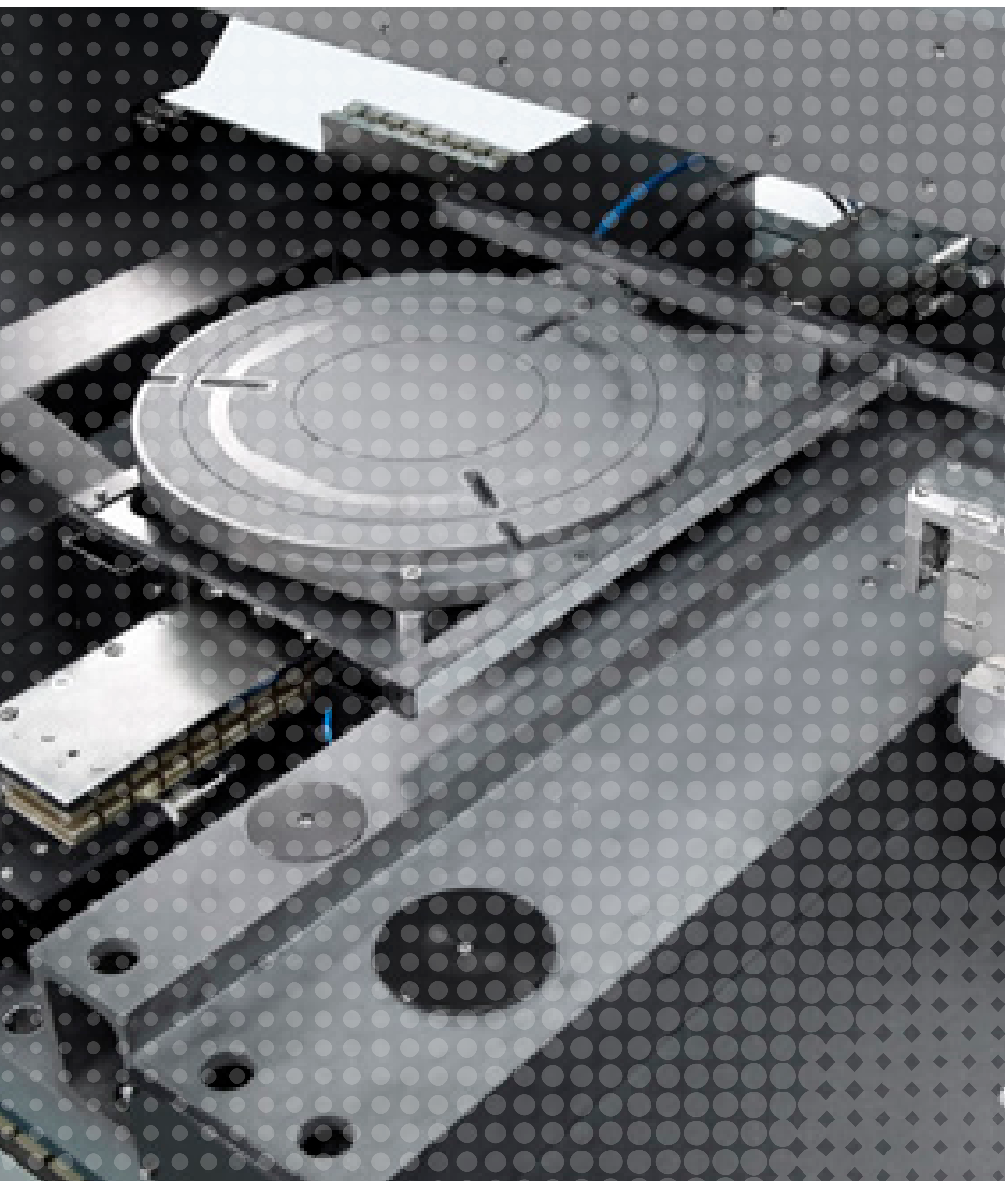
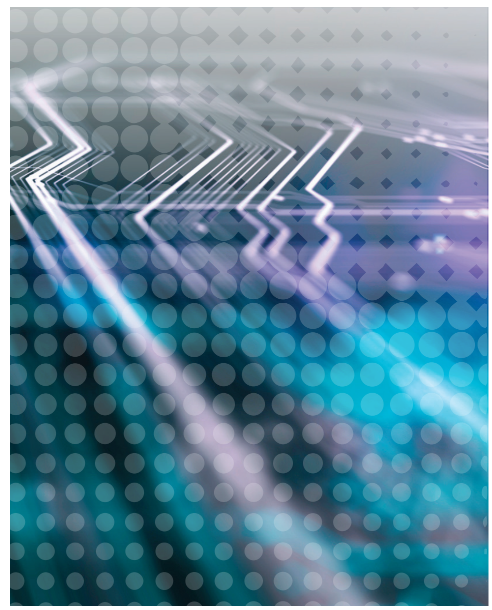
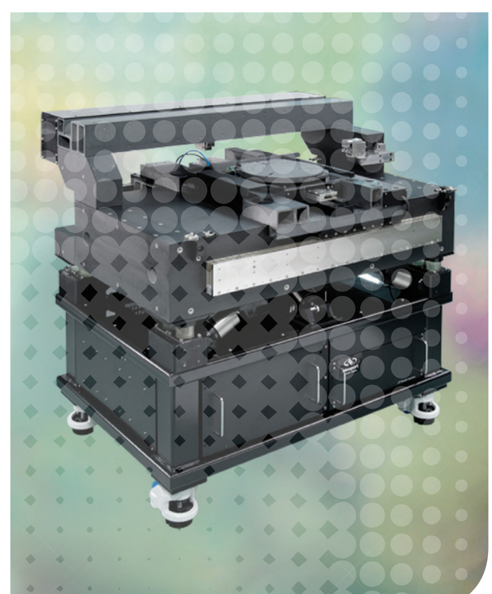
