Estimation of Actual & Generated Wind Power Using Artificial Wind

Mr.Shailesh K.Kokate, Prof.N.N.Shinde, Miss.Madhuri B.Mulik

Abstract— Wind energy is clean & inexhaustible source of energy. Wind turbines used to extract power from wind. This paper considered small size of rotor diameter of wind machine. The device mounted on the two wheeler .Firstly vehicle's speed considered as the speed of wind. The available power in wind calculated using the speed of vehicle. Then wind speed recorded on moving vehicle using analog anemometer. For the corresponding wind, generated power calculated. Author also examined percentage of change in speed of wind using two wheeler. It also exam ined the actual power available in the wind and expected power from artificial wind generation.The rotational speed and torque produced on wind mill blade computed.

Index Terms— Artificial Wind, Actual & Generated Wind Power, Rotational Speed, Small Size Rotor, Wind Data, Torque, Two Wheeler.

1 INTRODUCTION

AS a clean, inexhaustible source of energy, wind ene gy is a steadily growing source of electric power and has received considerable amount of attention in many countries of the world. Energy is available in two different alternatives, nonrenewable (coal, fuel, and natural gas) and renewable (solar, wind, hydro, and wave) sources. Especially, after the industrial revolution in the nineteenth century, first coal and then fuel oil are used as primary energy sources for the needs of modern communities. As it is known, fossil fuels have limited potential, and at the current rates exploitations they are expected to be depleted within the next centuries. This is one of the reasons why clean, sustainable, and environmentally friendly alternative energy resources are currently sought.

With increasing significance of environmental problems, clean energy generation becomes essential in every aspect of energy consumption. Wind energy is very clean, but not persistent for long periods of time.

In addition to this, ability of a wind turbine to extract power from varying wind is a function of three main factors, namely, the wind power availability, the power curve of the machine, and the ability of the machine to respond to wind fluctuations. In contrast to conventional power generation where input energy can be scheduled and regulated, wind energy is not a controllable resource, due to its intermittent and stochastic nature.**[1]**

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Wind energy is a source of renewable power which comes from air current flowing across the earth's surface. Wind turbines harvest this kinetic energy and convert it into power. The electricity is sent through transmission and distribution lines to customers. Wind generation is one of the fastest growing sources of electricity and one of the fastest growing markets in the world today. With an average annual growth rate of more than 25% over the past decade, wind is the fastest growing sector of the energy industry all over the world. The advantages of wind energy are numerous and clear, and the technology itself has taken a leap forward in recent years.[2]

Wind power is the most mature and cost-effective renewable energy technologies available today, costing between 3 and 5 cents/(kW · h), depending upon the wind resource and financing of a particular project. It is competitive with traditional power plants. Unlike the electricity from fossil-fuel-powered sources, which depend on fuels whose prices are costly and may vary considerably, the cost of wind power is relatively stable.

Wind is a converted form of solar energy. Wind power is inexhaustible and requires no "fuel." Wind turbines do not produce greenhouse gasses that may cause global warming. Wind turbines can be erected on farms or ranches, thus benefiting the economy in rural areas. Farmers and ranchers can continue to work on the land because the wind turbines use only a fraction of the land.

The percentage of wind energy in electric power systems is growing rapidly due to enhance public concerns environment impacts and escalation in energy cost associated with the use of conventional energy sources.**[3][4]**It is estimated that by 2020, about 12% of the worlds electricity will be supplied by wind generation**[5].**Electric power from wind energy is quite different from that of conventional resources. Unpredictability and variability of wind power generation is one of the fundamental difficulties faced by power system operators. Good forecasting and modeling tools are urgently needed forth effi-

cient integration of wind energy into the powersystem.**[6][7]** especially for forecasting of the power generating by wind farms**[8][9].**

2 METHODOLOGY

The method adopted for artificial wind data generation is anemometer mounted on vehicle and readings noted for wind speed. The speed of vehicle increased by decimal digits and readings noted for generated wind speed. The generated wind velocity noted in table 1. This gives the vehicle speed and actual speed generated. The readings of speed are in m/s.

In order to determine power estimation, it is necessary to simultaneously consider the frequency of wind velocities and the power curves of the wind turbines **[10][11]**. Generating electricity from the wind is environmentally friendly, socially acceptable, and economically competitive **[12].**

Wind power has become the dominant source of alternative energy **[13]** and experienced a dynamic growth in recent years **[14].** The fact that wind energy is considered as the most preferred alternative energy source by many researches **[15]** has motivated further growth of wind farms and research in wind energy. The power extracted from the wind is expressed by **[16]**

$$P = \tfrac{1}{2} \rho A V^3 \quad (1)$$

Where, ρ is a air density & it's value is 1.225kg/m^2.
A is swept area of small wind mill, V is the flowing velocity.

