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SIMULATION BASED STUDY OF SPEED CONTROL OF AN ASYNCHRONOUS MACHINE WITH RENEWABLE SOURCE

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ABSTRACT

Through simulation, this study examines how an asynchronous machine , usually an induction motor, may regulate its speed when fuelled by a renewable energy source. The major goal is to use simulation tools to study and create a control system that keeps the asynchronous machine running at the intended speed even when the output of the renewable source varies. Due to its intrinsic fluctuation, the renewable source which may be wind or solar photovoltaic (PV) introduces difficulties for speed control. It is possible to represent the asynchronous machine, the renewable source, and the control system in the simulation environment in order to assess various control approaches. The study most likely investigates methods for controlling the asynchronous machine speed, such as vector control or V/f control. The outcomes of the simulation would contrast how well these techniques performed under different operational environments, including as variations in the power production of the renewable source. Additionally, the research may tackle possible problems such as power quality difficulties that may arise from the combination of renewable energy sources and asynchronous machine. The goal of the research is to create a reliable and efficient speed control system for asynchronous machines that run on renewable energy sources by examining these factors in a simulation.

KEYWORDS – Solar Photovoltaic (PV), Induction Motor, MPPT, Speed Control (V/f method)

INTRODUCTION

Integrating renewable energy sources like solar and wind power into the grid is becoming more and more crucial as the focus on sustainable energy sources grows. Because of their dependability and simplicity, asynchronous machines also referred to as induction motors are extensively employed in a variety of industrial applications. However, when these machines are fuelled by renewable sources, efficient speed management is essential for both grid stability and optimal performance.

This work explores the speed control of an asynchronous machine driven by a renewable energy source through the use of simulation techniques. The study seeks to: Create a simulation model that includes the renewable energy source and the asynchronous machine. Examine how the features of renewable energy

sources affect the asynchronous machine's speed control. Analyse various control strategies to get the intended speed regulation. across a range of operational circumstances. The method based on simulation enables: Experimentation with various control techniques in a safe and regulated manner. thorough examination of the behaviour of the system under varied load conditions. control parameter optimization for better performance. The results of this research will facilitate the integration of renewable energy sources into the power grid by aiding in the creation of dependable and efficient control systems for asynchronous machines that run on renewable energy.

METHODOLOGY

In our proposed work, we simulated the research of speed regulation of an induction motor using MATLAB/SIMULINK program. A linked PV system consists of solar panels, a DC–DC converter, an MPPT controller, an inverter, and the equipment needed to connect an induction motor. We generated 24.134KW of energy with this arrangement. We employ a 24.134 kW photovoltaic array that is linked to a three-phase inverter and a DC-DC boost converter. Using P&O approach, we implemented the Maximum Power Point Tracking (MPPT) Algorithm in the boost converter. For optimal power gain, this MPPT algorithm monitors the maximum power.

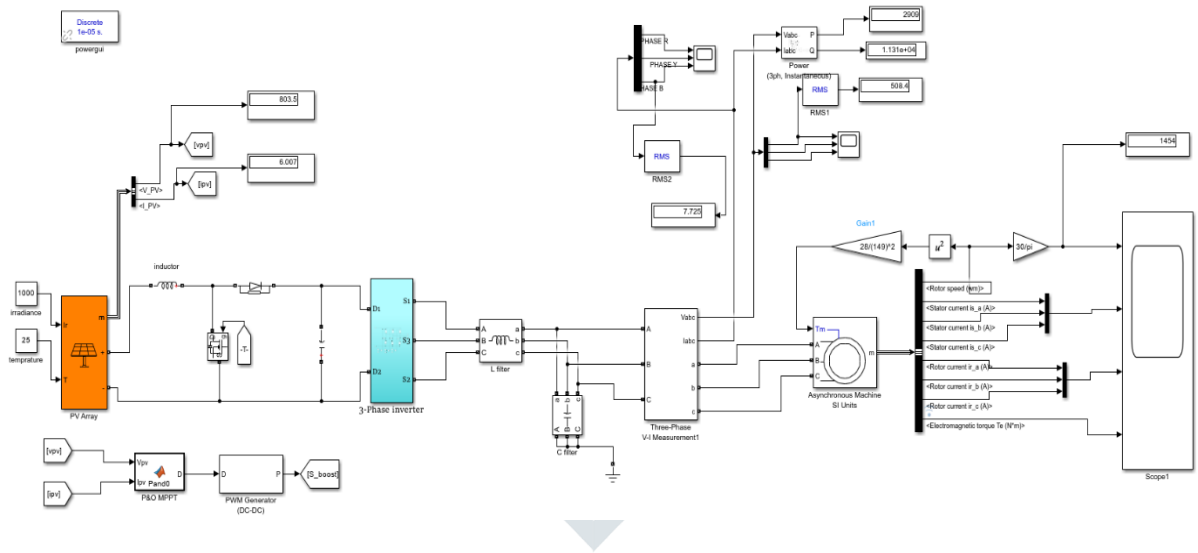

Figure: Overall Simulink model of Speed Control of Induction Motor

MODELING ANALYSIS :-

PV array Setup:

A photovoltaic array is a group of solar panels joined electrically to form an array, which is a larger PV installation (PV system). The array will generate more solar electricity the greater its total surface area. To create 24.134 KW of power, we utilized 6 solar panels in parallel and 12 solar panels in series.

