

# Substituting the PID Controller with a Recurrent Neural Network Model for the Optimization of Solar Photovoltaic Systems

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## Abstract

Photovoltaic (PV) systems are of paramount importance to the global energy transition. However, their operational management cannot be considered easy, as it is affected by climate changes as well as sudden weather alterations. Typically, a PID controller is employed to manage energy generation by systematically adjusting the values of the setting parameters. This, however, has a shortcoming regarding how quickly one can adapt to changes in the environment. The aim of this research is to improve the control and performance of photovoltaic systems through the adoption of neural network models to replace the conventional PID controllers. The proposed recurrent model has the potential to forecast energy production levels based on past and present weather conditions, thus allowing for more intelligent management of PV systems. In contrast to PID, which tends to follow fixed methods, this model learns from previous experiences and alters system output parameters according to changes in conditions instantaneously. Such adaptability improves the systems capability to cope with prevailing climatic conditions and enhances performance and energy efficiency. To validate this new approach, simulations were conducted in comparison with those of the conventional PID controller. The findings show that the production and response time of the recurrent neural model in photovoltaic systems are far superior to those of the PID controller. This technique can be utilized more quickly without losing quality when new weather data becomes available, representing a powerful alternative for improving the production of solar energy systems.

## Keywords

PID Controller, Recurrent Neural Network, Optimization, Solar Photovoltaic Systems, Forecast Energy Production