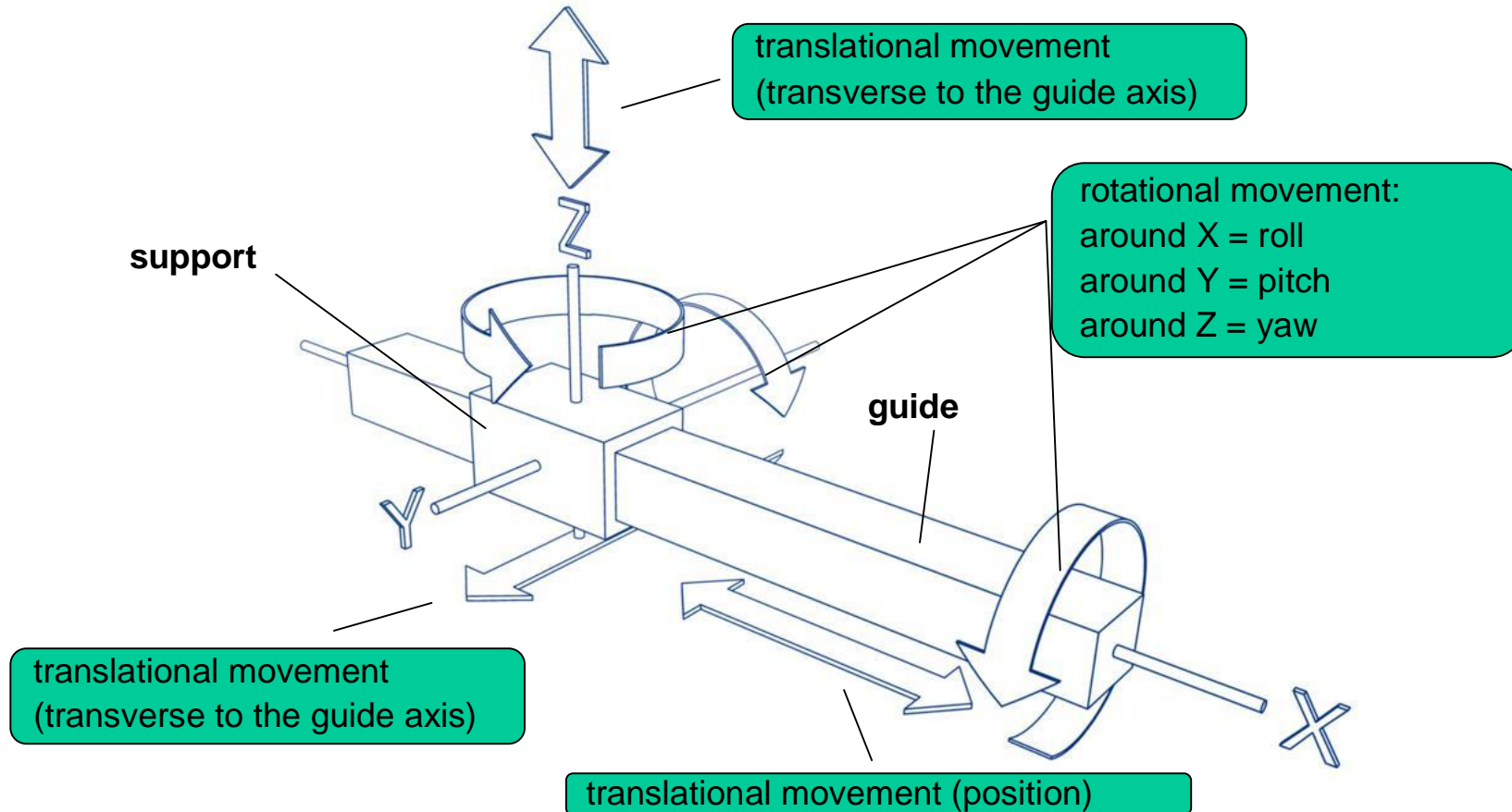


AfM Technology GmbH

Accuracy for Machines

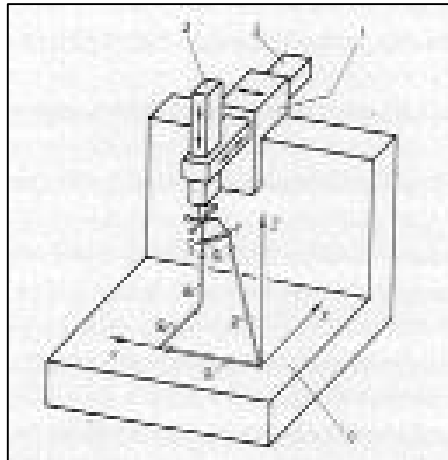
Geometric deviations of one axis

Each linear guide have 6 degrees of freedom, 3 translational und 3 rotational

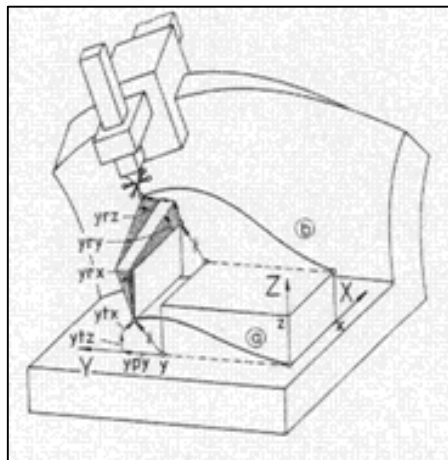


Geometric errors in 3- axes CMM

Ideal



Real



For each linear axis X, Y and Z in total 6 geometric errors can appear (T: Translatory R: Rotatory) :

- § Positioning XTX YTY ZTZ
- § Straightness XTY XTZ YTX YTZ ZTX ZTY
- § Yaw XRZ YRZ ZRX
- § Pitch XRY YRX ZRY
- § Roll XRX YRY ZRZ

For 3 linear axes this means 18 error sources in total.

Additionally the 3 squareness errors of the linear axes must be taken into account:

- § $x \wedge y$ XWY
- § $x \wedge z$ XWZ
- § $y \wedge z$ YWZ

In total 21 geometric errors have to be handled for a 3-axes machine tool.

