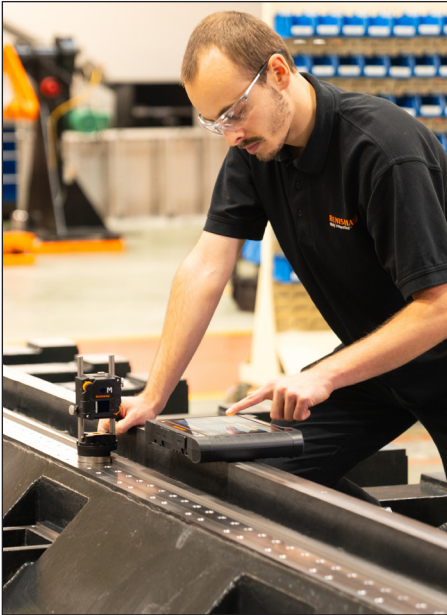


Long range straightness using the XK20 alignment laser system



Introduction

Laser measurement in an environment of still air at uniform temperature provides the best results. However, this is rarely achievable in real application environments. Sources such as air conditioning, heaters, motors producing heat, and open doorways can lead to air turbulence along the measurement path. Air turbulence is caused by moving pockets of warm and cold air passing through the measurement path. This causes deviation of the laser beam resulting in positional errors that do not represent the true axis error.

Long range straightness in the CARTO XK20 app uses a test method which helps eliminate the effects of air turbulence by recognising when data is outside a user-specified repeatability value. The software breaks the measurement into sub tests. On completion of all sub tests, the data is stitched together to provide a single measurement for the entire axis length.

Before using the long range straightness mode, there are some considerations to be aware of to help reduce the effects of air turbulence in the measurement.

Identifying air turbulence

When measuring straightness data over longer distance, there can be noticeable amounts of instability in the laser reading.

- Slow ‘wandering’ of the laser reading is likely to be an effect of air turbulence in the measurement path.
- High-frequency ‘flickering’ of the laser beam reading is likely to be a result of mechanical vibration.

Measurement considerations

Preparation is an important part of the measurement process to gain quality results.

Reduce sources of air turbulence

Minimise air turbulence by switching off air conditioning, heating and closing open doors. This helps to eliminate the warm and cold pockets of air from the laser beam path, resulting in better stability of laser readings.

Filtering

Filtering can improve the precision of the data captured. The XK20 laser uses a median averaging filter to exclude anomalies included within the data sample collected at a single point. The filtering options available are:

Filtering level	Sample period
Off	0 seconds
Low	2 seconds
Medium	6 seconds
High	10 seconds

Key software terms

The software requires some additional parameters:

Repeatability tolerance

The difference between two error readings at the same target position.

The value is user-defined. The software reports a start position for a sub test when the data is out of tolerance.

Overlap

The target positions to be repeated for the software to stitch the data together.

The default value in the software is four. However, the range is from three up to nine depending on the accuracy required.

When should I use long range straightness mode?

Accuracy requirements and environmental conditions need to be considered, especially when measuring over 4 metres.

