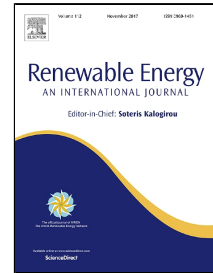


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Hanin Al-Hamidi, Jamil Al Asfar



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Hybrid Renewable Energy System with Minimum Noise Wind Turbine

Al-Hamidi, Hanin¹ and Al Asfar, Jamil*^{2,3}

¹Mechanical Engineering Department, The University of Jordan, Amman 11942, Jordan, email: hanin.2712@gmail.com

²Mechanical Engineering Department, The University of Jordan, Amman 11942- Jordan, email: jasfar@ju.edu.jo

³Mechanical Engineering Department/ Al-Zaytoonah University of Jordan / email: j.alasfar@zuj.edu.jo

ABSTRACT

In this study, a photovoltaic-wind hybrid renewable energy system has been examined and analyzed, with concentration on wind turbine to minimize generated noise. Mechanical and electrical analyses were performed. Harmonic electrical analysis on the wind turbine generator and electronic devices within the conversion system was conducted to get better performance. Mechanical vibration analysis was also done on selected wind turbine to estimate the forces and frequencies that may affect the blade during operation and cause noise and disturbance effects.

It was found that Harmonics and total Harmonic Distortion were minimized after implementing an AC/DC/AC conversion system consisting of a diode full wave rectifier and an LC filter to stabilize the DC bus. Finally IGBT inverter was used to convert the DC signal into AC output signal with a useful frequency of 50 Hz after reshaping. The total harmonic distortion was minimized to 2.81 %, less than the IEEE standards of 5% of the fundamental current frequency.

Furthermore, it was also found that according to suggested arrangement of the hybrid system in this study, the blade of the proposed wind turbine, if operated even under its natural frequencies, its performance will be slightly affected resulting in minimized resonance effect.

Keywords: Hybrid renewable energy systems; PV-wind turbine; free noise; harmonic distortion.

1. Introduction

Global energy demands are growing daily, which makes renewable energy options such as solar and wind power representing attractive sources. Hybrid photovoltaic – wind (PV/ wind) energy system has become viable alternatives to meet environmental protection requirement and electricity demands. Due to the complementary characteristics of the PV-wind system such as higher efficiency and almost all time operation, it presents a very good option for loads in remote locations where grid extension is difficult and not economical.

Solar energy, in general, is considered the main renewable energy source in the world. In Jordan, solar radiation is high, where the annual daily average of solar irradiation lies in the range 4-7 kWh/m² taken on average insolation intensity on a horizontal surface. That total annual solar irradiation reaches 2.2 GWh/m², with around 300 sunny days per year.

In present days, wind energy is one of the main renewable energy used globally. The global cumulative wind capacity until the year 2015 exceeds 400 GW. In Jordan, the average wind speed ranges between 5- 6.5 m/sec, while in certain areas it sometimes exceeds 7 m/s.

Hybrid photovoltaic-wind source is considered an excellent solution technically and economically compared to stand-alone single source; since wind is usually more available in colder months, and solar resources are available during the warmer months.

The advantages of each type are integrated together showing most effective operating conditions, which in turn makes the overall efficiency of the whole system increase. Increasing adequacy of wind turbines by making it immune to disturbance will do such a progress in generating energy, and will raise the renewable energy demand instead of fossil fuel.

* Corresponding Author: Jamil Al Asfar, e-mail: jasfar@ju.edu.jo, jamilasfar2012@gmail.com, Tel. +962795568716, Fax +96265355588.

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