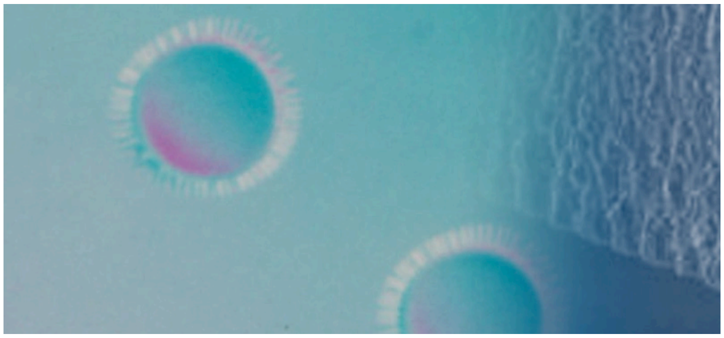
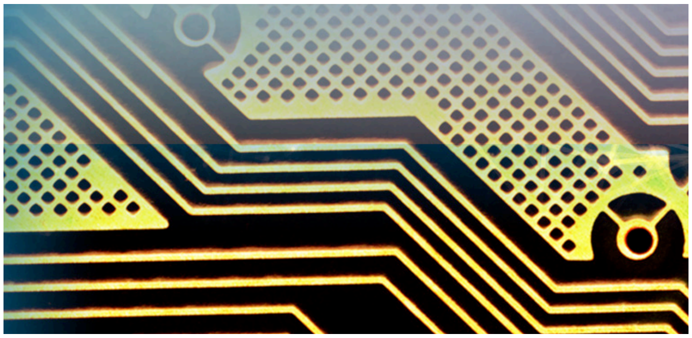
CERAMECH
UNIQUE TECHNOLOGY FOR DYNAMIC MOTION SYSTEMS











