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Efficient Machine Error Measurement

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Introduction

Machine tool (MT) capability & availability are of paramount importance in modern manufacturing industry. The first is determined by measurement, the second depends on maintenance & calibration which includes measurement procedures.

Increasing measurement efficiency leads to:
1. More accurate & repeatable results
2. Machine downtime decrease
3. Uncertainty estimation

Novelty

More investigated
Modelling
Measurement
Compensation
Efficient measurement

Less investigated
Prediction

Methodology

Input
Sort
Analyse
Compare
Report
Format
Store

MS Office Access DBMS

Data management

Measurement Equipment
Environmental & Machine Type
Manual Input
Report Generator
Uncertainty Estimation

Novel Database

Graphical User Interface
Machine Tool Controller Data
Capability Assessment
Application
Purchase
Comparison

Capability Assessment

Statistical Process Control

The alternative to a traditional laser measurement is proposed for a straightness. Simple, precise and more effective on long ranges, the method utilizes taut wire and an optical sensor, mounted on a moving table (saddle).

Sensor displacement is measured in a number of points which form a graph showing a combined error of the guide and the wire like shown on the graph:

To remove the wire error a method of sensor shifting is used:

After measuring once another measurement is done with the wire shifted one step forward or backward, and then both wire and guide errors are calculated separately:

\[ x_i = s_{i-1} + c_i - e_{i-1} \]

where
- \( x \) - guide error on a step \( i \)
- \( e \) - combined error (measured), and
- \( s \) - combined error on the shifted wire

The accuracy of measurement does not depend on wire surface defects and its straightness, the only factor which affects the result is repeatability of the wire which proved to be very high. This brings final measurement error to a sub-micron level.