A high-performance control model of grid-connected wind conversion system to grid

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Abstract: *A control scheme for integration wind energy conversion system into the utility grid is presented. As the performance of WECS depends heavily on climate condition and wind speed, integration into the grid is difficult. A suitable control scheme of WECS is required for satisfactory performance when grid connected. Several voltages and current controls that stabilise the system has been discussed earlier. Here, a PID controller in the system is tested under deferent weather conditions. A pitch angle controller module with PID control is developed in this work that is suitable for wind power conversion system. Then, the system behaviour and performance are studied. The system stability is also considered when there is a change in pitch angle or a fault in the system. This paper advocate that the proposed PID controller gives a good performance.*

Key Words: *The Wind, PMSG, PID controller, the utility grid, A Pitch angle.*

1. INTRODUCTION:

The wind energy system is free kind of a green energy that is sustainable and inexhaustible energy from the solar-powered. The wind comes with the irregular warming of the air by the sun, the characteristic of the earth's terrain and circulation of the Earth. Wind flow is adjusted from the earth surface and environmental status and construction type. By utilising this flow of air, or movement power, and when harvested with convenient wind turbines, allowing the producing of electricity. Terms of wind energy or power production represent the task that the exploitation of wind energy in order to reach into mechanical or electrical energy [1].

Wind energy has increased continuously to participate in the share of power generation. To transport power generated from wind power plants (pilot projects) networks AC, and the perception of high direct current voltage endings multi-systems (HVDC) as the backbone in the future to generate energy from the European super wind network connectivity with various AC and countries mainstream networks. Control scheme coordinator for the pilot projects abroad connected through multiple endings HVDC systems is able to contribute to the control of the fundamental frequency of the AC ground networks[2].

It becomes assess power quality (PQ) is an essential part in the integrating of a network of wind power systems. To provide an accurate estimate of the conditions of the network, it is designed calibration test platform to assess the ability of commercial tools separatist party[3]. The integration of wind power from small-scale facilities with installed wind turbines and represent as generated power sources. Since wind power can be integrated customer service load or enter distribute clean energy area, we introduce a theoretical scheme is vital to define the purpose of wind energy and present trust over the long term. This proposed design in controlling the simple dynamic model which will increase the earnings forecasts for the benefit of the green and easily implemented on the Internet[4]. To study the fundamental properties of the operating system integrated with a microgrid familiarise joined the grid, and also prepared a platform on a laboratory scale. Comparative experimental and simulation results reveal that the lesson to be an integrated system to maintain a stable power-saving operation under diverse operating situations employing the proposed microgrid [5].

The design of the converter is to integrate renewable source such as wind system with the grid. Generally, the energy of renewable power systems is always inconstant in real life.
This requires the insertion of an interface, such as simultaneous network adapters so as to synchronise and regulate the sustainable power system to the grid.
Phase locked loop is used (PLL) is applied to manage the synchronisation of the network [6]. Achieve the method to obtain the greatest output of mechanical power which can be produced from wind turbines at specific wind rate and integrate the produced energy to the utility is a challenging area. A permanent magnet synchronous generator is a used generator, which is also a changeable speed generator. Also, the pitch angle controller is used to allow the stability of wind power conversion and protect it from mechanical damaging [7].

The suitable control structure when the wind producers supply a large part of the burden. The way a record low in demand to compel generators to participate in accordance with the wind energy available and not only in the classification of the generator load.

The control network connection by energy conversion, and also to connect HVDC[2]. Proposal for variable speed sensor system less control for permanent magnet synchronous generator (PMSG) network through back to back converters for wind power generation. back to back converters for wind power system. The side inverter controller system uses a proportional-integral (PI) control with the current separation of cross-coupling line voltage feed forward compensation disorder. Also, the estimation of the positive angle series control by the observer, including the case of voltages asymmetric and automatic transfer meaningless method[9] from an integrated network to stand single, and vice versa is used to filter D unit to extract strongly on the line voltage positive flow followed and a phase-locked loop. Study the effect of control doubling feeding the induction generator and process stability rotor angle. It is proposed to control all of the rotor-side converter strategy and the network side converter of DFIGs to decrease the impact on the performance of the system [10].