3 EXPERIMENTATION & RESULTS

For experimentation purpose initially we taken into account the speed of vehicle.We refered the speed of vehicle as a actual speed and generated the wind speed. The following fig.1 gives us information about the actual speed of vehicle and generated wind speed.

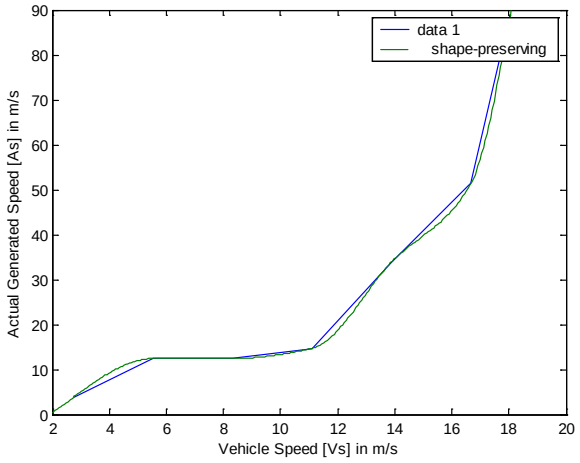

Fig.1 Vehicle Spped Vs.Actual Generated speed

From fig.1 author got information about change in generated wind speed. From above fig.1 we noticed that for reading first, third, & fourth we noticed maximum percentage of change in wind speed measurement. The percentage of change in wind speed is maximum up to 75% and minimum upto 20%.

From the vehicle speed the author calculated the available power in wind.It is plotted in fig.2. The available power is refered as a actual power in wind. The measured vehicle speed is in m/s & available power is in watts.The ploted graph is a exponential type. It means that the available power in wind increased with increased in vehicle speed. From the fig.2 we noticed that wind velocities of 13.88 m/s, 16/67 m/s, & 18.05 m/s produces maximum power viz. 118.39 watt, 205.103 watt,260.37 watt respectively.

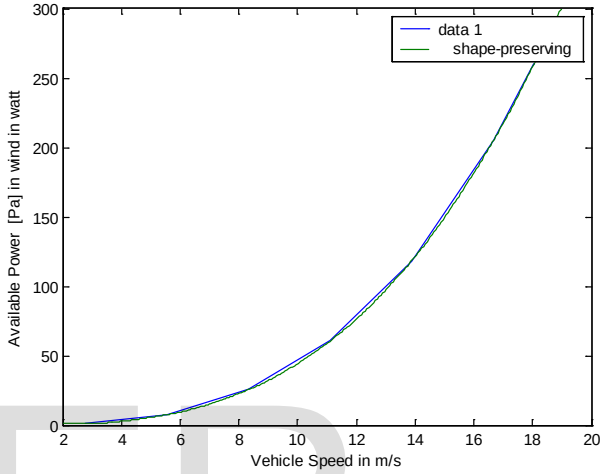

Fig.2 Vehicle Speed Vs.Available Power in Wind

Now the artificial wind speed (Generated Speed) measured on vehicle and the corresponding generated wind power is given in fig.3.

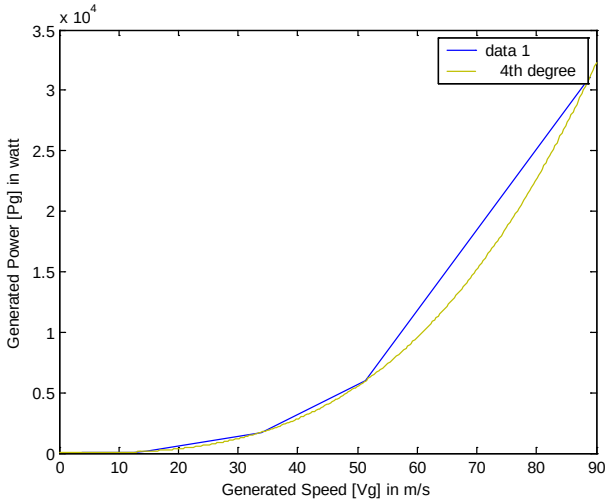

Fig.3.Generated Speed Vs.Generated Power.

To exact prediction of generated wind power the author used MatLab Curve fitting option. The fourth order degree used which gives the smooth curve which resembles exponential type. From above fig.3 we again noticed that wind velocities of 14.71 m/s, 33.87 m/s, 51.37 m/s, & 88.88 m/s produced maximum power viz. 140.93 watt, 1720.33 watt, 6001.20 watt, 31082.9 watt respectively.