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Table-1: Configuration of single solar panel

Output Voltage	687.6 V
Output Current	35.1 Amp.
Max. Power	335.205 W
Open circuit voltage	67.9 V
Short Circuit Current	6.23 Amp.
Total Output Power	24.134 KW

DC-DC Boost Converter:

A boost converter is a DC-to-DC power converter that lowers input current while raising output voltage. A DC-DC boost converter is connected after the solar PV panel in order to increase the voltage.

Table-2: Configuration of DC-DC Boost Converter

Input		Output		C	L
Voltage	Current	Voltage	Current	2400 μF	3 mH
800 V	6 A	813	10 A		

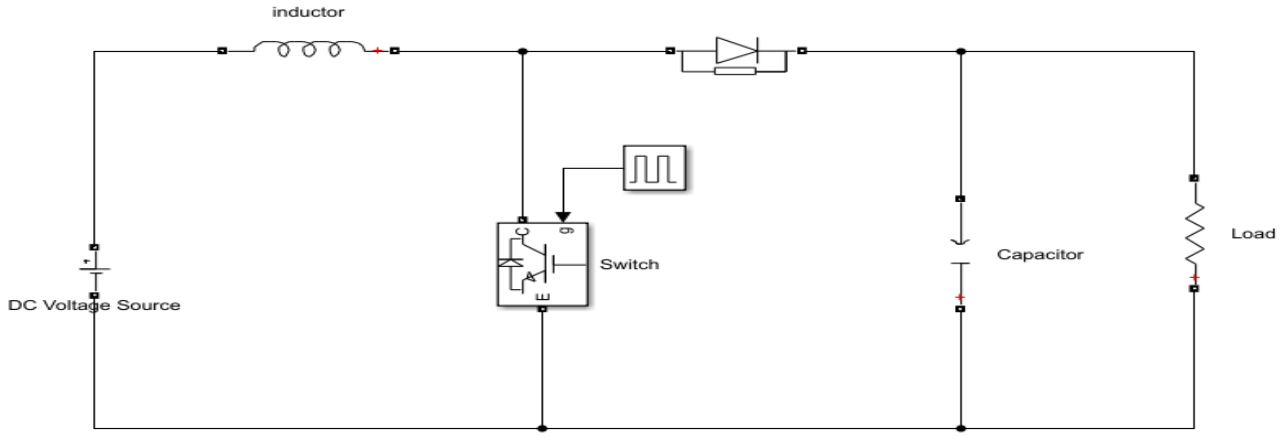

Figure : Circuit Diagram of DC-DC Boost Converter

Maximum Power Point Tracking (MPPT):

In photovoltaic (PV) systems, Maximum Power Point Tracking (MPPT) is a critical technology that maximizes power output by continuously altering operating settings to improve solar panel efficiency. We shall examine the fundamentals, strategies, and uses of MPPT in-depth in this post.

Inverter :

The maximum DC power generated by an MPPT-equipped PV array needs to be transformed into AC power in order to be used and transmitted. To convert DC electricity to AC voltage, a three-phase inverter uses two DC input sources and six MOSFETs.

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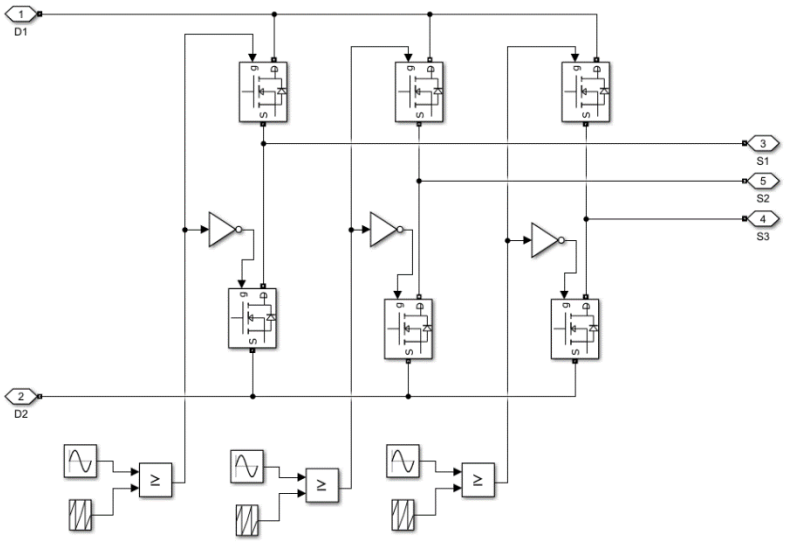