Study the effect of control doubling feeding the induction generator and process stability rotor angle. The Wind turbine depends on the flow of air, which itself is depend on the speed of weather situation and local influences. This leads to the corresponding differences in the initial energy supply across which the turbines have no effect. Production cannot modify through decrease the generation of electricity. Thus only the network are not affected by fluctuations on the side of energy consumption, only in the case of nutrition is coordinated from the wind turbines - from the influence of weather on energy supplies [11].

A control technique to integrate the distributed generation (DG) resources to the utility grid. Which can be compensate reactive, active, and harmonic load current components while linkage of DG links to the power grid. The performance of the control method in distributed generation enforcement is demonstrated for adding the maximum energy from the distributed generation into the network, while, the rise of the power factor of the network. Decreased total harmonic distortion of grid current in simulation and real-time situation under relentless status and element working cases is also studied [12].
Here a simple PID control is proposedwhich improve the performance of the system when tested under a varies conditions.

2. MODELLING CONTROL OF WIND TURBINES CONNECTED TO THE GRID:

In this paper, the effectiveness of PID controller in the system under different weather condition is analysed[13], using a pitch angle control Mechanical strength arrested (in W) of the (VSWR) is:

$$\rho m=0.5\cdot P\cdot Ar\cdot V_W CP\cdot(\gamma,\beta) \tag{1}$$

Wheneverρ air density$\left(\frac{k}{m^3}\right)$, Ar is the area code effect, Is the wind speed (m^2) , V_W is the speed of wind turbine the$\left(\frac{m}{s}\right)$ which are the dimensions (VAWT) power plants. Power plants (VAWT) is given by:

$$\mathrm{C}_\rho(\varphi_k,\beta) = c_1(c_2\varphi_k - c_3\cdot\beta - c_4\cdot\beta^{c_5} - c_6)exp\left(-c_7\varphi_k^{-1}\right) \tag{2}$$

In which

$$\varphi_k^{-1} = (\lambda + c_8\cdot\beta) - c_9(\beta^3+1) \tag{3}$$

$$\lambda = (R_{b\omega}\cdot\omega_{b\omega})V_W^{-1} \tag{4}$$

Where $\omega_{b\omega}$is the angular speed of the wind, the wind speed is$R_{b\omega}$ is the blade radius (m), theλ is percentage of the tip speed, and β is blade pitch angle,(c_1, c_9) also are the fixed coefficients of C_ρ.

Pitch Angle Control

Wind turbines can work with both steady speed and irregular speed. The pitch control for the changeable-speed wind turbines attained a distinguished consideration during the last decade. The motivation for the development of variable speed wind turbines recently is to reduce of both the mechanical structure pressure also acoustic pressure, then availability to regulate active and reactive power. Indeed, inconstant speed process raises the dynamic performance

and decreases the drive train torque and forces the producing flow to be unstable. Thus the control of pitch angle is critical to get the rotational speed constant. A little deviation in the pitch angle can produce an extensive change on the output power.

3. SYSTEM DESIGN OF THE WIND TURBINE:

In this part, classical pitch angle control design, use the proportional and integral PID controller is debated. The system design of the turbine is clarify in the following fig.1.
The input is the generator speed(Wr1) which is reference of summing point and the feedback of pitch angle is given to summing point. Then the error is fed to PID controller to make the WECS block. The pitch angle of wind speed in degrees and the rate limiter is limiting angle of the pitch. The output is the generator terminal.