Now another test was carried out to mesure Rotational speed

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(rad/sec) & Torque (NM). For this purpose the author used WARLOCK'S Wind Blade Calculator. The observations are noted below. Firstly we refered the speed of vehicle for calcu-

Wind Velocity in m/s	Rotational Speed in rad/sec	Torque in NM
2.7	64	0.02
5.5	128.2	0.09
8.3	192.4	0.21
11.11	256.7	0.38
13.88	320.7	0.59

lation.Following were the assumptions considered

1) Number of Wind Mill Blade are 3
2) Tip Speed Ratio is 7.
3) Blade Efficiency is 40%
4) Blade Radius is 0.303 m.

TABLE 1.
MEASURED ROTATIONAL SPEED AND TORQUE USING VEHICLE SPEED

From the above table1 we observed that for the first reading of vehicle speed i.e 2.7 m/s the rotational speed is 64 rad/sec while the Torque is 0.02 NM. Similarly we carried out the test for remaining wind speed. The maximum Rotational Speed is 320.7rad/sec and maximum Torque is 0.59 NM is noted at the speed of 13.88m/s.

Following fig. 4 is the graph of Rotational Speed of Blade Vs. Torque. For the calculation purpose we refered the vehicle speed.

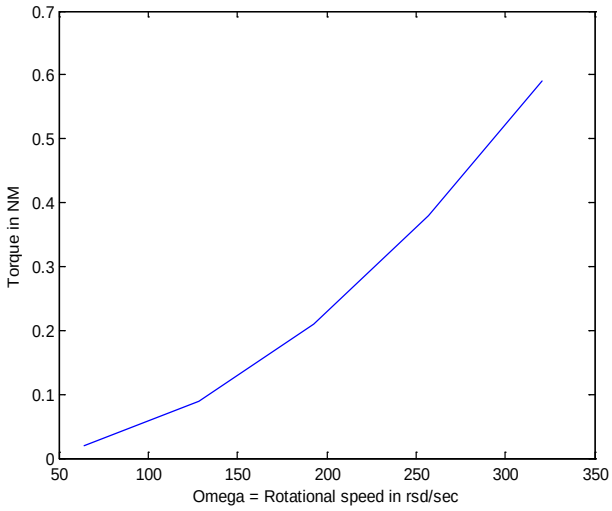

Fig.4 Rotational Speed Vs.Torque.
[Considering Vehicle Speed]

From above table 1 & fig.4 we should noticed that maximum rotational speed, maximum torque witnessed at 13.88 m/s wind speed. The graph is a type of exponential. The Torque increases with increase in Rotational speed of blade.

Considering Generated wind speed we again measured the Raotational Speed and Torqure. The results are noted in Table2.

TABLE 2
MEASURED ROTATIONAL SPEED AND TORQUE USING GENERATED SPEED

Wind Velocity in m/s	Rotational Speed in rad/sec	Torque in NM
3.89	89.9	0.05
12.46	287.9	0.47
12.46	287.9	0.47
14.71	339.8	0.66
33.87	894.3	2.29

The fig 5. is the graph of Rotational Speed of Blade Vs. Torque. Now we considered the Generated Wind Speed.

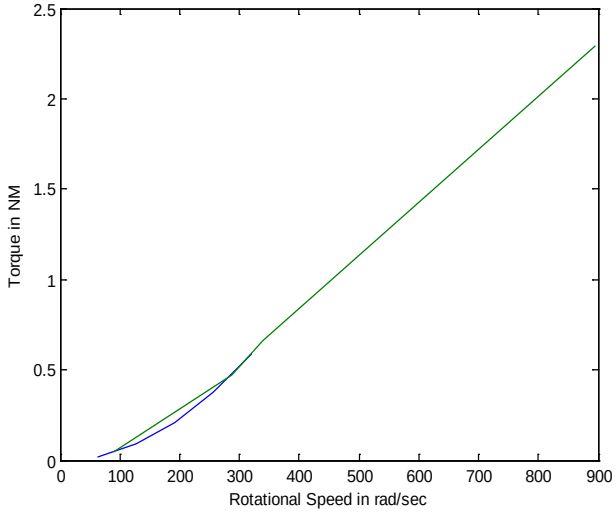

Fig.5 Rotational Speed Vs.Torque
[Considering Generated Wind Speed]

From Fig.5 we understood that there is slight bend occurred at 287.9 rad/sec then the remaining part increased sharply. Here the graph is linear.

4 CONCLUSION

Globally the number of two wheelers increasing day by day

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Many research are under going to implement the use of renewable energy sources as a fuel to run these vehicles.The author considered the moving vehicle as a source for wind energy and predicted the available wind power. The available power is in the range between 0.94 watts to 260.37 watts.The generated wind speed gives the power in the range of 2.606 watts to 31082.9 watts. In order to cater the need of 60 watts for 100 C.C. bike this generated wind power helps to charge the battery which can be used for regular or Electric Vehicles.

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