FINKL
A. FINKL & SONS CO.

ILLINOIS INSTITUTE OF TECHNOLOGY

IPRO It takes a team!
INTERPROFESSIONAL PROJECTS PROGRAM

Methology

•Success was found, provided there were no issues with data acquisition, with analysis methods involving the following:

Transfer the raw, chaotic data from the time domain to the frequency domain.

Thus, the signal is broken up into all of its various elements, making the previously indecipherable data far more comprehensible.

Isolate a narrow frequency range, which corresponds to the cutting interaction.

Establish consistent breakage conditions

Identify breakage detection criteria

Produce digital algorithms that trigger the alarm

•Create a computer interface that will notify when a tooth breaks.

The Implementation

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

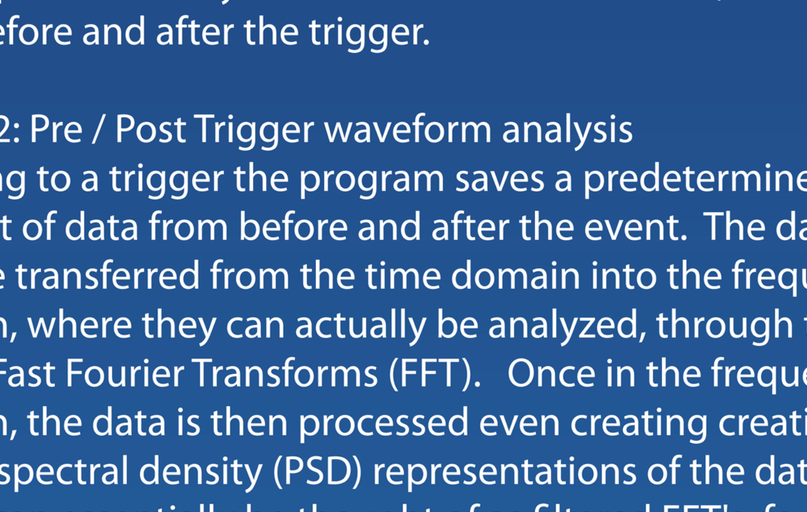
Check 1: The Trigger

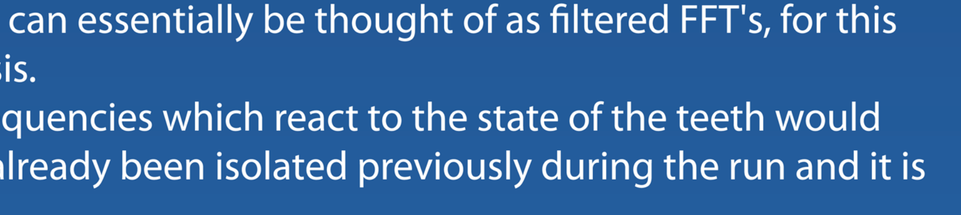
It is understood that in a typical scenario when an insert fails, it fails catastrophically. This destruction of a carbide insert results in a significant shock to the system that is easily identified by the monitoring program. When the program encounters a spike in activity that ex-ceeds this threshold, it collects data before and after the trigger.

Check 2: Pre / Post Trigger waveform analysis

Reacting to a trigger the program saves a predetermined amount of data from before and after the event. The data sets are transferred from the time domain into the frequency domain, where they can actually be analyzed, through the use of Fast Fourier Transforms (FFT). Once in the frequency domain, the data is then processed even creating creating power spectral density (PSD) representations of the data, which can essentially be thought of as filtered FFT's, for this analysis.

Frequencies which react to the state of the teeth would have already been isolated previously during the run and it is





Results

•The use of Fourier Analysis was key to the progress that was made.

Through the comparison of unaltered PSD's it was possible to clearly see when a tooth had been broken, in many cases. In these cases it was also possible to quanitfy the change through various methods having to do with amplitude and bandwidth comparison.

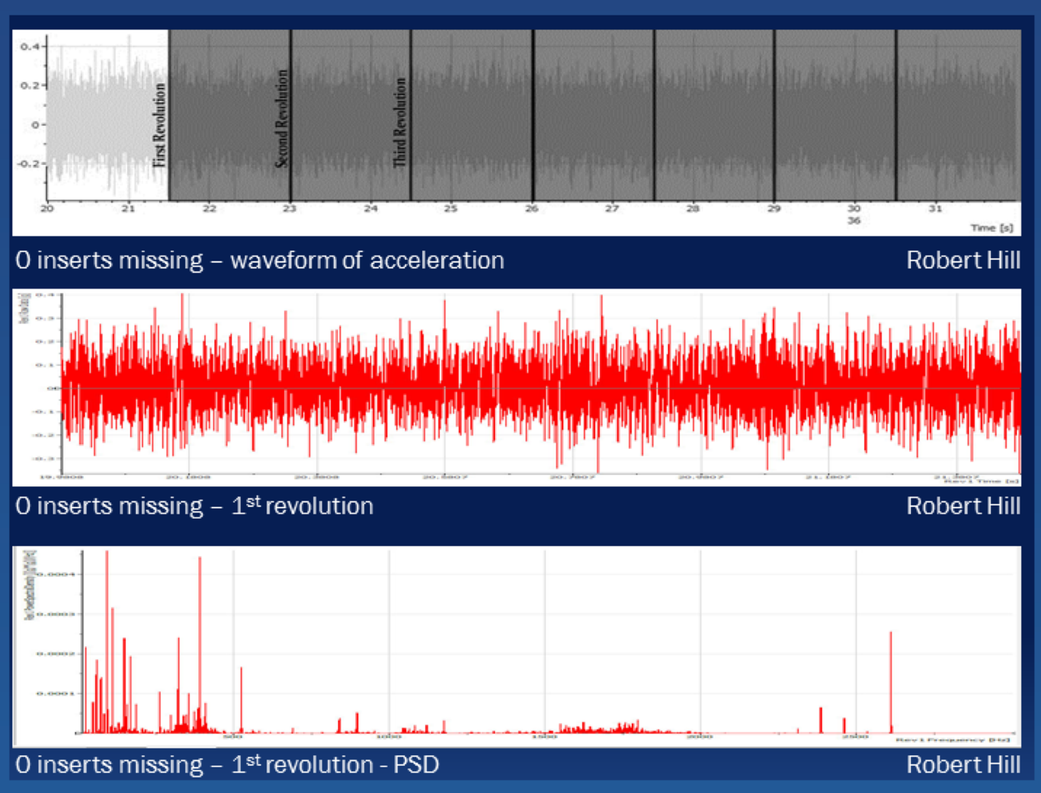
% differences of up to 99% were seen.

•Some groups of data were much harder to analyze than others and made the methods used seem ineffective.

It seems that this added difficulty corresponded to slightly different data acquisition setups.

If this analysis were to be used permanently, such changes in data would not occur, for the accelerometers would be permanently fixed, along with the rest of the setup.

It is believed that, once the effect of accelerometer placement has been studied further, it will be easier to improve the analysis methods tested this semester.



0 inserts missing – waveform of acceleration Robert Hill

0 inserts missing – 1st revolution Robert Hill

0 inserts missing – 1st revolution - PSD Robert Hill

Conclusion

Permanently fixing the accelerometer in a constant placement on the milling machine is the required next step. This will eliminate the variable of the accelerometers placement and orientation, making it into a constant. Other future work necessary to continues with the next semester team members using our data and knowledge in LabView programming to begin developing a program to incorporate this new method into an automated system.