Translational deviation

§ Positioning error

XTX

YTY

ZTZ

§ Straightness error

XTY

XTZ

YTX

YTZ

ZTX

ZTY

Rotational deviation

§ Yaw

XRZ

YRZ

ZRX

§ Pitch

XRY

YRX

ZRY

§ Roll

XRX

YRY

ZRZ

§ squareness errors

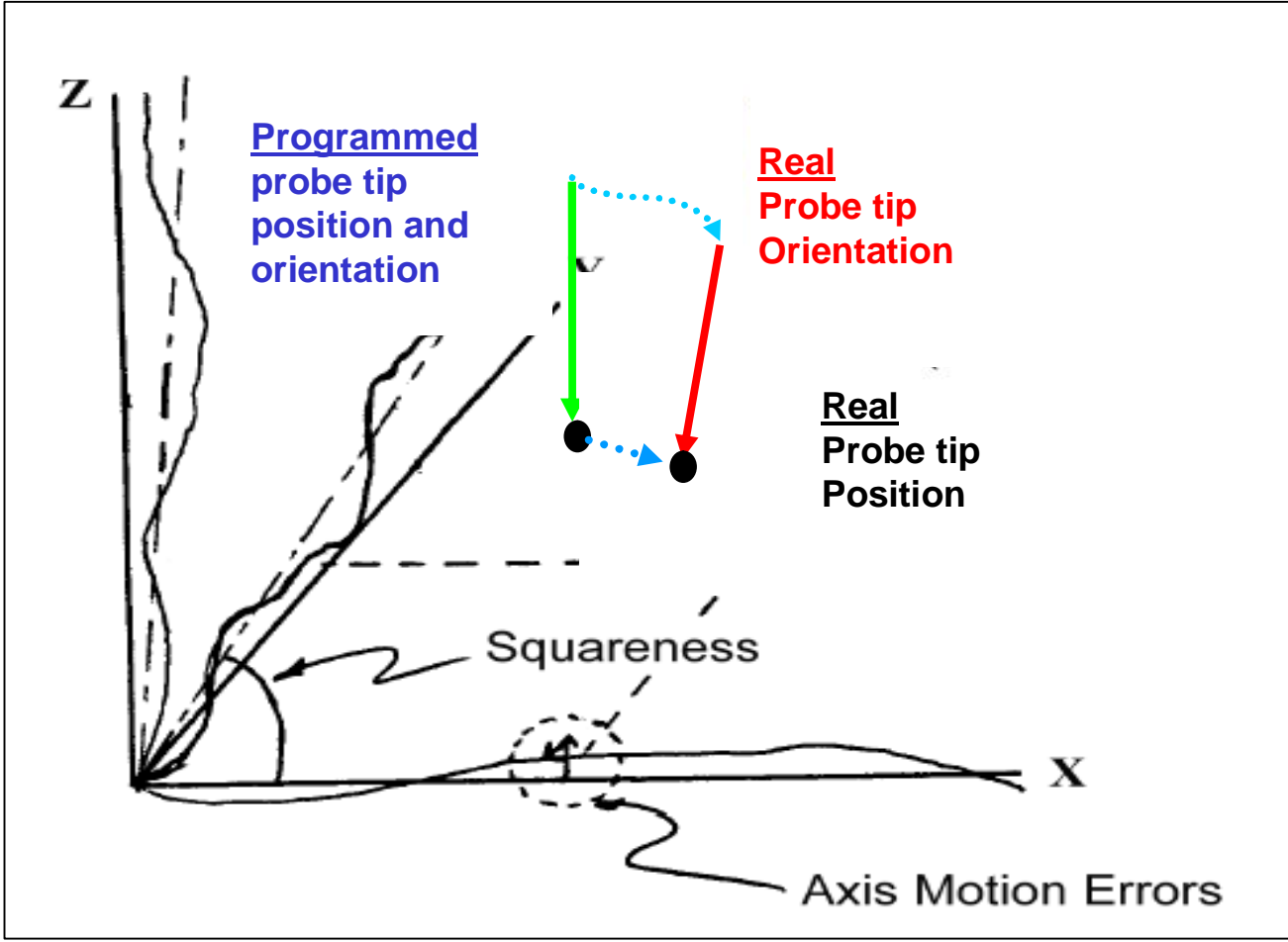
XWY

XWZ