TECHNOLOGY AND MATERIALS

To illustrate the advantages of SiC in motion applications, the table below details the weight and stiffness advantage of SiC. Comparable to the density of aluminum and granite, SiC has the added advantage of higher stiffness than any material used in precision motion applications, including steel and aluminum. The thermal conductivity of SiC is l 6 X lower than aluminum. While its thermal expansion coefficient is lower than granite.
The benefits of using SiC are the ability to move and stop at higher accelerations coming from its light weight and high stiffness and better accuracy and repeatability due to less susceptibility to thermal changes. Another measurable benefit from SiC's desirable characteristics is in position stability.

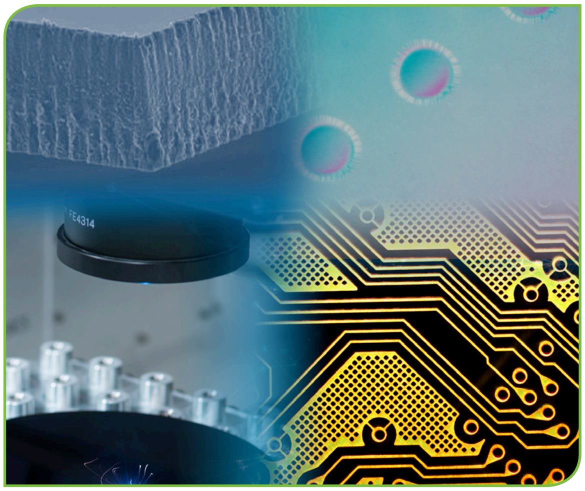
Material Properties of SiC, Granite, and Other "Traditional" Stage Material

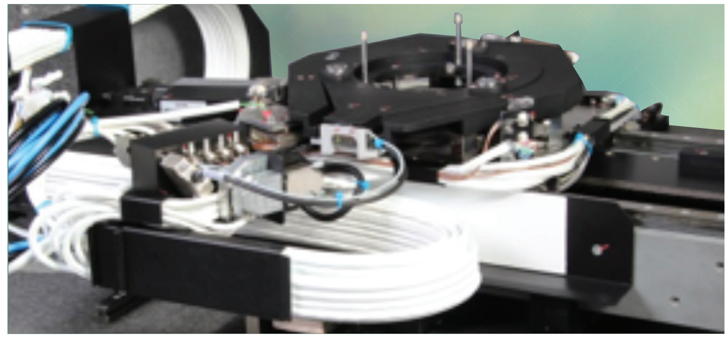
	Granite	Steel	Aluminum	SiC
Density: d	3	7.8	2.7	2.7
Young's Modulus: E, (GPa)	70	210	70	250
Stiffness (E/d)	23	27	26	93
Thermal Conductivity: TC (W/m*K)	2	50	180	30
Thermal Expansion: TE (10-6/K)	5	11	22	3.5

Applications

CeraMech's stiffness and light weightiness makes it ideal for production environments that require high dynamic and high precision performance. From wafer level processes or inspection, to large panel laser drilling, there are ideal applications where the performance needed is close to air bearings, but the price point is pulled down by mechanical bearing systems. Examples of applications that demand higher precision and throughput are listed below:

a. Automatic Optical Inspection
b. Wafer Inspection
c. Wafer Dicing/Grooving
d. Metrology
e. Laser Microprocessing of Large Panel Displays
f. Laser Via drilling of Large Panel Boards
g. Flex circuit cutting, drilling





BENEFITS AND VALUE PROPOSITION

a. Lightweight

Using hollow SiC beams, CeraMech has a lower mass and 3.5 times stiffer than similarly-sized aluminum structures.

b. Straightness/Flatness

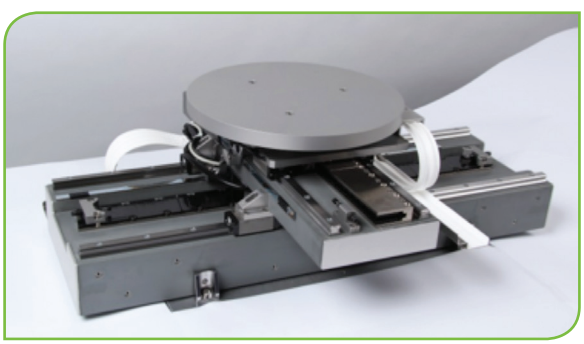
Taking advantage of SiC’s material properties and expertise in surface machining of ceramics, CeraMech surfaces can be made flat, down to granite level flatness. This is 2-3 times better than can be achieve with Aluminum.