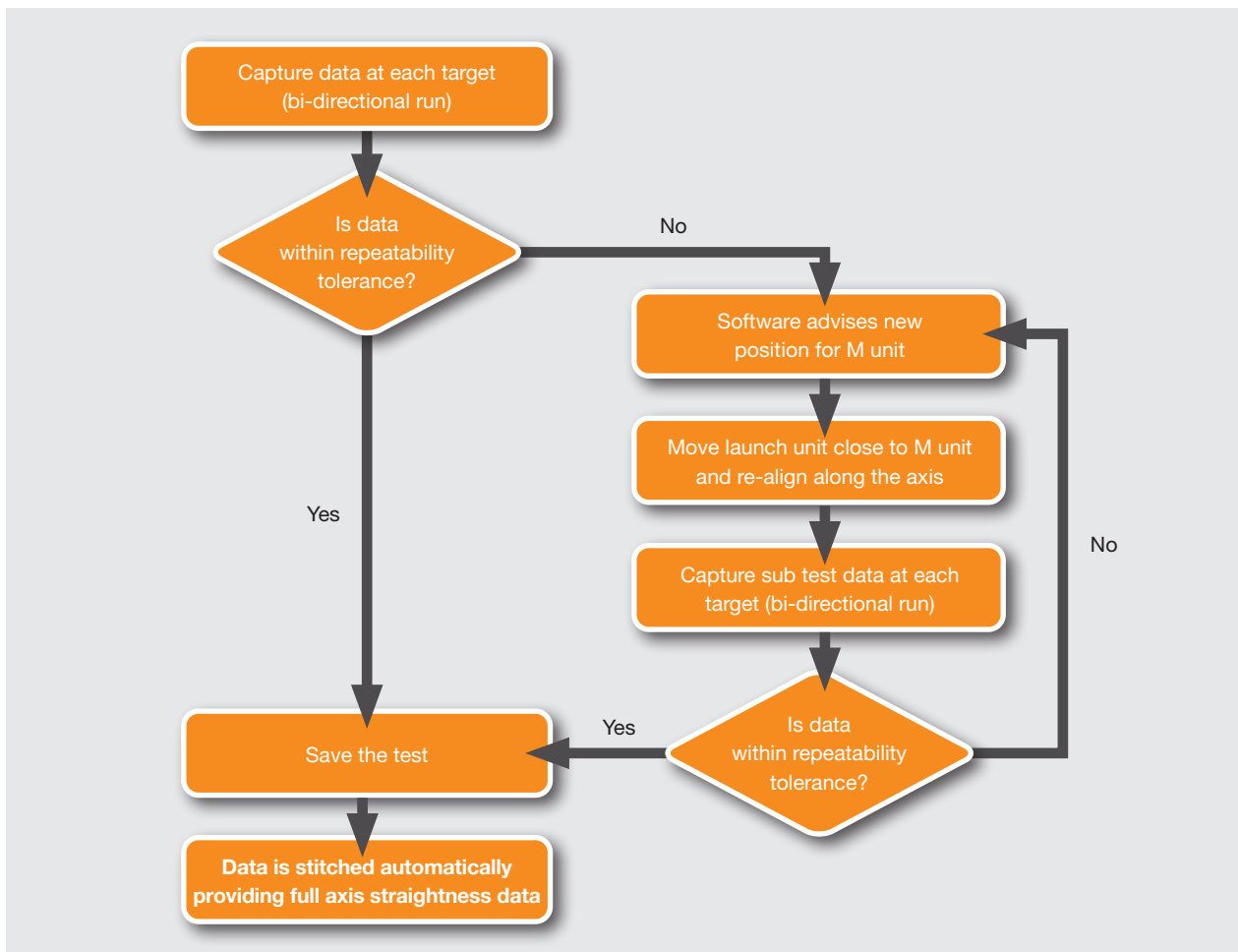
Distance	Capture method
Up to 2 metres	Short range straightness mode
2 metres to 4 metres	Consider using filtering in short range straightness
4 metres to 40 metres	Use long range straightness mode

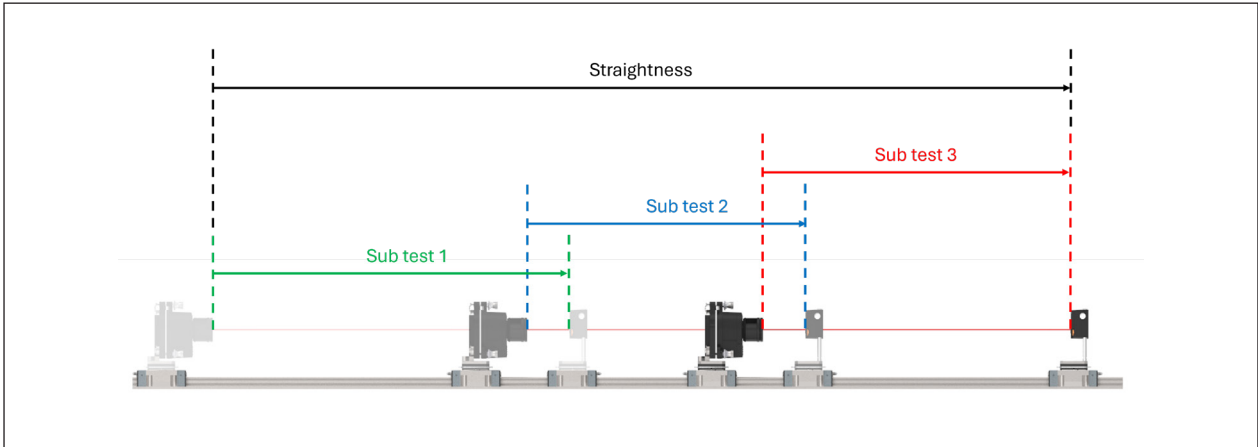
For guidance only.