YWZ

- Geometric errors**
- n positioning error
 - n straightness
 - n roll
 - n yaw
 - n pitch
 - n squareness

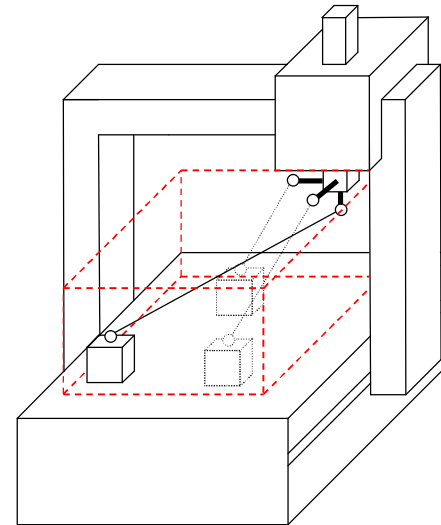
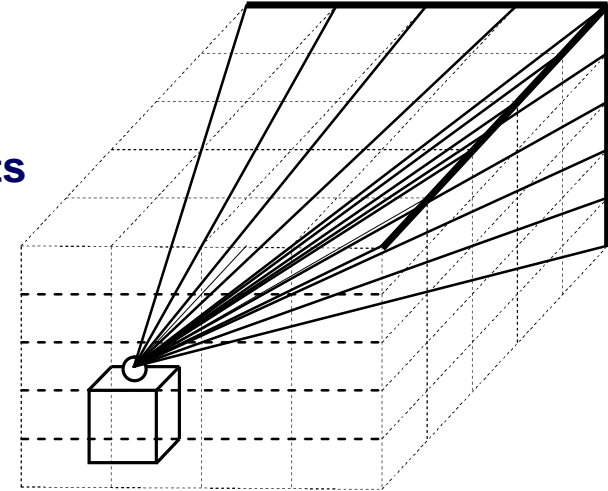
- Resulting error at probe tip**
- n positioning error
 - n orientation error



