THERMAL AND ELECTRICAL PERFORMANCE EVALUATION AND DESIGN OPTIMIZATION OF HYBRID PV/T SYSTEMS

This study aims to evaluate the performance and cooling effectiveness of both photovoltaic (PV) and hybrid PV/Thermal systems under various ambient conditions. Two models, namely, standard PV module subject to ambient conditions without active cooling and a single pass hybrid PV/T air collector, have been designed and simulated using the CFD software of COMSOL Multiphysics V5.3a. The PV material used in our analysis is monocrystalline silicon with a power temperature coefficient of 0.41% ºC-1. The thermal and electrical performances of both systems are evaluated numerically and compared to experimental data for validation. The results predicted for cooling effects show noticeable enhancements in both the electrical and thermal efficiencies of the systems, with up to 44% compared to the PV module without active cooling. The electrical PV/T arrangement has increased the performance of air cooling in a laminar flow regime with up to 4%. A numerical-based design optimization is carried out to enhance the system performance.