DEVELOPMENT OF WIND TURBINE EMULATOR FOR RESEARCH AND EDUCATIONAL PURPOSES

OMKAR BHAT, MECHATRONICS, MECHANICAL, & MANUFACTURING ENGINEERING TECHNOLOGY
FACULTY ADVISOR: DR. ZEEL MAHESHWARI

INTRODUCTION & OBJECTIVES

- Installation and maintenance of the wind turbines can be time-consuming, space-consuming, and expensive for education & research purposes.
- Wind velocity is intermittent in nature - it yields variable electrical power delivered by the wind turbine.
- Essential to analyze the performance of wind energy before installing a turbine at the proposed site.
- This project mimics the behavior of wind turbines for hardware level simulation.
- Can reproduce the characteristics of any given wind turbine at any wind speed.
- It analyzes and assesses the performance of the wind turbine to provide the user with valuable results

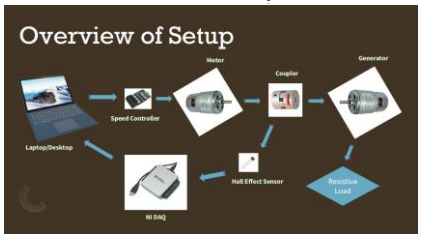
METHODOLOGY:

- Users input - wind speed, pitch angle, temperature, and humidity, which are fundamental in calculating the energy generated.
- Result - Torque generated by the turbine used to run the generator, Overall Power generated, Coefficient of Performance.

INPUTS	Low	High
Power	2.2KW	850KW
Nominal Rotational Speed of Blade (rps)	10.5	0.43
Elevation (m)	1.23	86
Rotor Diameter (m)	6	26

	Constants
Temperature (Degree Celsius)	30
Beta	0
Speed Multiplication Ratio	1.8
Rated Wind Speed (m/s)	12

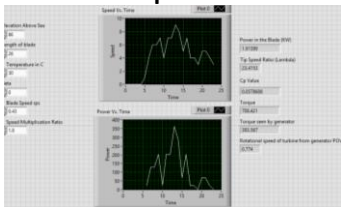
OUTPUTS	Low	Mid
Cp	38.80%	35.50%



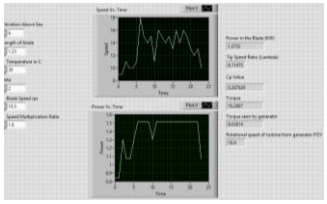
RESULTS OBTAINED:

- High and Low Power Rated Wind Turbine (2.2KW & 850KW)
- Low & High Wind Speeds on the Higher Rated Turbine (850KW)
- Coefficient of Power for different values of Beta (Blade Angle)

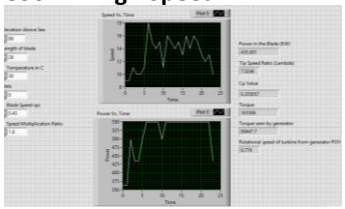
850KW Low Speed

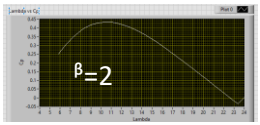


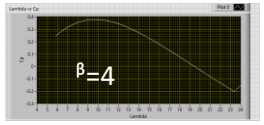
2.2KW High Speed

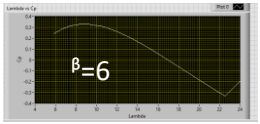


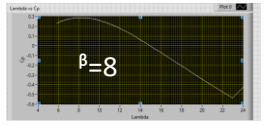
850KW High Speed



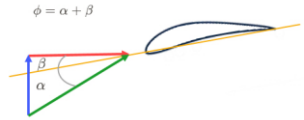








Beta	Max Cp
2	0.44
4	0.38
6	0.32
8	0.29



COST ANALYSIS:

Major Components	Average Price
DC Motor & Generator (1.2 kW)	$240
Coupler	$15
DC Power Supply	$1400
Laptop	$900
NI Application License	$500
NI DAQ System	$595
Cart	$200
Other fixtures/cables	$305
Total	$4155
Average Laboratory Wind Turbine Emulator	$10,000
SAVINGS	**$5845**

CONCLUDING REMARKS:

- Developing a wind turbine at NKU proves to be cost effective for research and educational purposes
- Current Objective – Successfully integrate the feedback loop to ensure smooth operation of the emulator.

ACKNOWLEDGMENTS:

Preparation of this poster was supported by the Faculty Project Development Award & Summer Fellowship