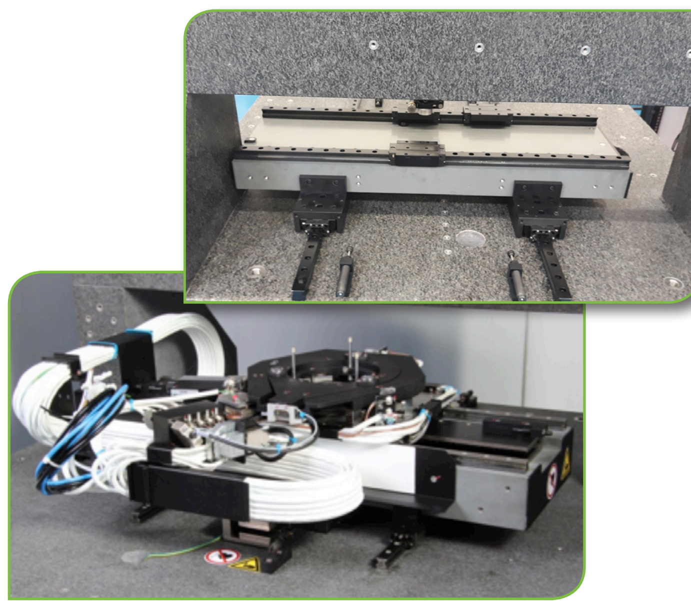
c. Lower than airbearing prices

Lower than Airbearing prices: Lower initial cost and maintenance while providing the flexibility to design longer travels while maintaining high stiffness for high dynamics performance.

CeraMech Configurations

There are two configurations that are possible with the CeraMech stages. These range from individual stages for single axis motion to integrated XY designs. The Applications team can help identify the best selection of standard motion stages for your application or recommend customized solutions that are optimized to your application, whether the main consideration is positioning stability, scanning speed, step/settle, price, etc.





Standalone

Single axis models, which can also be stacked for XY configurations. An example on the right shows 2 different sizes of CeraMech stages assembled in an XY. System level enhancements like orthogonality and error mapping are available.

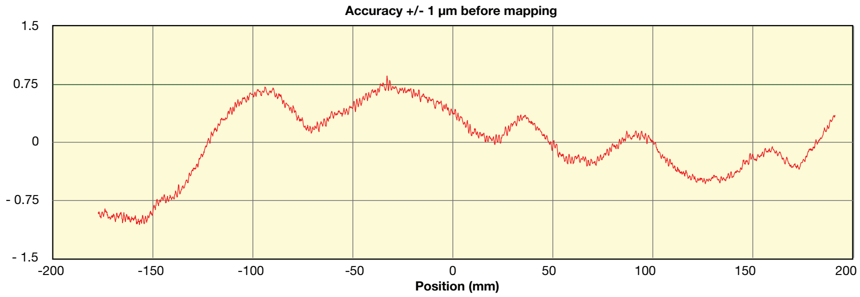
Integrated XY on granite

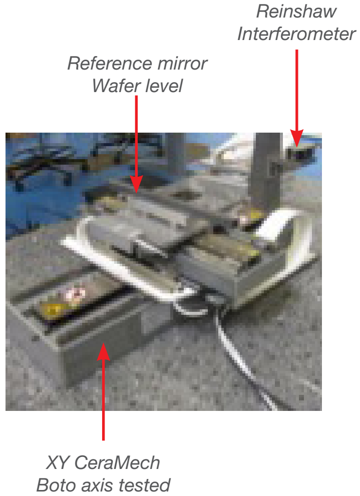
CeraMech stages can be directly integrated into tables, granite for example. This eliminates the lower X-axis base plate, while still utilizing the CeraMech structure for the Y-stage base. This configuration demonstrates the effectiveness CeraMech for ultra-precision performance, achieving 10nm in position stability.

