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Influence of Solar Irradiance on Power Quality Disturbances on a non-linear load in a Hybrid Renewable Energy System

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Abstract

- Renewable energy grids are gaining popularity and increasing market share.
- Hybrid renewable energy systems are becoming common but introduce power quality issues.
- Research using MATLAB simulation and FFT analysis found:
- Lower solar irradiance and low wind speed significantly impact power quality.
- Non-linear loads are more affected than linear loads.
- Findings can help optimize hybrid renewable energy systems.
- New techniques can be developed to mitigate power quality disturbances.

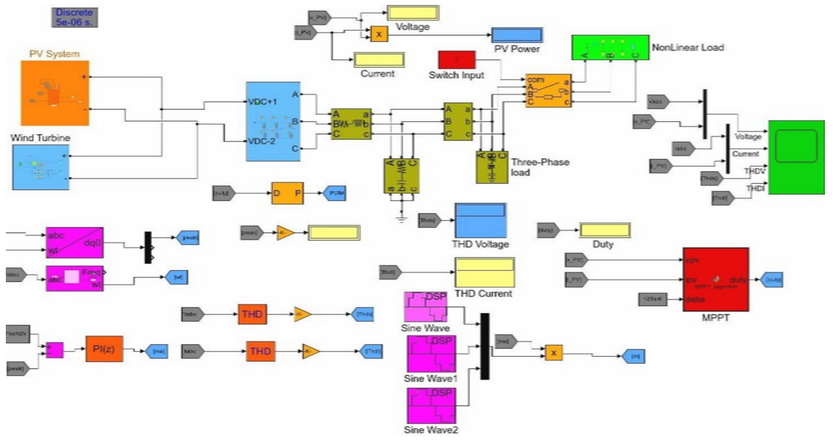

Figure 1

Methodology

- MATLAB was used as a simulation tool.
- FFT analysis was used to analyze the data.
- The MATLAB circuit included a PV source and a wind turbine.
- Different conditions were simulated by varying temperature and wind speed.
- Constant irradiance values were used in the simulation.
- The simulation used a non-linear load.
- The load size remained constant during the simulation.

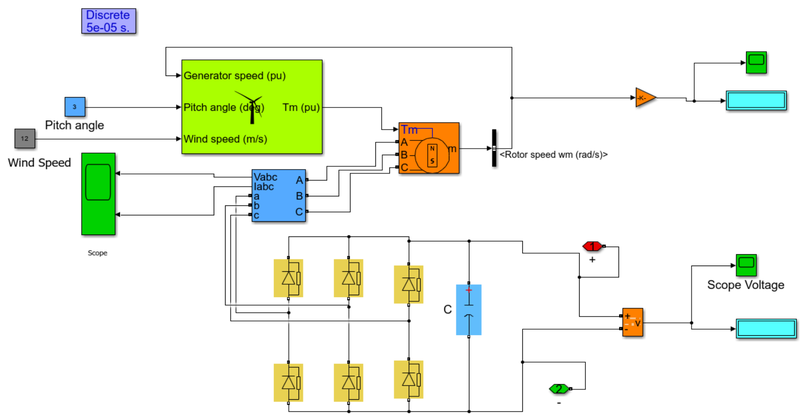

Figure 2

Conclusion

- Findings indicate that decreased irradiance levels had a pronounced effect on power quality (PQ) disturbances, especially on harmonic distortions.
- Reduced irradiance values led to increased PQ disturbances, causing prolonged voltage sags compared to other weather conditions.
- Voltage swells were more prolonged in scenarios with low irradiance.
- Lower irradiance levels were also associated with heightened current spikes.
- Future research should focus on identifying and addressing these fluctuations within Hybrid Renewable Energy Systems (HRES).
- The system must discern the underlying causes of these fluctuations and implement effective mitigation measures.
- Comprehensive data collection and system modifications are needed to manage PQ disturbances at their source.
- The enhanced system should proactively undertake preventive actions to minimize such fluctuations in the future.

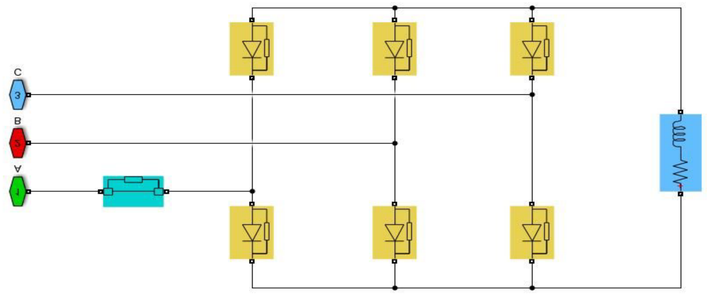

Figure 3

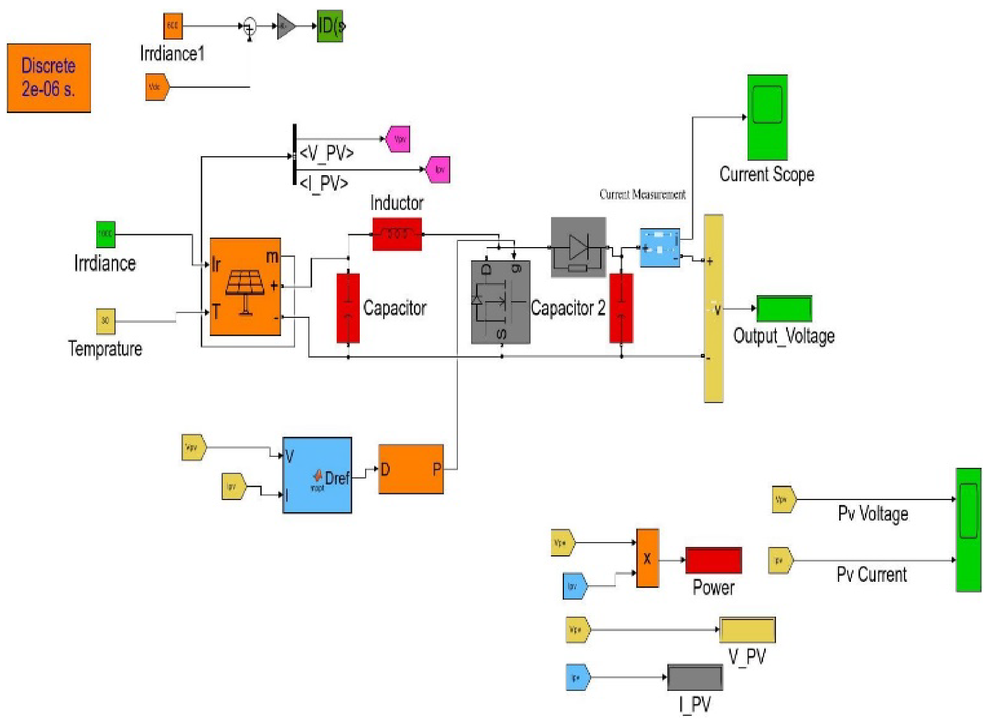

Figure 4

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