



---

**Innovating Process Improvements  
in Manufacturing Operations**  
IPRO 304

**Advisors:** William Maurer  
Sheldon Mostovoy

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



---

# Table of Contents

*Page*

1

2,3

4

5

6

7

8

9,10

11

*Content*

Table of Contents

Roster

Purpose and Objectives

Team Values Statement

Breakdown Structure

Results

Budget

Tasks and Milestones

Informal Assignments



---

# Team Roster

Anandha Abhay - aabhay@iit.edu

Computer Science and Education major. Anandha also has an outgoing personality that will be a great asset to obtaining information and holding onto contacts.

Matt hopes to meet people within the industry and make those life long contacts. Also, he would like to see the development of a product for A Finkl and Sons Co. that will solve their tooth breakage detection issue.

Anthony Bergeron - abergero@iit.edu

Tony's strengths come from his major, computer science and his current job. He works technical support in IIT's architecture department. This gives him the distinct advantage when dealing with software and hardware issues. He expects to get a well rounded education from this experience. This IPRO is a chance for him to meet people in the industries, and expand his network without much stress of the normal work place.

Christopher Catalina - ccatalin@iit.edu

Chris knows contacts at Finkl already. He is a headstrong, committed student. He expects to get contacts within his network that will last him a lifetime. Also, he hopes to learn new applications to the material sciences he already knows.

Jason Entler - jentler@iit.edu

I will leverage my manufacturing experience to help find new and innovative ways to improve the process

I will continue to develop my patience and working with others

I expect to find that this process is impractical

Maximillian Estrada - mestrad2@iit.edu

The strengths of Max's contribution will draw upon three sources: lessons learned in his last IPRO (Augmented Reality Entrepreneurial IPRO), engineering skills acquired in courses of the MMAE curriculum, and work experience as part of the O'Hare Modernization Program.

There is much to gain from participation in this IPRO, and Max is particularly interested in acquiring greater knowledge of the steel industry. Max hopes that the project can lead to the development of a tooth failure detection system for A. Finkl and Sons.

Joel Huish - jhuish1@iit.edu

Good with computers and able to understand software. Experienced at taking data and analyzing the data.

Develop a program that can detect the breaking of teeth so that the operator can be informed and make the necessary change.



---

# Team Roster

Alexander Kobalsov - Akobalsov@iit.edu

Vishal Patel - vpatel87@iit.edu

I have an extensive background in MatLab programming. I have taken various numerical classes which directly involve the use of programming languages and software to solve problems. I recently worked over the summer with a professor whereby my job was to analyze data obtained from radio telescopes. This involved making various programs and simulations so as to arrive to a conclusion. I feel my background in data analysis will prove useful for this IPRO team as we will have to analyze data we obtain using the accelerometer.

I expect that we will eventually be having two teams one which will collect data and the other that will analyze it. We have a lot of fire power and enthusiasm for this project and hopefully we will solve Finkl and Sons problem.

Vien Quach - vquach@iit.edu

Design Experiments, Run Experiments, and Analyze Data in the Andrew Fejer Unsteady Flow Wind Tunnel including:

- Simulating longitudinal and vertical gust components in the wind tunnel

- Documenting flow structure by using smoke wire, hotwire, and 3D PIV

- Measurement of aerodynamic forces by using the ATI-Nano 17 force transducer

- Application of AFC (Active Flow Control) in lift suppression and enhancement in the oscillating free stream

Expects to:

- Be able to detect broken insert of the milling machine

- Design a system that can automatically detect broken insert and alert the operator

Jay Taggart - jtaggart@iit.edu

- Strengths: programming, project management, communication;

- New Knowledge: integrated systems, working under a sponsor with clear expectations;

- Expectations: understanding of a dynamic team structure;

Yeo Sunghwan - syeol@iit.edu

- Solidworks, knowledge about materials and steel manufacture industry.

- We will be able to find patterns which can be applied to milling machines.



---

# Purpose and Objectives

## *Abstract-*

The purpose of this IPRO is to develop a robust, working prototype that can automatically monitor and detect a problem with a milling machine at A. Finkl & Sons Co. This IPRO is in its fourth semester and there are two challenges remaining: (1) alerting management to the detection of broken teeth during machining; and (2) developing spatial representations of items undergoing heat treatment. However, A. Finkl & Sons has asked us to concentrate solely on the goal of finding a way to detect when a break occurs in one of the milling teeth and then alert the mechanic monitoring the machine in order to replace it. This system will involve measuring vibrations using an accelerometer or by the use of laser detection. The goal of this IPRO is to research, test, and inform A. Finkl & Sons of the best solution to invest in, therefore they can decide what is better for their company.

