Advances in Intelligent Energy Systems

Computer Vision and Machine Intelligence for Renewable Energy Systems

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ELSEVIER

Elsevier
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ISBN: 978-0-443-28947-7

Publisher: Megan Ball
Acquisitions Editor: Rachel Pomery
Editorial Project Manager: Manisha Rana
Production Project Manager: Sujithkumar Chandran
Cover Designer: Vicky Pearson Esser

Typeset by MPS Limited, Chennai, India

ScienceDirect

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Advances in Intelligent Energy Systems

2025, Pages 67-84

Chapter 4 - Utilization of computer vision and machine learning for solar power prediction

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Abstract

Solar power has become a viable option due to the worldwide need for sustainable energy. This chapter uses computer vision for predictive analysis to improve solar energy system efficiency and dependability. Integrating variable energy sources into the electricity grid requires accurate renewable energy forecasts. It helps power systems manage energy supply unpredictability over time and space. Traditional modeling methodologies employ numerical weather prediction or physical models to estimate cloud movements' influence on solar energy output. The systems struggle to integrate cloud data and recognize frequent errors. Using machine learning and computer vision, restrictions may be overcome. This is done by combining real-time cloud cover measurements with surface data from other sources. This chapter uses computer vision to assess real-time solar panel photos for dust collection, shading impacts, and structural concerns. Adding weather data to the prediction model increases complexity and accuracy. The study considers cloud cover, atmospheric conditions, and temperature. By associating these environmental elements with past solar power-generating data, machine learning algorithms may find trends and create prediction models to improve the system's energy output forecasting under different weather circumstances. This chapter allows real-time solar panel health monitoring and proactive energy output optimization. The capacity to estimate solar power production based on visual and environmental characteristics allows system operators to prevent efficiency bottlenecks. This proactive method boosts energy generation, lowers maintenance costs, and extends solar power system lifespans. The results show that computer vision can forecast solar electricity generation. Operators may maximize energy output and system performance with real-time monitoring and proactive decision-making. This chapter shows how computer vision may improve solar power production monitoring and prediction, enabling a more sustainable and dependable renewable