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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**

Modelling  
Measurement  
Compensation  
Efficient measurement  
More investigated  
Less investigated  

**Methodology**

Input  
Sort  
Analyse  
Compare  
Report  
Format  
Store  

MS Office Access DBMS

**Data management**

Measurement Equipment  
Report Generator  
Novel Database  
Uncertainty Estimation  
Statistical Process Control  
Capability Assessment

**New test development**

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:

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

where  
- \( x_i \) - guide error on a step \( i \),  
- \( c_i \) - combined error (measured), and  
- \( s_{i-1} \) - 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.