World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:18, No:12, 2024

Harmonic Mitigation and Total Harmonic Distortion Reduction in Grid-Connected PV Systems: A Case Study Using Real-Time Data and Filtering Techniques

Authors : Atena Tazikeh Lemeski, Ismail Ozdamar

Abstract : This study presents a detailed analysis of harmonic distortion in a grid-connected photovoltaic (PV) system using real-time data captured from a solar power plant. Harmonics introduced by inverters in PV systems can degrade power quality and lead to increased total harmonic distortion (THD), which poses challenges such as transformer overheating, increased power losses, and potential grid instability. This research addresses these issues by applying the Fast Fourier Transform (FFT) to identify significant harmonic components and employing notch filters to target specific frequencies, particularly the 3rd harmonic (150 Hz), which was identified as the largest contributor to THD. Initial analysis of the unfiltered voltage signal revealed a THD of 21.15%, with prominent harmonic peaks at 150 Hz, 250 Hz, and 350 Hz, corresponding to the 3rd, 5th, and 7th harmonics, respectively. After implementing the notch filters, the THD was reduced to 5.72%, demonstrating the effectiveness of this approach in mitigating harmonic distortion without affecting the fundamental frequency. This paper provides practical insights into the application of real-time filtering techniques in PV systems and their role in improving overall grid stability and power quality. The results indicate that targeted harmonic mitigation is crucial for the sustainable integration of renewable energy sources into modern electrical grids.

Keywords : grid-connected photovoltaic systems, fast Fourier transform, harmonic filtering, inverter-induced harmonics
Conference Title : ICDRE 2024 : International Conference on Desalination and Renewable Energy
Conference Location : Istanbul, Türkiye
Conference Dates : December 23-24, 2024