Integration of Sensors on the UNH Wind Turbine

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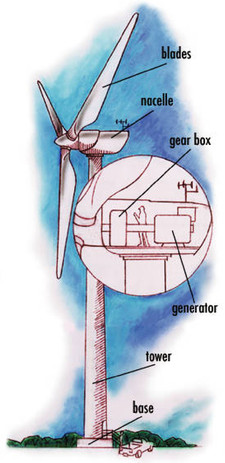
Introduction

A common renewable source of energy is wind energy. A wind turbine is a common way to harness wind energy and convert it into electrical energy. There are two common types of wind turbines, the Vertical Axis Wind Turbine(VAWT) and the Horizontal Axis Wind Turbine(HAWT). I am working with a HAWT, located on the roof of the Tagliatela College of Engineering.



With the data collected we will be able to better understand small wind turbines under different environmental conditions. Further research can be done to maximize the efficiency of small wind turbines.

Sensors used include:

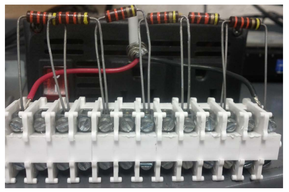
- **Integrate sensors that will provide RPM, voltage and current data;**
- **Implement current sensors to measure the current being supplied by the turbine and a power rheostat to provide a variable load;**
- **Use a Data Acquisition Card (DAQ) and LabView® software to gather data: frequency, voltage and current sensor outputs.**
- **Mounting and integrating a weather station on the roof to gather data such as a wind speed, rainfall, etc.**

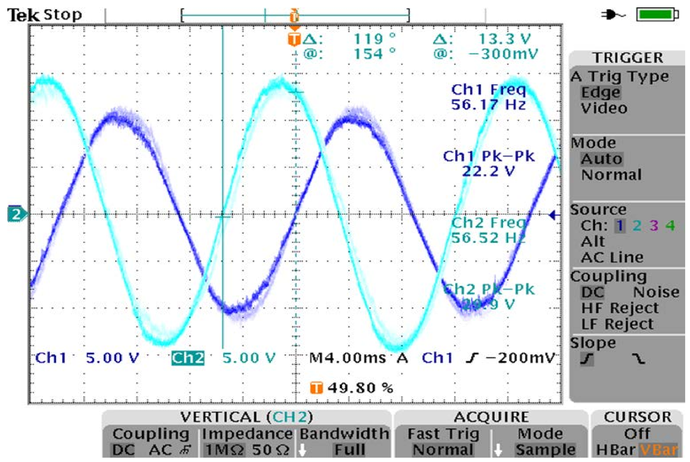
Materials and Methods

- Frequency will be measured using a DAQ Card to calculate the RPM of the Turbine
- The peak voltage has to be no greater than +/- 10 volts, in order to be wired to the DAQ Card.
- The turbine output voltage was scaled down to accommodate for the DAQ Card
- The DAQ Card could be wired across one of the resistors for a differential measurement at 1/6th of the actual voltage from the turbine
- This voltage scaling is based on Kirchhoff's Voltage Law
- For verification, we measured RMS and peak voltages as well as frequency using an oscilloscope and DMM.

Results

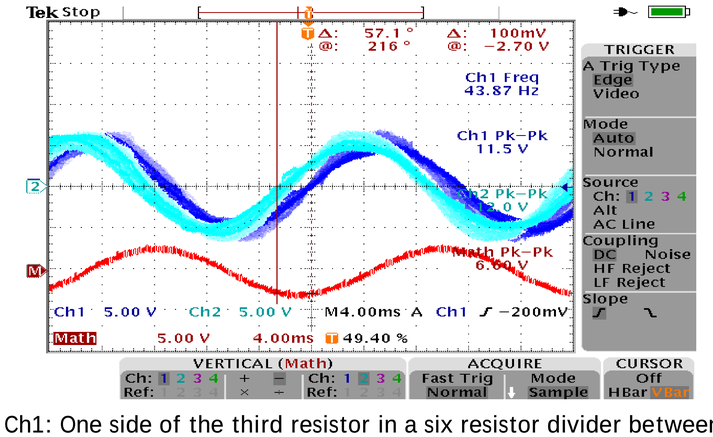
The picture depicted on the right shows the series of resistors used to scale the peak voltage down. The two leads of the oscilloscope are attached across one of the resistors so we could analyze its wavelength. Below are the displays of the peak voltage across two of the three legs. The potential difference(Peak Voltage) between those two legs were in between +/- 10 volts.





Ch1: Outside of the first resistor in a six resistor divider between the BLK & RED phase outputs

Ch2: Outside of the sixth resistor in a six resistor divider between the BLK & RED phase outputs



Ch1: One side of the third resistor in a six resistor divider between the BLK & RED phase outputs

Ch2: Other side of the third resistor in a six resistor divider between the BLK & RED phase outputs

Math (Differential): +/- 3.30Vpk @ 43.87Hz representing 1/6 of the 14.00Vrms @ 43.87Hz between the BLK & RED phase outputs

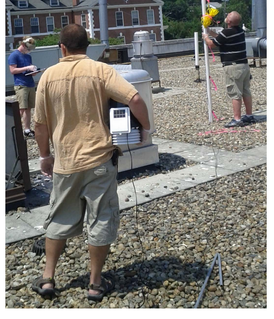
Conclusions

The integration of sensors on the wind turbine is necessary in order to analyze the turbine's performance. Through the use of the weather station data and current/voltage/frequency measurements from the DAQ Card, we will be able to better understand the conditions when the turbine performs best.

In order to baseline for eventual DAQ measurements, we used an oscilloscope and DMM to measure frequency, peak voltages and RMS voltages. Now that peak differential voltages are under 10 volts, we can wire a DAQ Card to the system. These DAQ measurements will allow for the creation of a Lab View PC interface. We can now have one interface to display the weather station data as well as the turbine RPM and voltage output along with the readouts from the current sensors. We now have a work station set up in Buckman 116 Lab for students to eventually use to collect and analyze wind turbine data.

Future Work

Another task will be the mounting of the weather station. We have started the preliminary research to see where the best location would be for both the weather station and the turbine. The concern would be inaccurate data if the turbine is currently located in the wrong place. Preliminary data done on the roof for wind speed and direction was not conclusive, so further measurements need to be taken.



References

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