

# Machining Centre Monitoring with Calibrated Artefact Probing

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# NC-Checker – hardware



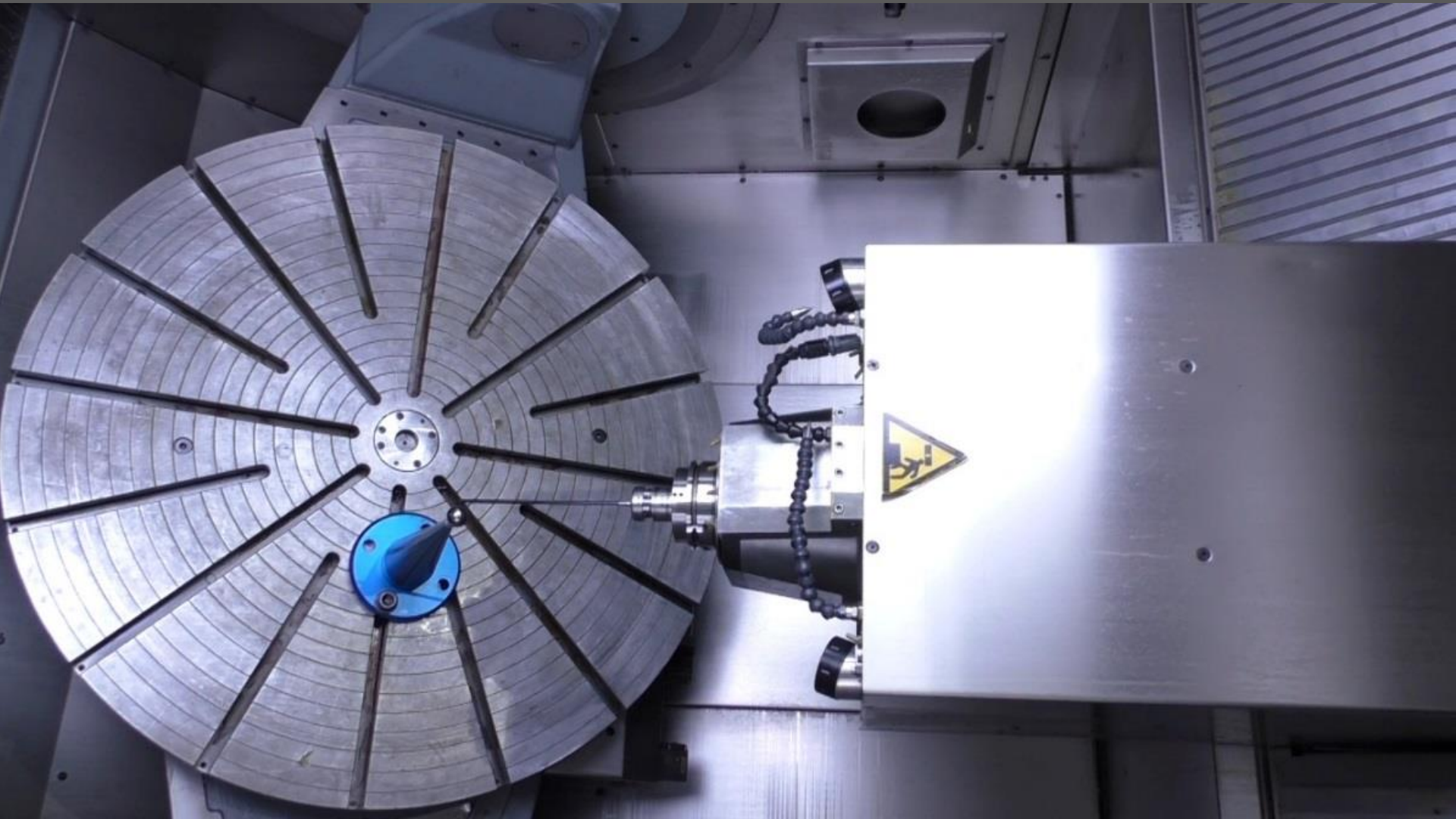
Calibrated spherical  
artefact [1]



Touch trigger probe [2]