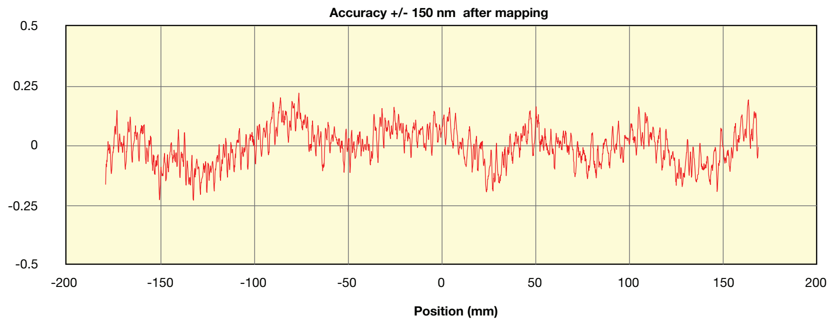
Another advantage of the Integrated XY is the trajectory performance of the XY is enhanced by the flatness of the granite surface, improving pitch and roll. In addition, the repeatability of angular deviation is very good, resulting from the combination of CeraMech combined with high quality of mechanical guideways. This enables the calibration or mapping out systematic errors, thereby improving performance.

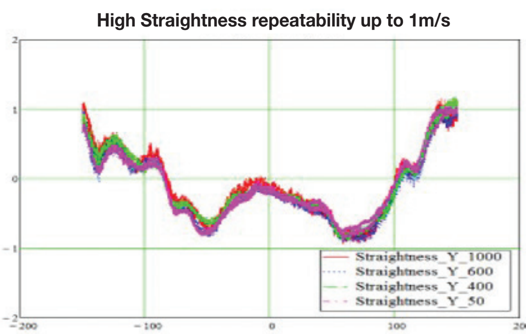
Performance Specifications

Standalone specifications and test results

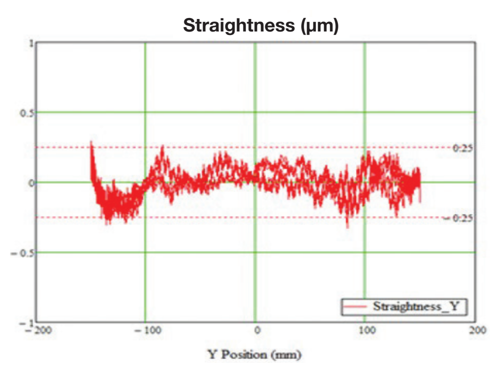








Straightness within ±1 µm @ 1 m/s and repeatability of Straightness within ±0.25 µm, ideal for mapping.



Straightness after mapping within ±0.25 µm @ 1m/s.

XY Stack

Below is a chart that shows the relative performance improvements of CeraMech technology over standard linear stages and how close the performance of CeraMech stages are compared to the top of the line DynamYX air bearing stages.

Specifications +/-µm) Over 300nm		IDL XY Stack	Integrated XY CeraMech	DynamYX Air Bearing
Without Compensation	XY Accuracy	5	3	2
	Straightness	3	1.5	0.3
	Flatness	3	1.5	0.25
	XY repeatability	0.4	0.2	0.05
With Compensation	XY Accuracy	1	0.4	0.2
	Straightness	0.5	0.25	0.1
	Flatness	0.5	0.25	0.05
Required for Compensation			XY mapping, Active ZTT Piezo stages	XY mapping, ZTT voice coils

Top Axis Flatness

Additional flatness performance at the top axis over a 25mm x 200mm area for the 3 XY configurations

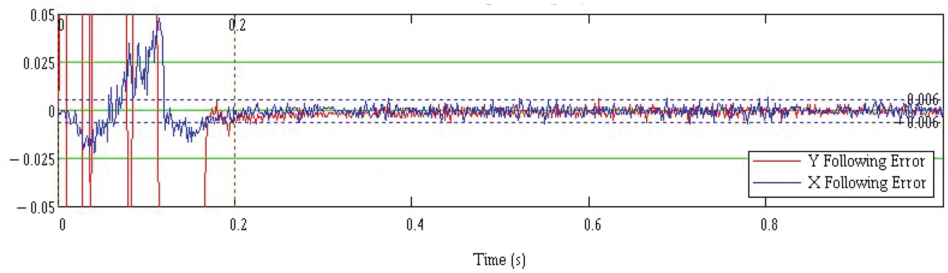
IDL	+/- 200nm
CeraMech	+/- 100nm
DynamYX	+/- 50nm

CeraMech XY Step/Settle

In the graph below, a Y move of 25mm was initiated and the Following Error of both top Y and bottom X Ceramech stages were monitored. The motion settles within 200ms in a ±5nm window. Acceleration is set at 7m/s2.