Figure: Inverter Model

RESULT

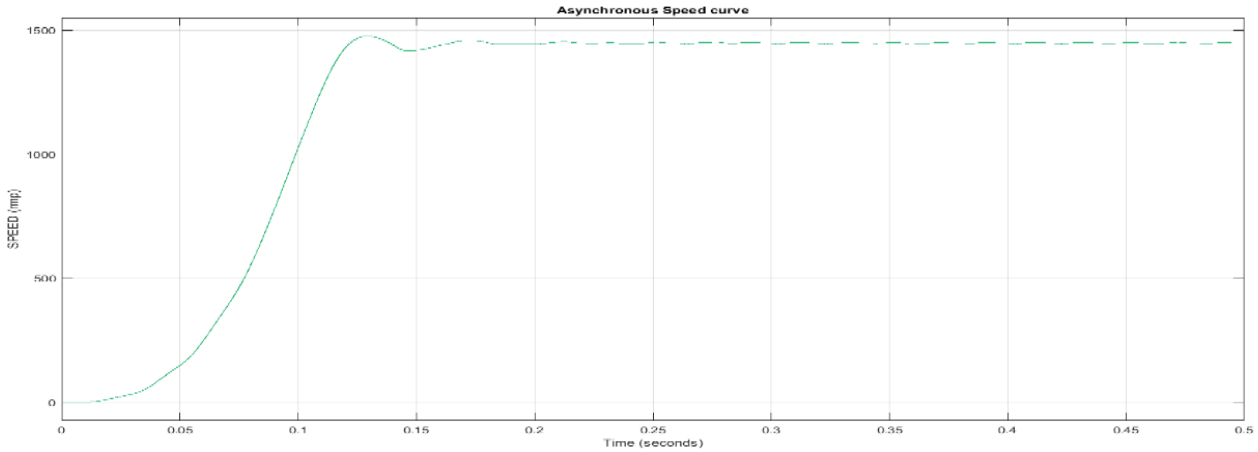

Figure : Rotor speed of an Asynchronous machine

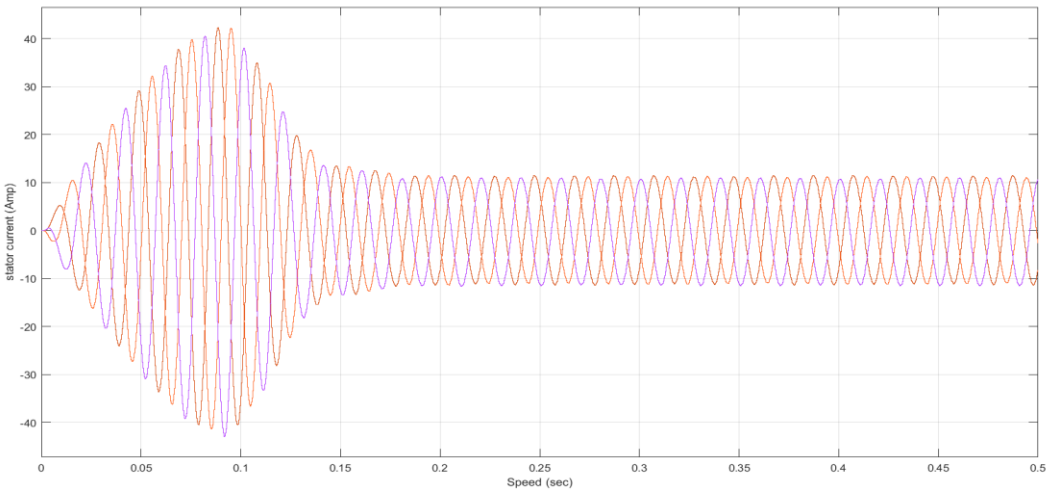

Figure : Stator current of an Asynchronous Machine

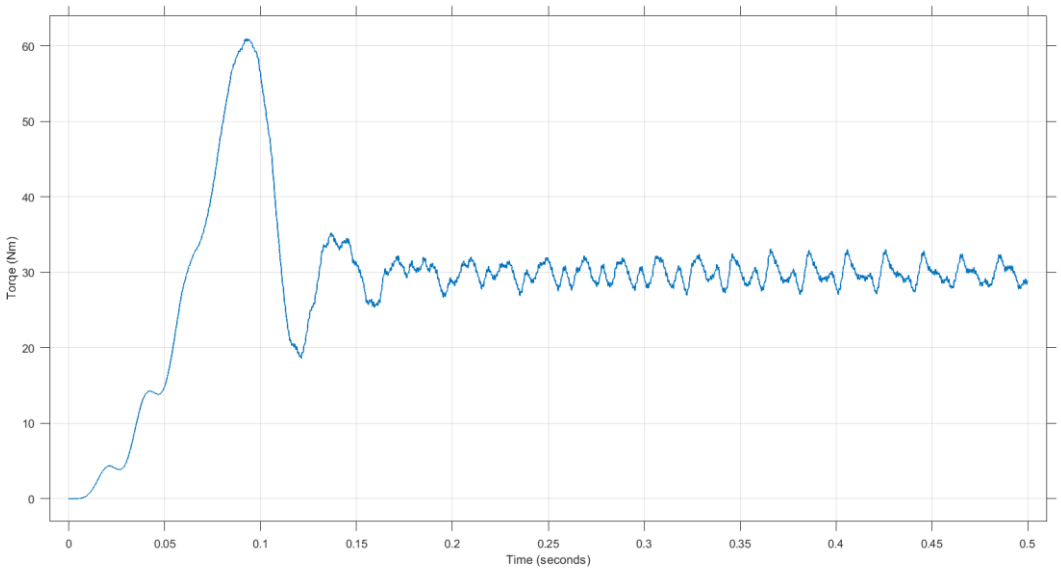

Figure : Torque of an Asynchronous Machine

CONCLUSION

For the analysis and design of control systems for asynchronous machines (induction motors) driven by renewable energy sources, simulation studies provide a useful tool. Using this method, researchers may assess how well different speed control strategies—like the V/f method—work in dynamic environments with variable renewable energy input. Simulations are a useful tool to illustrate the advantages of better speed regulation and power quality for the entire system by contrasting managed versus uncontrolled scenarios. The creation of reliable control systems that guarantee asynchronous machines operate at their best in schemes integrating renewable energy is made possible by these research.

REFERENCE

[1.] Divyanshu Raj and Krunal Ajay Rokde. "MATLAB Simulation Of Three Phase Grid Connected Solar Photovoltaic System". *IRJMETS* Volume:04, Issue:05, May-2022, e-ISSN: 2582-5208.

[2.] A. Syal, K. Gaurav and T. Moger, "Virtual laboratory platform for enhancing undergraduate level induction motor course using MATLAB/Simulink," *2012 IEEE International Conference on Engineering Education: Innovative Practices and Future Trends (AICERA)*, Kottayam, India, 2012, pp. 1-6, doi: 10.1109/AICERA 6306691, 2012.

[3.] E. Hegazy, W. Saad and M. Shokair, "Studying the Effect of Using a Low Power PV and DC-DC Boost Converter on the Performance of the Solar Energy PV System," *2020 15th International Conference on Computer Engineering and Systems (ICCES)*, Cairo, Egypt, 2020, pp. 1-8, doi: 10.1109/ICCES51560. 9334581, 2020.