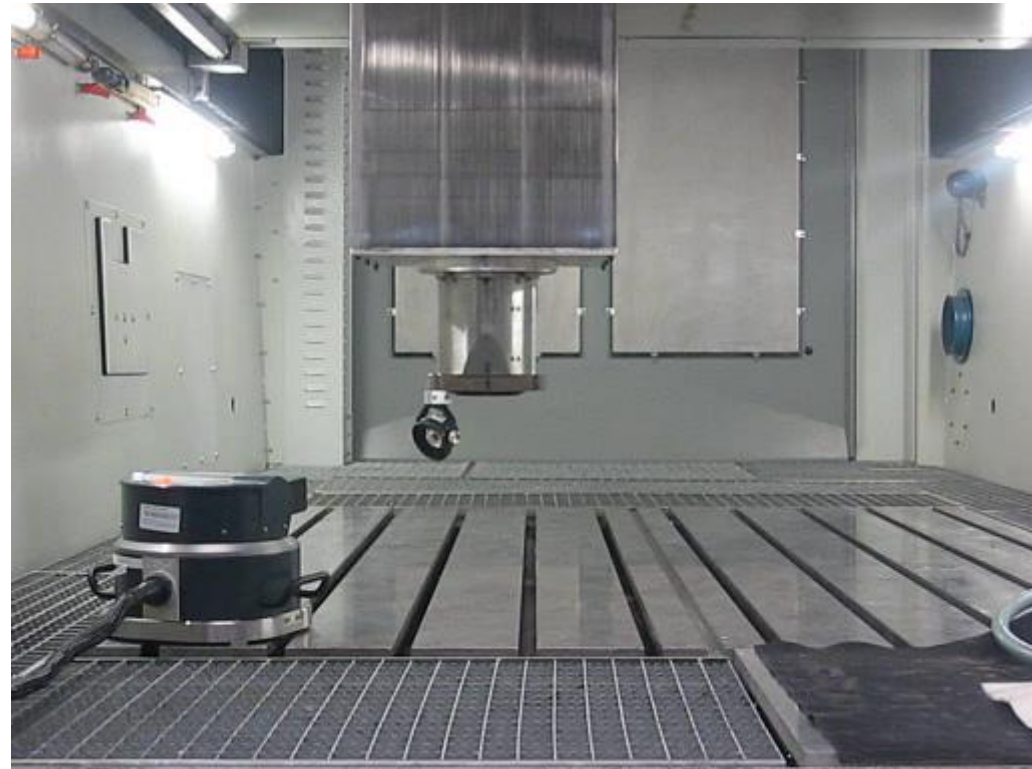
The geometrical errors of the linear axes of a 3-axes CMM cause spatial errors of the probe tip concerning position and orientation.

Measurement technique: LaserTRACER

- Developed especially for the calibration of coordinate measuring machines and machine tools
- Complete error analysis solely by length measurements
- Automatic tracking interferometer
- Resolution: 1 nm
- Length measuring error: $0,2 \mu\text{m} + 0,2 \mu\text{m/m}$
- Measuring range: 10 m
(extendable by mathematical superposition)