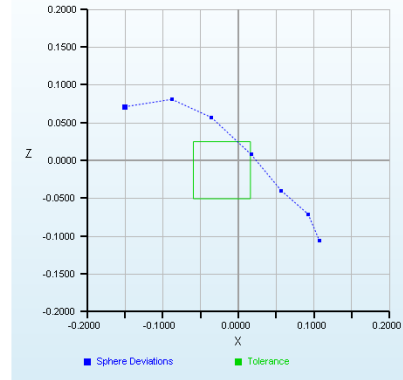
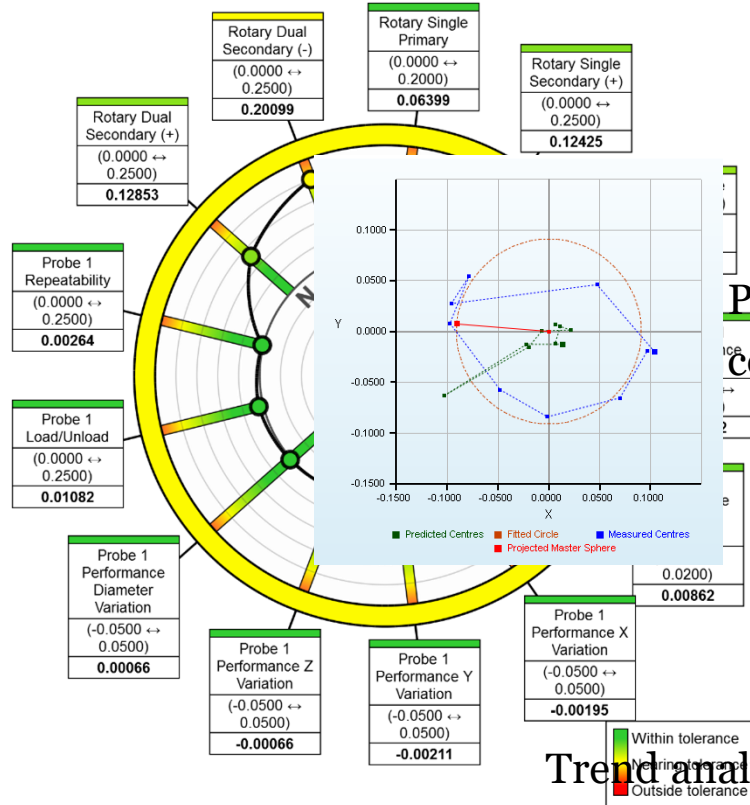
[1] Image credit – metrology software products ltd.

[2] Image credit – Renishaw plc.