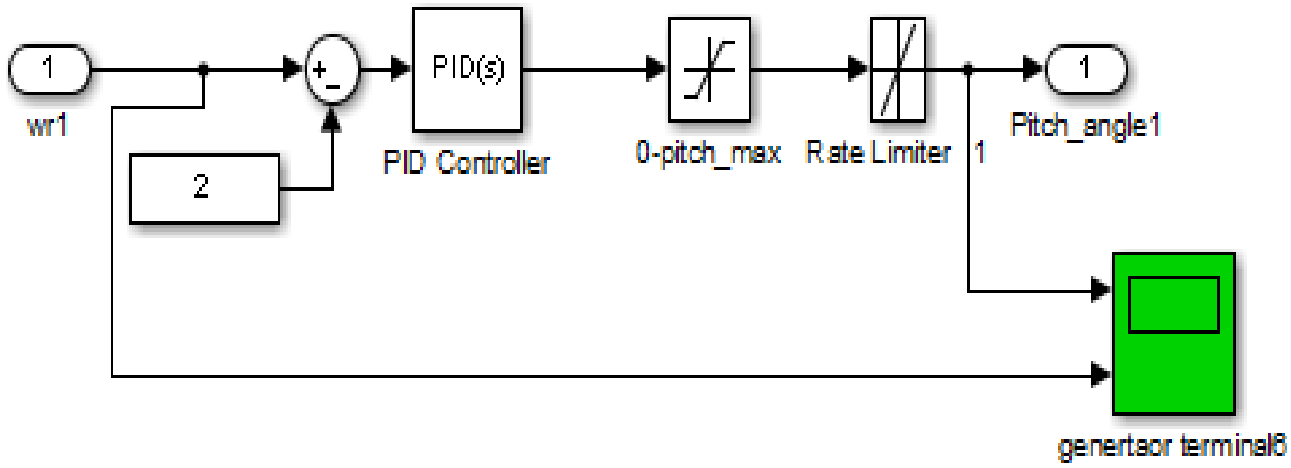

Fig. 1. Pitch angle controller scheme

4. SIMULATION RESULTS:

The PID controller for integration of wind system into a grid is developed and analysed by using of MATLAB/SIMULINK utilising block set of the power systems.