## *Problem-*

Finkl & Sons Co. which is looking for a way to detect a break in their milling machine, so that it can be replaced quickly and efficiently.

## *Objectives-*

Continue off the research of the previous semester's research to find a solution to the given problem. Here is a brief description of the technology that will be employed:

we are focusing on is the accelerometer. There are two aspects to the accelerometer technology, wireless or wired. One is a wireless accelerometer provided by Techkor, which seems to be the best option. There were a few companies that were investigated, for example, Honeywell and G-Link. However, Techkor is the better of the three because the G-Link is too slow for the required frequency. Honeywell has not answered our inquiries at the moment. We have a high frequency issue and Techkor is the only one that demonstrates the capacity that we need on measuring vibrations. We will be conducting our research solely based on the wireless accelerometer.

Find an algorithm that will read accelerometer input and detect the tooth breaking on the milling machine.

This algorithm will read the input data from the accelerometer software. It will signal to the machine to stop the manufacturing process so that the teeth may be rotated, or replaced.



---

# Team Values Statement

The team members support the values and ethics of IPRO 304 as a project with a clear objective. The backgrounds of the members are primarily from engineering and computer science disciplines. This will allow them to directly apply their academic experiences to the development of a tooth failure detection system.

The team members are expected to attend the team meetings during the allotted course time. Also, they must be present at meetings or activities that are specifically volunteered for or are assigned to. Should a time conflict arise, members must inform the team in advance of the inability to make the meeting or scheduled task by conversation, email, or phone call.

The group structure deemed most fitting for the team is an informal one that is task oriented. Decisions will be reached by consensus of the IPRO 304 team. The required tasks and direction of further development regarding the project will be reached upon by decision. Should a consensus not be reached on a matter, the team will conduct a vote to determine the outcome.

Information gathered and accomplished tasks significant for the further development of the project must be shared with all team members in a timely fashion. The team will determine the necessary objectives as they gather information and also determine the required tasks to attain the stated objectives.

Tasks will be assigned on a volitional basis to individuals or sub-groups. If a team member is without a current task or assignment for the project, he must raise the issue at the team meeting so that an appropriate task may be assigned or so that he may join a sub-group to assist them their task.

As the team structure is informal, roles will be appointed after being decided upon as necessary by the team. The duties of an appointed role must be clearly outlined by the time of an individual's assignment to that role. Reaching the goals of the course requires cooperation. If there are team conflicts that inhibit progress, they may be raised by an individual or group at a team meeting to determine how to best overcome the experienced difficulties via consensus or vote.



---

# Breakdown Structure

The problem A. Finkl & Sons has is that it does not have an efficient and effective way to detect broken inserts. They see a more effective management tool to detect breakage on their vertical milling equipment.

This team will solve this problem by advanced radio topography. We will be attaching accelerometers to the work piece and recording the frequency of the vibrations transmitted through the work piece. The appearance of specific frequency spikes and specific frequency patterns will enable us to determine the tool breakage. Once specific patterns are recorded we will be able to develop a matrix that will allow us to accurately predict tool life. We will also develop a computer generate user interface that will help the management monitor the equipment in real time.

There will be very little testing involved throughout this process. The previous semester has already developed a well rounded theory that has proven to be successful and repeatable. We will initially confirm their findings and then continue to collect streams of data. This will be necessary for us to develop an accurate matrix that we will implement.

The results of the testing will be documented on the laptop computer we have dedicated to this project. The streams of data are emitted in a .txt file. The raw data will then be processed and filtered through specific software. This will allow us to analyze the data and find patterns.

The IPRO deliverables report will be generated by everyone in the IPRO team. This specific task is of paramount importance and it will be absolutely necessary the receive input of the whole team. The tasks will be shared and completed by everyone in the group.



