIP SIZE AND FLEXIBILITY

Products may have small features, such as narrow ridges or small holes, which cannot be measured with a large probe tip. Reducing the probe tip size greatly increases the measurable feature of such work pieces. For our probe system, spherical tips with radii between 0,035 and 0,5 mm are available.

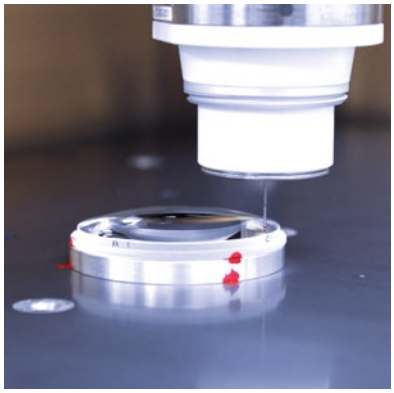
ROBUST DESIGN AND LOW REPLACEMENT COSTS

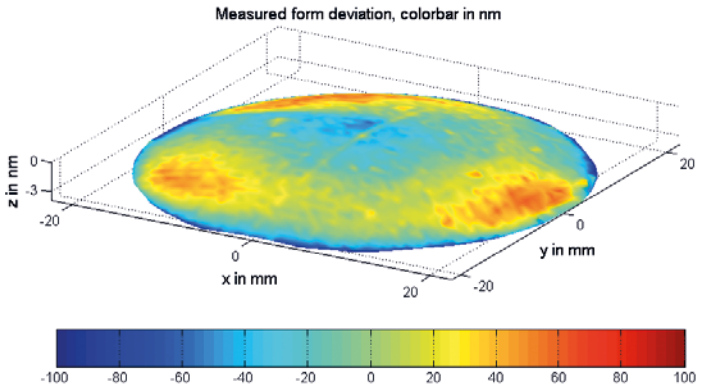
The Triskelion design concept separates the highly accurate measuring system from the moving part of the probe. In the case that the probe tip should be replaced or the probe is damaged by a collision only the moving part of the probe has to be replaced.

EXAMPLE APPLICATION

The images below show an asphere measurement using the Triskelion standard probe system. For this measurement, the probe system was integrated in an ultra-precision CMM.

Measurement of an asphere





SPECIFICATIONS

	Triskelion A-250 Standard probe	**Triskelion B-35** Micro-tip probe	**Triskelion C-500** High aspect ratio probe
Tip diameter	0,5 mm	0,07 mm	1 mm
Stylus length	8,5 mm	6 mm	13 mm
Probe housing diameter	35 mm	20 mm	28 mm
Suspended mass	160 mg	75 mg	300 mg
Probe stiffness (at tip)	70 N/m isotropic	XY: 13 N/m Z: 20 N/m	XY: 35 N/m Z: 113 N/m
Measurement range X, Y, Z	± 10 µm	± 10 µm	± 10 µm
Measurement resolution (RMS)	2 nm	2 nm	2 nm
3D measurement uncertainty of tip deflecation (k=2)	< 15 nm	< 20 nm	< 20 nm

Custom probes for specific applications are available upon request.

IBS Precision Engineering

THE NETHERLANDS
HEAD OFFICE
IBS PRECISION
ENGINEERING BV
E-mail: info@ibspe.com
Internet: www.ibspe.com

GERMANY
IBS PRECISION
ENGINEERING
DEUTSCHLAND GMBH
E-mail: info@ibspe.de
Internet: www.ibspe.de

FRANCE
IBS PRECISION
ENGINEERING SARL
E-mail: info@ibspe.fr
Internet: www.ibspe.fr