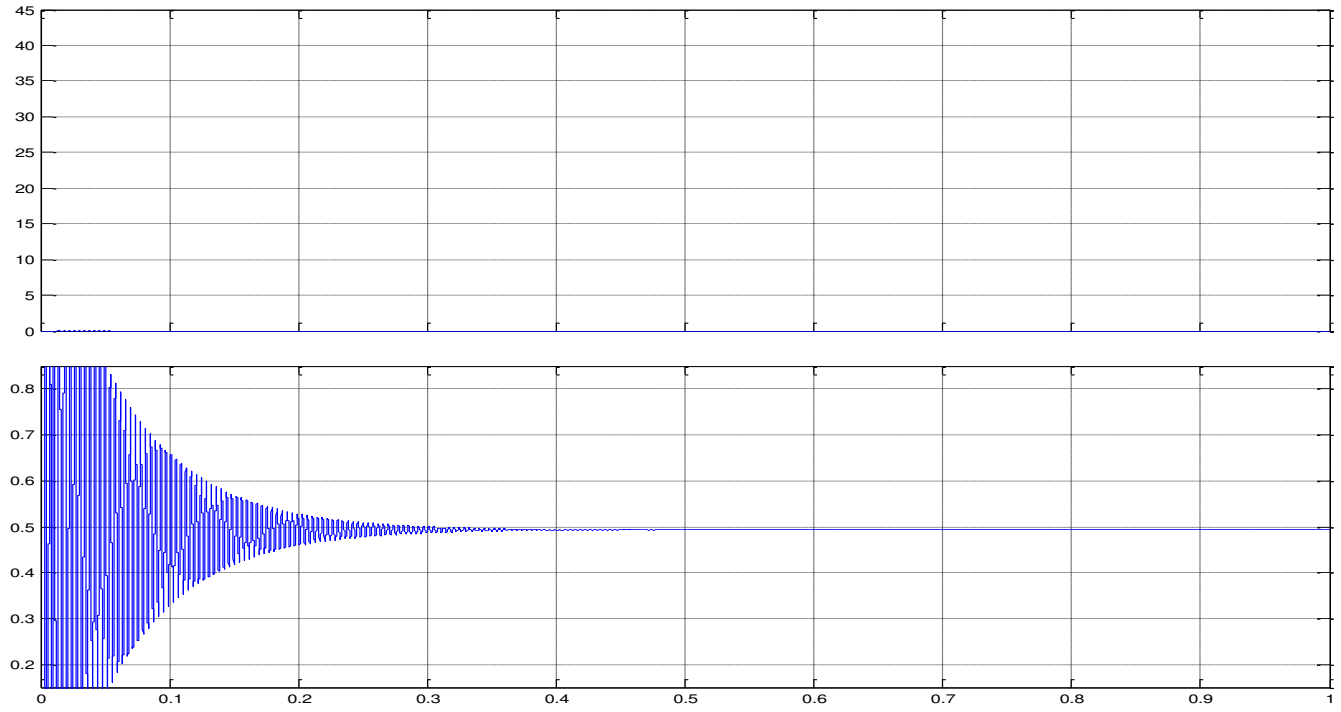

Fig. 2. Pitch Angle control system

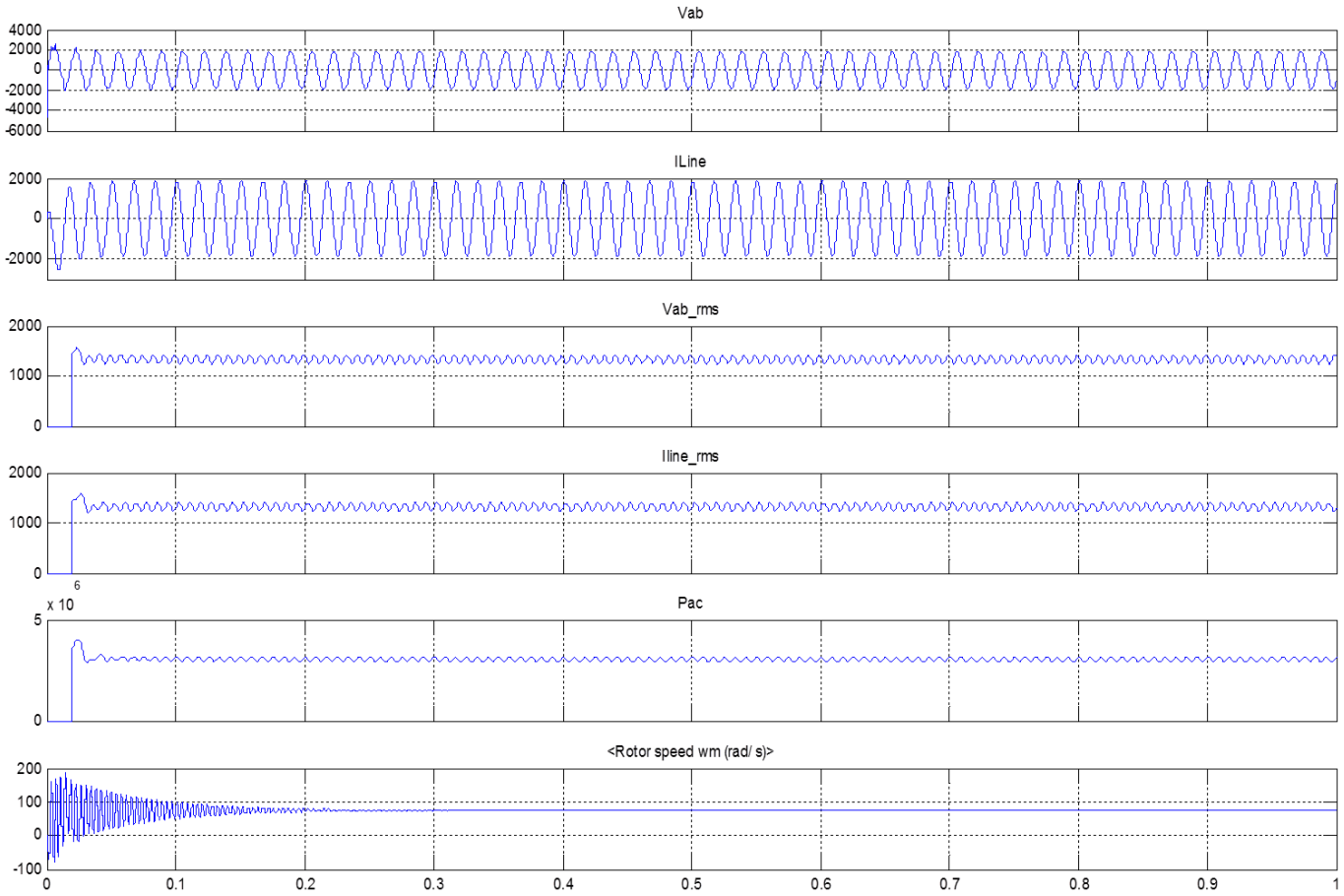

Fig. 3. Simulation results (a) V_{ab} (b)I_{line} (c)rms of V_{ab} (d) rms of I_{line} (e) Power (f) Rotor speed

As given in Fig.3, the current and voltage in stable and give a good response, but the power is stable and it is not disturbing. So that the PID controller is only applied to solve the problem of voltage variation without affect the power quality as depicted in Fig.1.