Step & Settle 25 mm within 200 ms Encoder Stabilized : +/- 10 nm

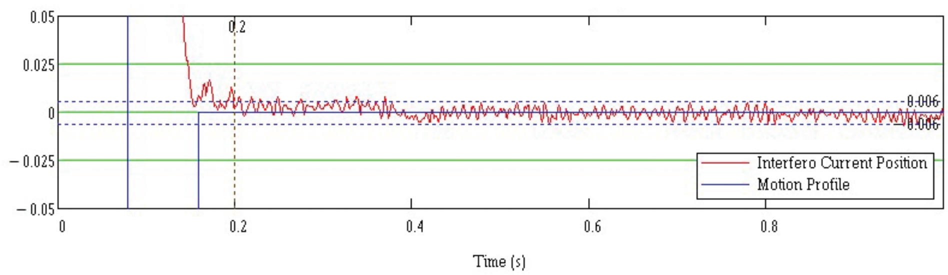
Following Error (µm)



RMS_X = 2.09 - nm RMS_Y = 1.97 - nm

Step & Settle 25 mm within 200 ms Interferometer Stabilized : +/- 10 nm

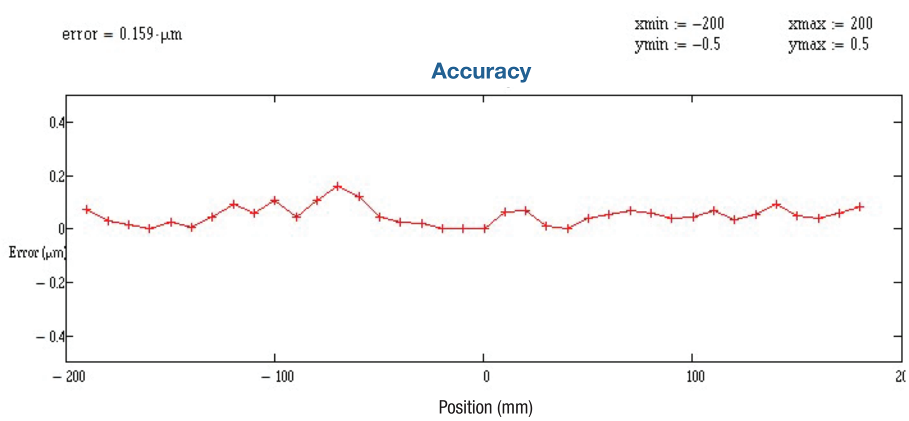
INTERF1 Current Position (µm)



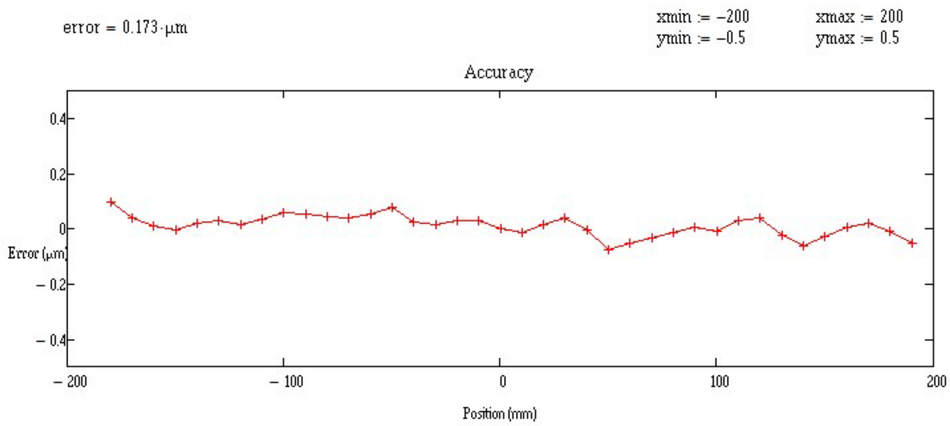
Integrated XY

The accuracy of a CeraMech-based, integrated XY is much better than aluminum stages. The charts below illustrate the accuracy for each individual X or Y axis,measured over 320mm. Results includes error mapping.