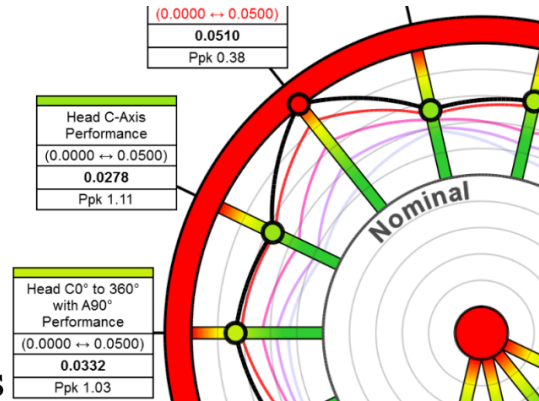
# NC-Checker – benchmark report

## Fault identification



## Pivot point correction

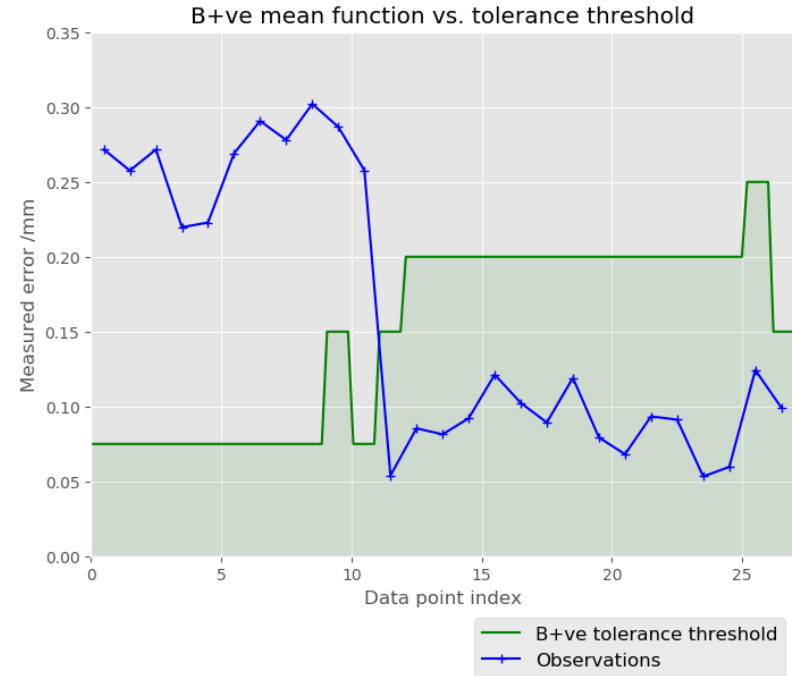
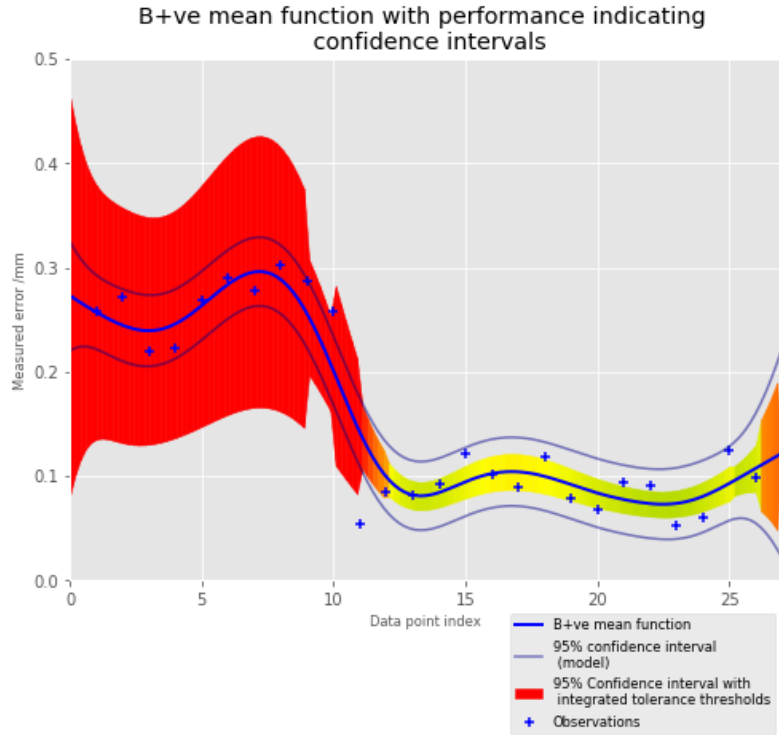
## Trend analysis



# Performance monitoring with NC-Checker

- Current trend analysis
  - 1-dimensional, overlaid onto benchmark wheel
  - Must be reset after significant machine event
- Objectives
  - Track long-term trends and generate user display
  - Data analytics for intelligent maintenance decision system

