

***EFFICIENCY ANALYSIS OF A HORIZONTAL AXIS WIND TURBINE
SYSTEM AS HARVESTING SYSTEM IN SUPPLEMENTARY BATTERY
CHARGING UNIT FOR ELECTRIC VEHICLES USING MATLAB
SIMULINK***

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ABSTRACT

The development of electric vehicles has encouraged the need for innovations to improve battery energy efficiency and extend driving range. One potential approach is to utilize wind energy generated by vehicle motion through an energy harvesting system based on a wind turbine. This study aims to model a wind turbine-based energy harvesting system, analyze the electrical power characteristics produced, and evaluate the system efficiency for electric vehicle battery charging using MATLAB Simulink R2024a. The modeled system consists of a wind turbine, a Permanent Magnet Synchronous Generator (PMSG), a three-phase rectifier, a DC-DC interleaved boost converter, and a 48 V 20 Ah lithium-ion battery. Simulations were conducted at vehicle speeds of 50 km/h, 60 km/h, and 70 km/h for a duration of 5 seconds. The results show that the available wind power increased from 206.8 W to 567.5 W, as vehicle speed increased. The electrical power delivered to the battery was 73.688 W, 121.556 W, and 192.480 W, respectively. The corresponding system efficiencies were 35.632%, 34.011%, and 33.917%. The findings indicate that the proposed system has potential as an auxiliary charging source for electric vehicle batteries. However, it is not yet optimal as a primary charging source because the electrical power generated remains relatively low and is highly dependent on vehicle speed.

Keywords: energy harvesting, wind turbine, electric vehicle, efficiency, MATLAB Simulink.