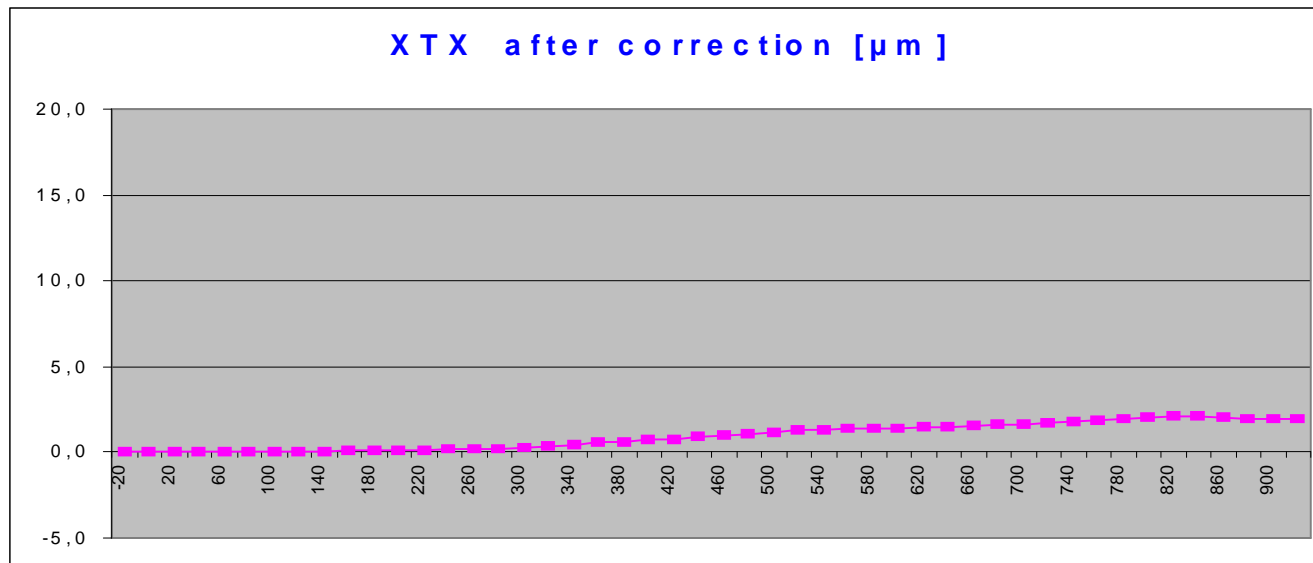
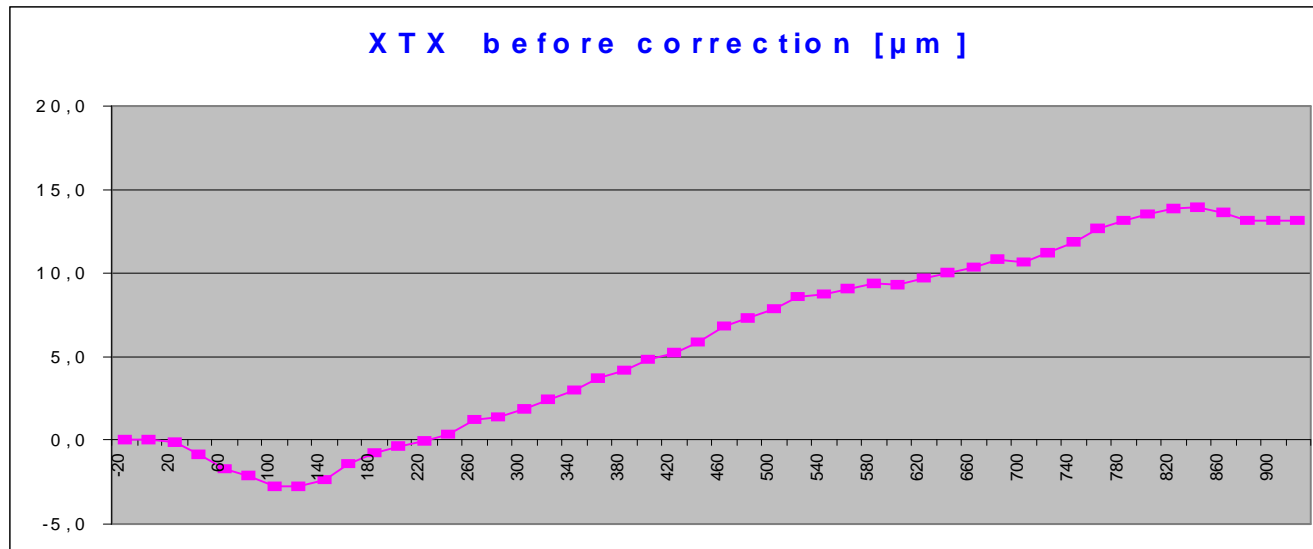


- § Mounting of the Cat Eye at the Z axis
- § Set-up of the LaserTRACER at 6 positions in space. An exact alignment of the LaserTRACER is not necessary.
- § Connecting CMM control with Laser tracer, running the CMM online controlled
- § Automatic measurement of the LaserTRACER during machine standstill
- § Measuring time about 1 h per position

