Innovating Process Improvements in Manufacturing
Advisors and Members

**Advisors:**
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- Sheldon Mostovoy

**Sponsor:**
- A. Finkl & Sons Co.

**Team:**
- Anandha Abhay
- Anthony Bergeron
- Christopher Catalina
- Jason Entler
- Maximillian Estrada
- Alexander Kolbasov
- Vishal Patel
- Vien Quach
- Jay Taggart
- Sunghwan Yeo
Preamble: IPRO 304 believes that a code of ethics is fundamental to maintaining an honorable and respectable presence inside and outside of the classroom. Members of IPRO 304 shall conduct their themselves in accordance with the ethics standards stated below.

- Conduct research and classroom discussion in a manner that is consistent with accepted honor and decency.
- We will strive to maintain the highest standards of honesty and integrity in all endeavors associated with the IPRO.
- Be civil and respectful in professional and academic interactions, avoiding discrimination, based on race, religion, or age.
- Treat other students, professors and host fairly.
- Be constructive without malice in evaluating the work of students.
- Encourage the free and open exchange of ideas and information without fear of retaliation.
A. Finkl & Sons Co.

Members

Introduction

Research

Accelerometer

Experimental Design

Data

Results

Questions

Melting

Forging

Heat Treating

Milling Process

Finished Product
Advancement Opportunity

- Milling machine (below) contains inserts that get broken during the milling process
- To develop a working prototype
- Automatically monitor & detect broken inserts
- Provide A. Finkl & Sons with the proper data & statistics of which solution to invest in
Business Perspective

Finish Cut with Broken Insert
Business Perspective

Finish Cut with Broken Insert

{ No Insert Failure } { Failure }
Business Perspective

Finish Cut with Broken Insert

\{ No Insert Failure \} \{ Failure \}
Develop a system to detect broken inserts by use of accelerometers.

Alert the machinist monitoring machine in order to replace inserts.

Research, test and inform A. Finkl & Sons of a possible alternative to pursue an automated insert breakage detection system.
Objectives of Current IPRO

Developing a method of analysis.

Intensive observational on site data collection.

Accounting for a wide range of variables:

- Depth of cut
- Speed of processing
- Hardness of material
- Operator inconstancies
- Part geometry
- Age of machines
- Location of accelerometer

Identifying characteristic signature of a broken tooth.
Team Organization

Data Collection

- Information Technology
  - Anandha Abhay
  - Anthony Bergeron
  - Jay Taggart

- Data Processing
  - Vishal Patel
  - Vien Quach

- Data Analysis
  - Christopher Catalina
  - Jason Entler
  - Maximillian Estrada
  - Alexander Kolbasov
  - Sunghwan Yeo
# Current Methods for Tool Monitoring

## Wireless Accelerometer

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wireless</td>
<td>Intermittent Data Collection</td>
</tr>
<tr>
<td>Easier Mounting</td>
<td>Fragile</td>
</tr>
</tbody>
</table>

## Wired Accelerometer

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant Data Feed</td>
<td>Wired Limitations</td>
</tr>
<tr>
<td>Robust</td>
<td>Connection Concerns</td>
</tr>
<tr>
<td>LabView</td>
<td></td>
</tr>
</tbody>
</table>
Experimental Setup

Wireless Accelerometer Placements
Data Lifecycle

**Raw Data**
(Acceleration vs. Time)

**Processing**

**FFT**
(Acceleration vs. Hz)
The domain the frequencies present.

**RMS**
(Root Mean Squared vs Time)
The statistical measure of the magnitude

**Power Spectrum**
(Power vs. Hz)
The amount of energy being produced over time.
Signal Analysis

Signal Pulse

Time = 1

Time = 2
Signal Analysis

Power Spectrum

No Broken Inserts
Signal Analysis

Power Spectrum

Broken Inserts
Conclusions

- Wired over wireless
- Collect data on work piece not spindle
- Data contingent on many variables
- Accelerometer signal requires a lot of processing
- Making incremental progress to fulfill the IPRO’s purpose
Future Work

Suggestions for Next IPRO

- Further implementation of wired accelerometer
- Use of LabView software
- Continue data collection
- Seek trends with processing considering all variables
- Signal processing assistance
We would like to thank A. Finkl & Sons, Professors Maurer and Mostovoy, Liz Bilitz, Paritosh Mokhasi, Vladimir Frankfurt, Gary Gregga and the IPRO office for all their guidance and support.

Thank You!

IPRO Team 304