---

# Expected Results

## *Expected Activities-*

There are four main expected activities this team will be involved. First, each divided group will collect and analyze wireless accelerometer data to verify the correlation between the amplitude and tooth broken moment. Second, this team will develop program that uses in the collected data. We should learn how to use the controlling software. Third, this team will develop test matrix. The developed test matrix will be useful for future presentation. Fourth, this team will learn the control system of A. Finkl & Sons. Co. It makes easier for team members to find the right person in A. Finkl & Sons. Co. for any information and advice.

## *Expected Data from Research-*

Stream of data will be collected by wireless accelerometers. The data will include particular frequency and amplitude and will allow us to find patterns when the teeth of milling machines are broken.

## *Expected Product-*

A method that will allow A. Finkl & Sons. Co to detect broken teeth on milling machines quickly. This detection will allow for an automated halt device, so the teeth may be rotated or replaced.

## *Potential Outputs Derived from Research-*

Patterns will be verified at the end of this project by which broken inserts are automatically monitored and detected. The patterns will come from the data returned by the accelerometers.

## *Benefit to Client-*

If our team is able to successfully produce an method to detect teeth breakage, we will be able to increase the productivity of the production floor.

## *Foreseen Obstacles-*

Because wireless accelerometers are affected by the exterior vibration, the unpredictable and disordered environment can be the biggest challenge.

## *How to Use Research Results-*

The results from our research will allow us to verify patterns that indicate teeth breakage. These results will lead to the ability to create an automated process to stop the milling machine to have its teeth rotated/replaced.





---

# Budget

Trips to Finkl:	\$10 for gas per trip X 8 trips = \$80
	\$25 for food per trip x 8 trips = \$200
Food for meeting:	\$50 for pizza and drinks
Food for IPRO day:	\$100 for sandwiches and drinks
Magnetic mount for sensor:	\$40
Total:	\$470

# Tasks and Milestones

## Tasks-

1. Defining the problem at hand
2. Verifying proof of concept from previous semester. Replicate data
3. Identify variables that can effect results
4. Test proof of concept against different variables.
5. Analyze monitored data
6. Verify results.
7. (optional) Create software to monitor data
8. Prepare for IPRO Day

## Deliverables-

Deliverable	Deadline
Project Plan	February 6th
Midterm Review Presentation Slides	Uploaded day of review
Abstract/Brochure	April 27 <sup>th</sup> by 9:00 am
Poster	April 27 <sup>th</sup> by 9:00 am
Final Presentation Slides	April 29 <sup>th</sup> by noon
Final Reports	May 8th
IPRO Deliverables CD	May 11 by 4 pm

## Breakdown of Tasks

Task	Abilities/Education
Defining the problem at hand	Listen, think constructively.
Verifying proof of concept from previous semester. Replicate data	Understand concept, collect data
Identify variables that can effect results	Engineering properties knowledge, constructive reasoning
Test proof of concept against different variables.	Understand concept, collect data
Analyze monitored data	Engineering properties knowledge, constructive reasoning
Verify results.	Understand concept, collect data, maintain proper testing procedures
(optional) Create software to monitor data	Computer science skills, database management

# Tasks and Milestones

## *Time Allotment-*

<b>Task</b>	<b>Hours</b>
Defining the problem at hand	4
Verifying proof of concept from previous semester. Replicate data	4
Identify variables that can affect results	2
Test proof of concept against different variables/scenarios.	20
Analyze monitored data	4
Verify consistency between results.	4
Create software to monitor data (optional)	8+ (optional)
Prepare for IPRO Day	5
<b>Total:</b>	<b>43+</b>



---

# Informal Assignments

I PRO 304, Spring 2009 has not created teams yet simply because we find it unnecessary at this point. Our members are very excited this semesters and each of us are contributing in every way we can. Each member's skills and expectations have already been covered in section 1 of this Project Plan. Matt Abhay has created a g-mail account whereby all of us are required to send our completed portions of every task and he compiles it. Our first objective is to collect data using the wireless accelerometers at Finkl and Sons and from those who have volunteered to go there, it seems like in the near future we will be having two teams i.e. one that collects the data and the other that will analyze it. When we require teams we will break ourselves apart. Abhay will be keeping track of all the information we collect in is his e-mail account and we will also upload the same files on i-groups. Christopher Catalina has volunteered and been forced to be our enforcer/leader. He is going to be in charge of making sure each member does their part.

In Summary, Abhay will be the primary point of contact between the students and advisors. Also, Catalina will be the primary recorder of iGroup sessions.