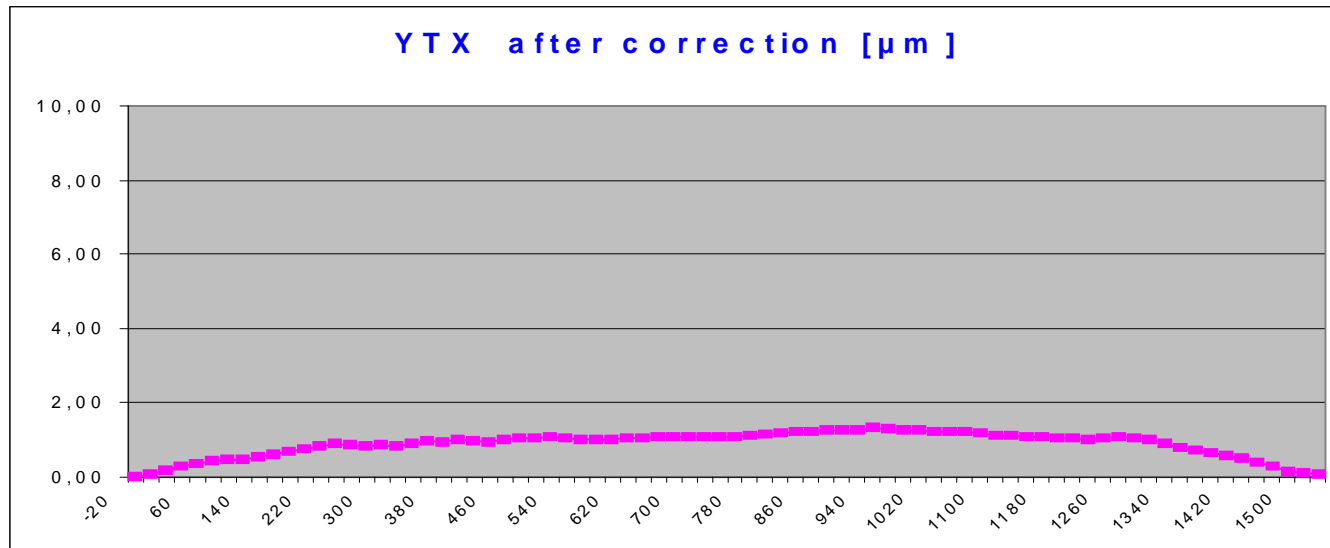
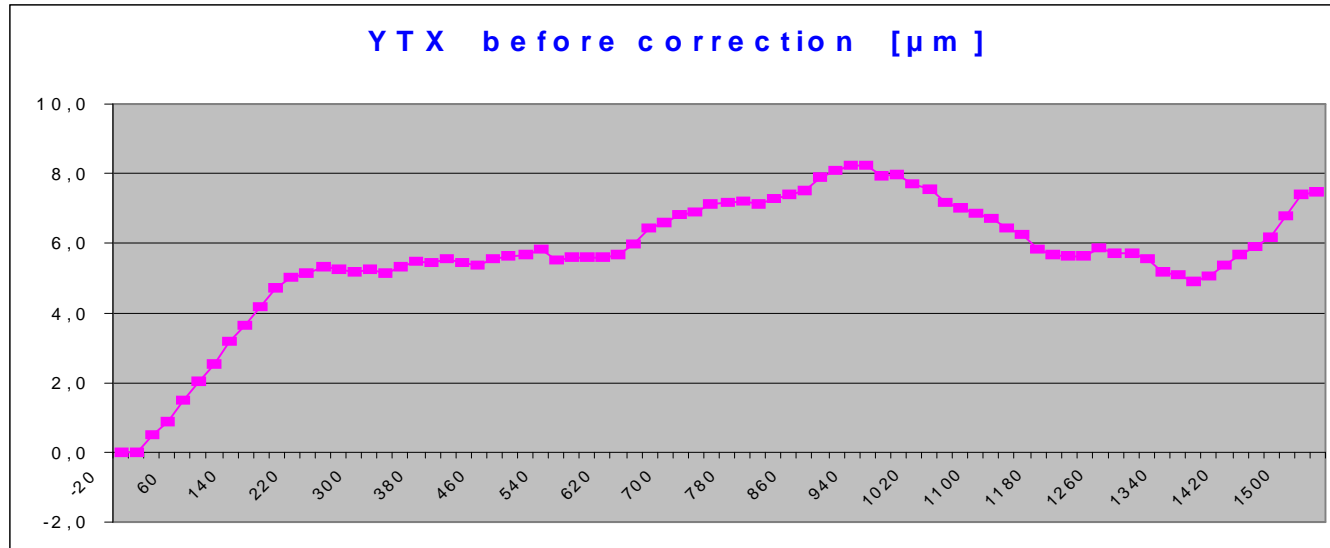


- § In preparation for the measurement for each type of machine will developed a measurement strategy.
- § The measurement strategy have to be adapt on-site.