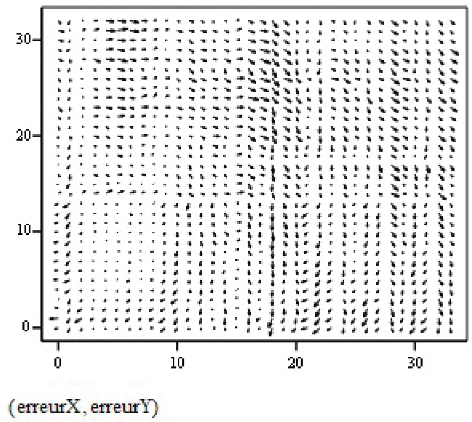
X axis ACCURACY over 320 mm after error compensation:



Y axis ACCURACY over 320 mm after error compensation:



For a combined XY motion, after error compensation, both X and Y-axis error are less than +/-250.



X error (nm) : ptpX = 515·nm

Y error (nm) : ptpY = 438·nm

Orthogonality = 0.634596 μrad

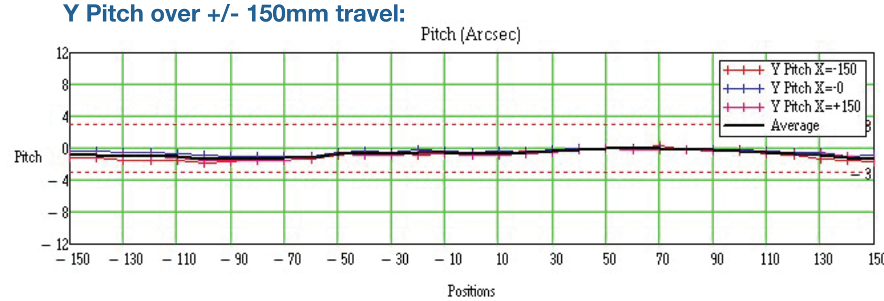
Temperature in °C: T = 22.8°

Pressure in mB: Pmb = 1000

Humidity in %: H = 46

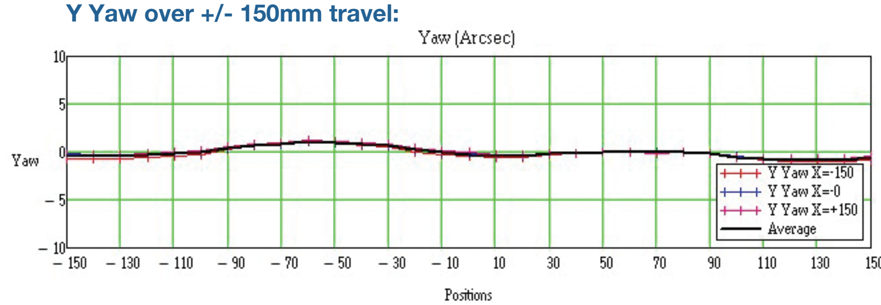
Pitch and yaw are also important parameters to consider when the point of interest is far from the bearing supports. Using a flat granite base, pitch can be minimized as illustrated in the Pitch chart of the Y-axis over a +/-150 mm travel. Pitch does not exceed 3 arcsec (10 μrad). Yaw, in the lower chart, also does not exceed 2 arcsec (10 μrad).

Y Pitch over +/- 150mm travel:



Pitch_ptp_Ym150 = 2.08 Arcsec Pitch_ptp_Y0 = 1.05 Arcsec Pitch_ptp_Yp150 = 1.56 Arcsec

Y Yaw over +/- 150mm travel:



Yaw_ptp_Ym150 = 2.08 μrad Yaw_ptp_Y0 = 1.92 μrad Yaw_ptp_Yp150 = 1.99 μrad

Compatible Controller/Driver

CeraMech stages are compatible with the XPS-Dx Universal Controller and its drivers: XPS-DRV11 and XPS-EDBL. Operating parameters are easily pulled from the stage database, allowing quick configuration, setup and operation. Built-in API's in the XPS-Dx enable quick programming of TCL scripts to replicate the needed motion profiles for the application.

The CeraMech, like all other Newport motion stages, can be integrated with 3rd party controllers and drivers. The Applications team is available to guide you through this process and provide the parameters needed for integration.

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