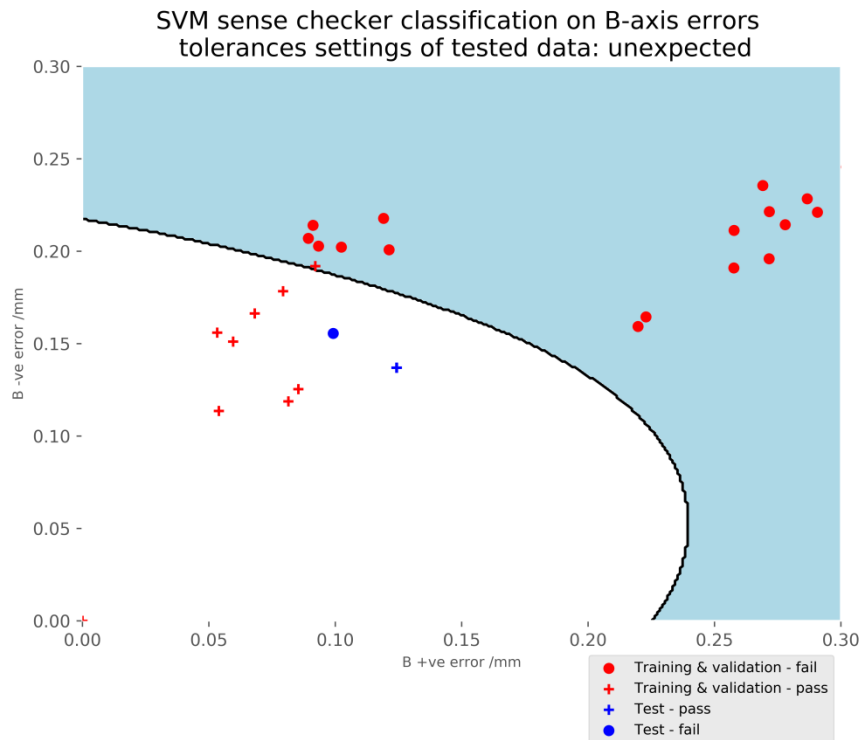
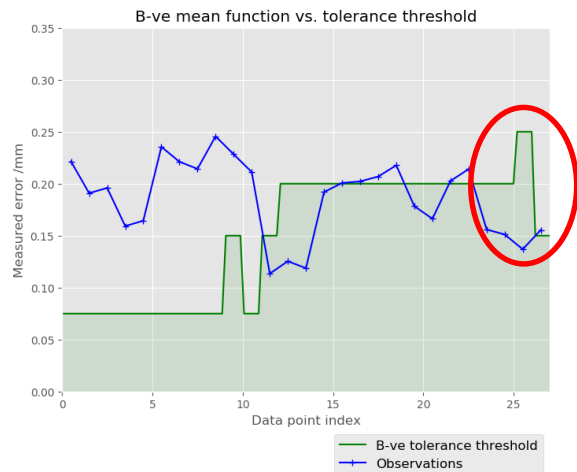
# Long term trend tracking



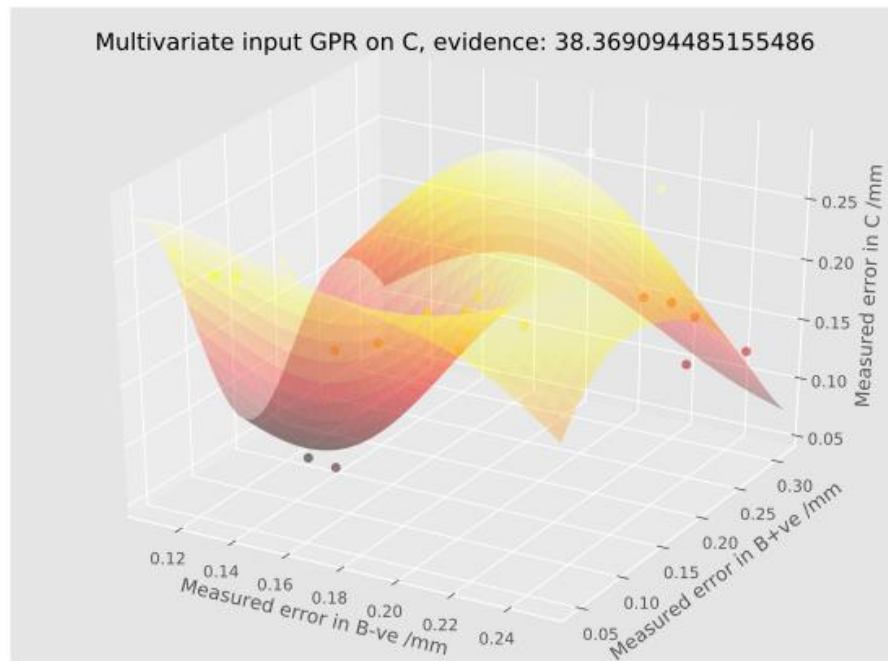
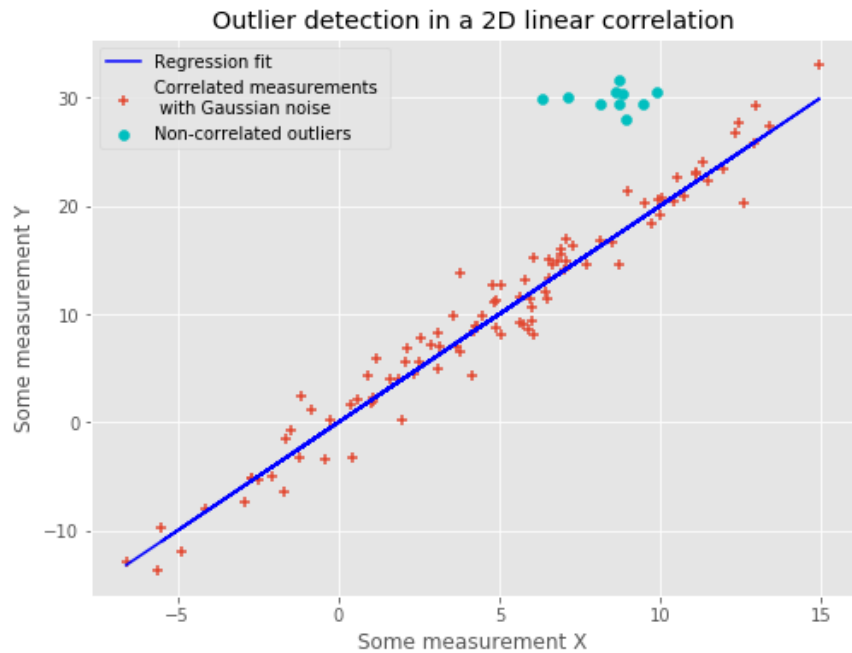
$$CI_{95}(GP, tol) = 1.96 \sigma_{GP} \left( \frac{\mu_{GP}}{tol} \right)$$