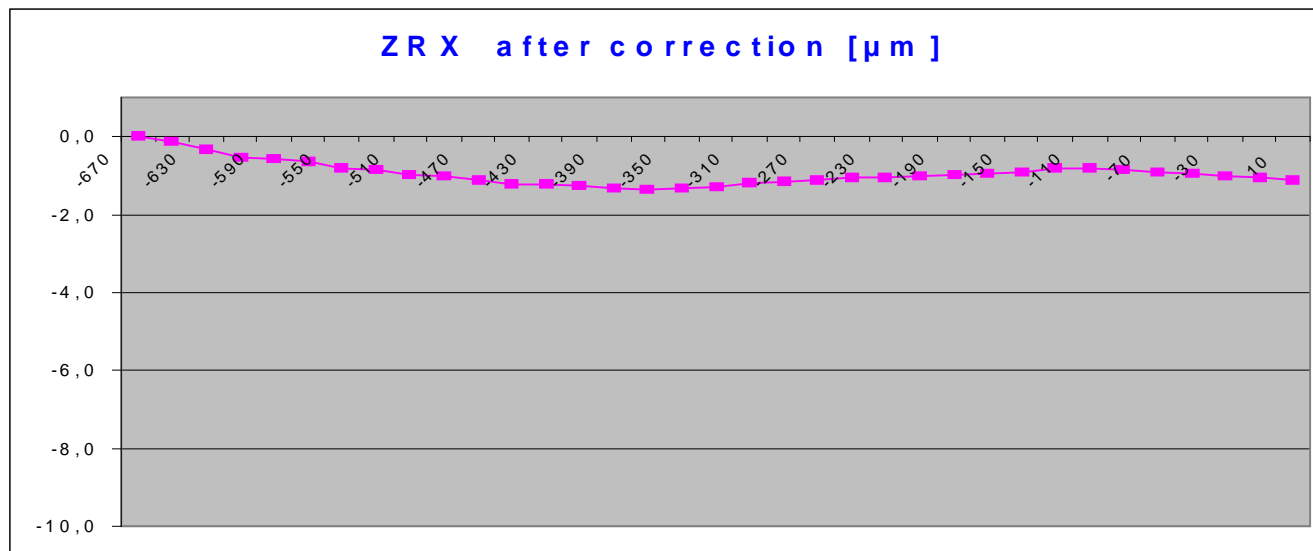
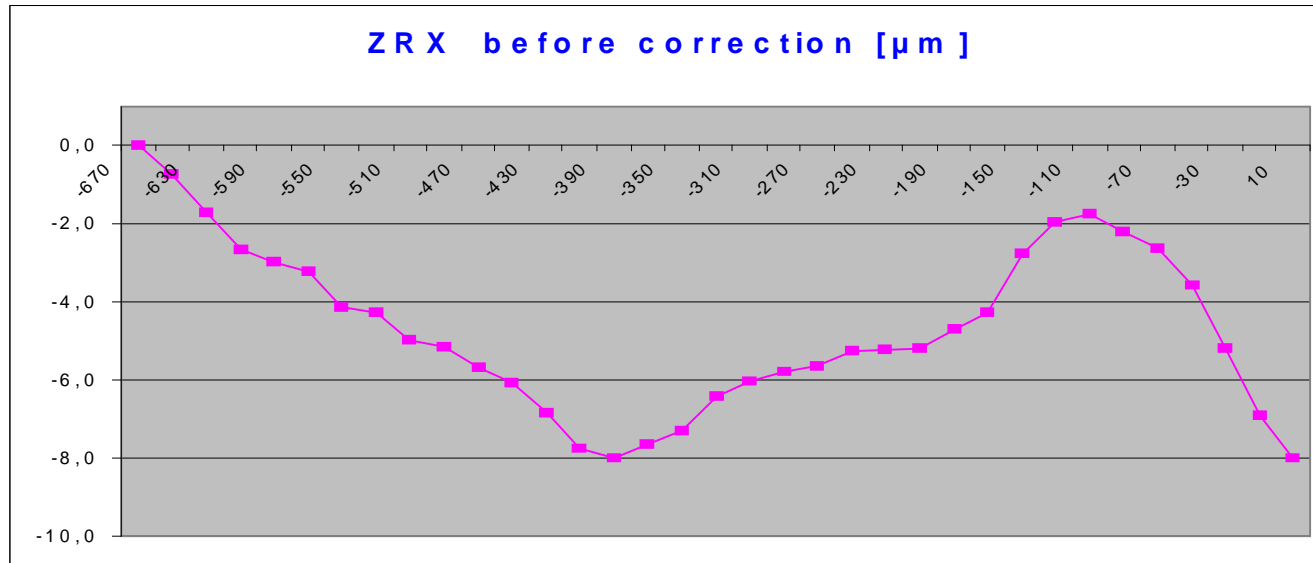
Example: Position errors XTX



