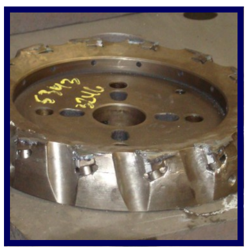
Background Information

About the Sponsor

Finkl & Sons Co. was founded in 1879. Finkl is the world's leading supplier of forging steel, processing 100,000 tons of steel each year. Finkl manufactures 100 percent of its products in Chicago. There products are distributed domestically and to more than 18 countries worldwide. With more than 100 patents to its credit, Finkl's steel formulations and steelmaking technologies set world-wide standards. Finkl's facilities are on the leading edge of technology, using the most automated process in the world.

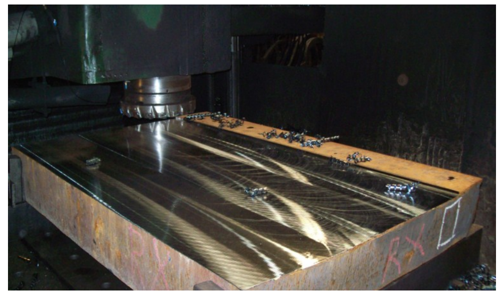
About the problem

As Finkl machines the steel during a milling operation, they rely heavily on the performance of the mill. The hardness of the steel being milled causes cutting inserts to chip and break. As a result, the surface finish of the steel can be substandard, and more stress will be placed on the remaining cutting inserts, making a systemic failure of all inserts highly probable. This poor surface finish often forces Finkl to remachine the part to meet customer specifications, and this leads to the loss of significant amounts time and money.



Results and Conclusions

We have determined that using a tri-axial accelerometer to detect broken inserts is plausible. More data will be required to complete our desired objective of creating software that can detect broken cutting inserts and alert workers on duty.



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IPRO 304

Integration of Process Improvements

Advisors:
Professor W. Maurer
&
Professor S. Mostovoy

Sponsor:
A. Finkl & Sons

Team Members:
Tomasz Chojnacki
Dorothy Collins
Yubo Diao
Paul Gal
Suk Won Kim
Tom Kozmel
Claudius Kuzmicki
Megan Meeke
Ray Jaiminkumar
Mike Regacho
Greg Sparks
Alex Szalko
Greg Tatkowski
Bill Watts

The Problem

Finkl's money and reputation is sacrificed to purchase new cutting inserts and correct milling errors. If a solution is created to detect when an insert fails, the insert can be replaced immediately, reducing the risk of a systemic failure of other inserts.

Objective

The previous IPROs were able to isolate individual cutting inserts through accelerometer output with an established baseline of performance with no broken cutting inserts. However, the isolation and detection did not occur in real time.

Thus, our main goal was to write a program that will allow a triaxial accelerometer mounted on the milling spindle to detect with a cutting insert has been broken. This program will then immediately notify the operator on-duty that a break occurred.

Methodology

The Strategy

A triaxial accelerometer is used to monitor the vibrations produced by the machine and milling inserts with the steel being machined.

The accelerometer data is collected in LabView; a data acquisition program that monitors and records, and analyzes data based on a set of parameters in real time. The data collected in our trials is then evaluated in DIAdem, a data analysis program that processes and extracts information for use by the team to determine the most distinguishable properties for the detection of insert damage and breakage.

Implementation:

It has been determined that the most effective way to reach our goal in such a vibratory environment is to have a series of several checks so as to avoid false alarms.

-> Check 1: The Trigger

The breakage of an insert results in a significant shock to the system that is easily identified by the monitoring program. When the program encounters a spike in activity that exceeds this threshold, it records data for 6 seconds before and after the trigger.

->Check 2: Pre/Post Trigger waveform analysis

The increments are integrated to produce the Power Spectrum Density (PSD) for analysis.

->Check 3: Limited Frequency PSD

This last check will insure that the differences found in the PSDs from before and after the trigger are concentrated in this area. This way, a missing insert is known to be the cause of the shock to the system and the redistribution of power across the spectrum rather than a change in the machines performance.