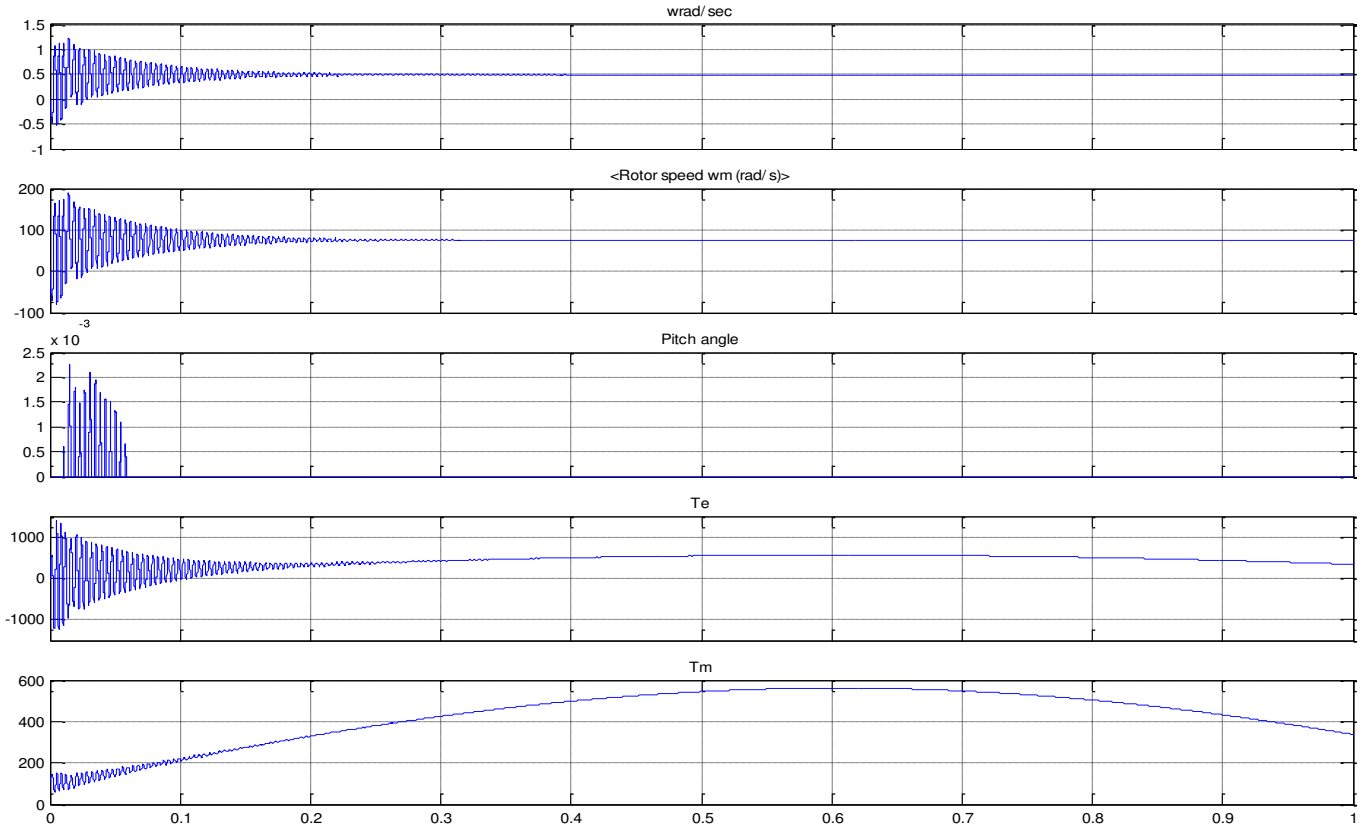

Fig. 4. Simulation result of wind turbine Generator

5. CONCLUSIONS:

The paper presents control model for integration wind energy conversion system into the utility grid. This model is count on the basic circuit of the wind energy system and integrated into the grid showing the effects of regulating pitch angle. The system behaviour and performance are studied. The controller system is based on pitch angle with PID-controller ensure the regulating power in case of fluctuating the weather, which is then integrated into the AC utility grid by DC/AC inverter. The results show a fair degree of relevance to the proposed theory.

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