Example: Straightness errors YTX

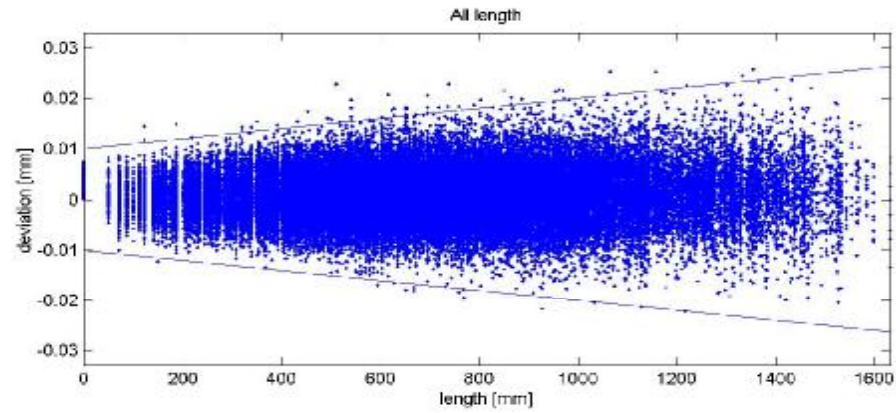


Example: Rotation errors ZRX

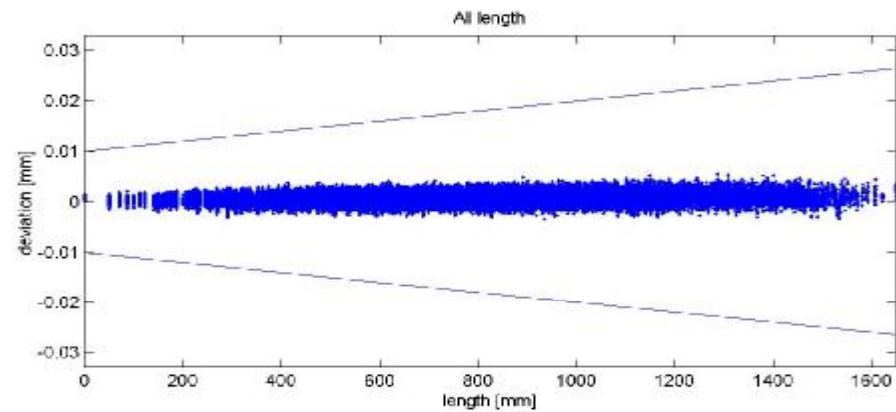


Comperement with 100000 simulated lengths

Before
Correction



After
Correction



Example KMG Nr.:123456
 $E_p(sim) = 10 \mu m + L \times 10 \mu m/m \leq 30 \mu m$
Sample size : 100000 length
Total coverage : 100%
Coverage [1_{loc} - 0] : 100%

- AfM generates a detailed report with figures and graphs from all 21 errors
- Additional contains the report the uncertainty of measurement results
- AfM creates the error map file out of the measurement results in different formats, depend on the control
- Transfer of correcture data into the control panel and activation of correction
- On costumer demand, verification according ISO 10360 including report

Service

- ∅ Performance test of CMMs according to ISO 10360 or VDI 2617,
- ∅ Determination of machine errors, complete error correction of CMM and performance test of the corrected CMM according to ISO 10360 or VDI 2617

Engineering

- ∅ Know how transfer for the implementation of the complete error correction in control panel of CMM.

Products

- ∅ LaserTRACER

The way to volumetric CMM-correction



ü AfM have the full error compensation knowledge, the mathematics, the source code, the measurement service, the inspection technology.

Ø AfM offers the full error compensation as a engineering package for online, inline or offline solution to cmm manufacturer



ü Everest represent AfM in China and have the inspiernce with chinese and europeen market culture

ü Everest will sales AfM products, engineering and service in chinese market

Ø Everest will perform the project management for these international joint venture business

chinese CMM manufacturer

Ø The chinese CMM manufacturer implemented the full error compensation in the own CMM

Advantages

Ø More accurate CMM give a bigger range of application

Ø Increase of market share

Ø Increase of the target price