# Threshold sense checker

- Data-driven tolerance threshold
  - normal operating condition
- Identify unexpected tolerance changes

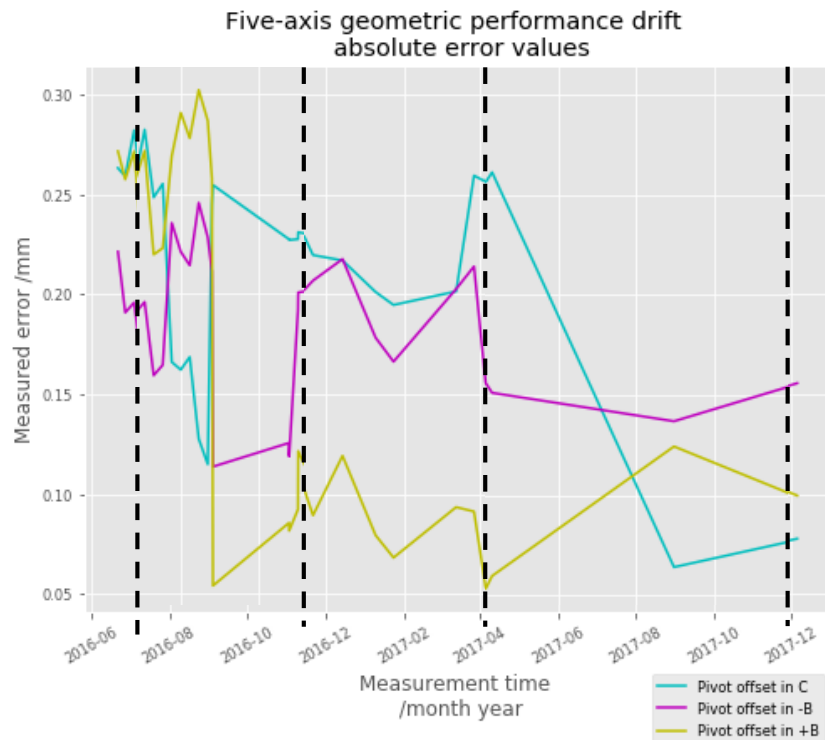


# Trend stability – outlier detection





# Trend stability – outlier detection



# Conclusions and further research

- NC-Checker as an interactive maintenance logger and monitoring system
- Unexpected tolerance changes can be identified and challenged where necessary
- Trend stability monitoring needs further dataset for verification
- Collect alternative operational data to predict errors and inform the benchmark interval

# Acknowledgements

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  - Industrial Doctorate Centre for Machining Science
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## Thank you

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