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Predictive Calibration-Based Tolerance Boundaries For Arresting Deterioration of Machine Tool Accuracy

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Machine tool failures in industrial organisations disturb production operations and cause production loss. Predictive maintenance is one approach which has been successfully applied in some circumstances to allow scheduled production stoppages. It is an approach that reduces the need for reactive maintenance. Predictive maintenance is a tool that has been adopted in some industries to improve operational efficiency and reduce maintenance cost. As a result, monitoring equipment providing information about the systems conditions have evolved rapidly over the last years.

Machine tools can change or drift over time and usage in both their mechanical and electrical performance and so reduce in accuracy. This paper proposes a new method for maintaining machine tool accuracy that is complimentary to the predictive maintenance paradigm. This strategy, called predictive calibration, is a methodology that depends on the prediction of the degradation in machine tool accuracy based upon regular data capture.

Although introducing such a strategy will introduce a new cost, the aim is to offset this investment by optimising the operational efficiency and reduce the downtime cost. The main objective is achieved by monitoring the condition of the machine tool by collecting data using quick check measurement techniques or post-process quality data. Calibration should, therefore, be driven by the data measured from either the machine or the part. Building a database of inspection history by measuring the machine on a regular basis with relatively non-invasive methods will make the decision of scheduling extensive calibration accurate better informed process.

The project presents a new method of identifying new boundaries of machine tool working tolerance. These boundaries of tolerance reflect the degradation level corresponding to production capacities and the quality of the part produced.

The significance of this work is that machine tool accuracy is critical for high value manufacturing. Over-measuring the machine to ensure accuracy reduces productivity. This piece of work seeks to optimise the frequency of calibration to reduce unnecessary downtime while maintaining the machine at the required tolerance.