The software requires data from the entire length of the rail in a bi-directional test and determines any further measurement action.

- If the data is within the repeatability tolerance, the capture process is complete.
- If the data exceeds the repeatability tolerance, the software advises where to move the hardware to capture further sub tests.

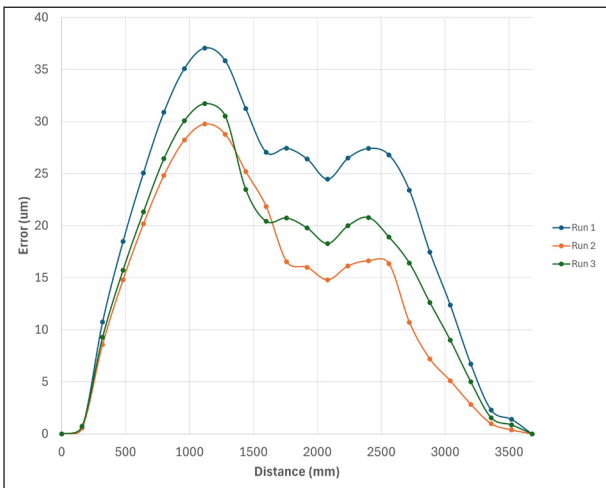
Measurement process



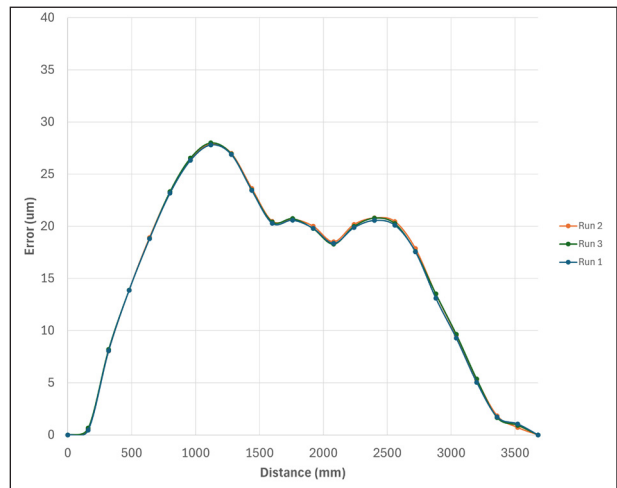


Example

The data plots demonstrate straightness data capture of a 3,600 mm axis in an environment affected by air turbulence.



The graph above shows three separate runs of a 3,600 mm rail in an environment with air turbulence. The differences between the three data sets show that the runs are not repeatable.



The graph above shows three separate runs on the same rail in the same environmental conditions. This data is captured using long range straightness mode with two 'stitch' areas of four overlapping target positions.

Summary

Air turbulence affects the accuracy and repeatability of long-distance straightness measurements. Minimising any sources of air turbulence is essential before capturing measurement data, especially for lengths of 4 metres or over.

The CARTO XK20 app long range straightness mode can identify areas of air turbulence. The software recommends where to stitch the data, which improves the accuracy and repeatability of the results.

www.renishaw.com/xk20

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+44 (0) 1453 524524 uk@renishaw.com

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