[4.] C. Abdelkhalek, E. B. Said, "A Study and Implementation of Interleaved Boost Converter with a Novel MPPT Tactic for PV Systems," *2020 IEEE 2nd International Conference on Electronics, Control, Optimization and Computer Science (ICECOCS)*, Kenitra, Morocco, 2020, pp. 1-6, doi: 10.1109/ICECOCS50124. 9314470, 2020.

[5.] V. S and R. Kannan Megalingam, "Design & Simulation of a PV system under varying temperatures for maximum power by considering the variation of efficiency with temperature in Simulink," *2022 IEEE IAS Global Conference on Emerging Technologies (GlobConET)*, Arad, Romania, 2022, pp. 349-354, doi: 10.1109/GlobConET53749.9872514.2022.

[6.] M. L. Azad, S. Das, P. Kumar Sadhu, B. Satpati, A. Gupta and P. Arvind, "P&O algorithm based MPPT technique for solar PV system under different weather conditions," *2017 International Conference on Circuit ,Power and Computing Technologies (ICCPCT)*, Kollam, India, 2017, pp. 1-5, doi: 10.1109/ICCPCT. 8074225, 2017.

[7.] A. R. Krishnan, S. Mohammed S and S. Manafudeen, "Comparison of P&O MPPT Based Solar PV System with Interleaved Boost Converter," *2019 2nd International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT)*, Kannur, India, 2019, pp. 1370-1376, doi: 10.1109/ICICICT46008. 8993209, 2019.

[8.] O. Plakhtii, V. Nerubatskyi, S. Mykhalkiv, D. Hordiienko, D. Shelest and I. Khomenko, "Research of Energy Characteristics of Three-Phase Voltage Source Inverters with Modified Pulse Width Modulation," *2021 IEEE 2nd KhPI Week on Advanced Technology (KhPIWeek)*, Kharkiv, Ukraine, 2021, pp. 422-427, doi: 10.1109/KhPIWeek53812.9570071.2021.