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Optimal control strategies for a hybrid renewable energy system: an ALANN/RNN technique

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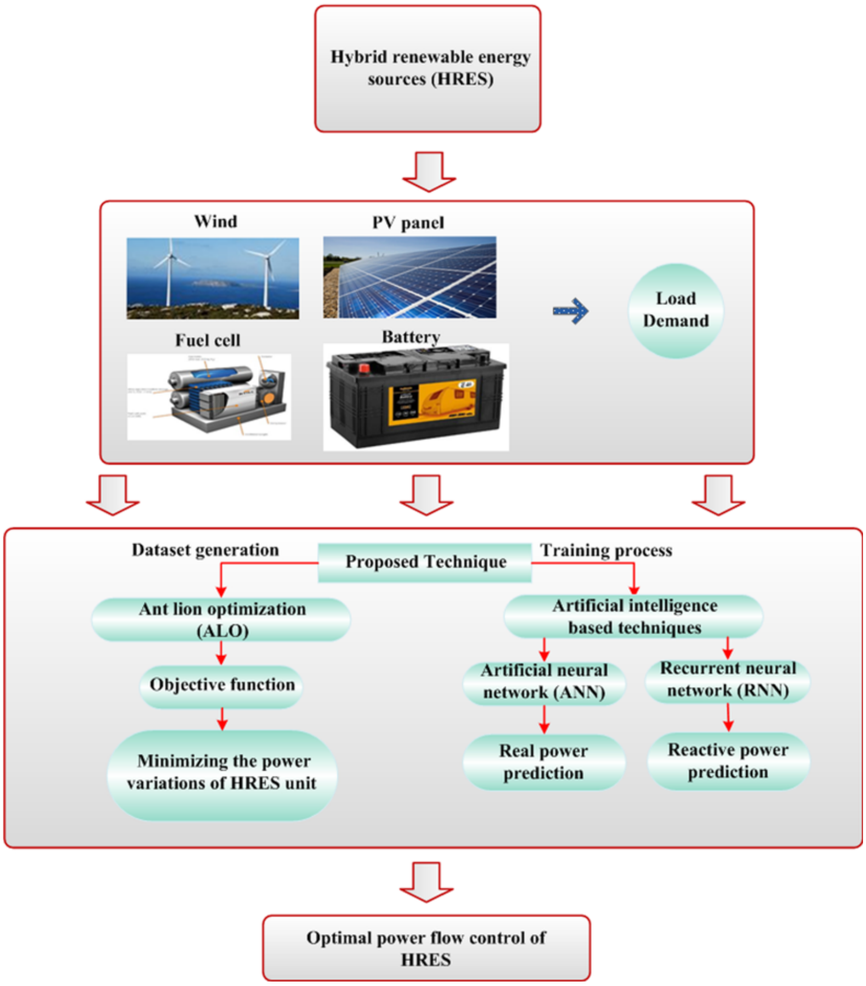
Abstract

In this paper, optimal control strategy for the power flow management of the grid-connected hybrid renewable energy system (HRES) is proposed. The proposed control strategy is the parallel execution of both the ant lion optimization with artificial neural network (ANN) and recurrent neural network (RNN), and hence it is named as ALANN/RNN. Here, the HRES is made out of photovoltaic, wind turbine, fuel cell, and battery which is associated with the DC link and can adjust the real and reactive power. The proposed ALANN/RNN technique predicts the required control gain parameters of the HRES to maintain the power flow based on the active and reactive power variation in the load side. To predict the control gain parameters, the proposed technique considers power balance constraints like renewable energy accessibility and load side power demand. By using the proposed technique, power flow variations between the source side and the load side and the operational cost of HRES in light of weekly and daily prediction grid electricity prices have been minimized. In the HRES unit, the power flow management of grid is accomplished while controlling the PI controller for producing the optimal control pulses of the DC/DC converter. The proposed method is actualized in MATLAB/Simulink working stage, and the effectiveness is analyzed via the comparison analysis using the existing techniques such as SPC, GA, PSO and BAT technique. The comparison results demonstrate that the occurrence of proposed approach confirms its ability for controlling the power flow in the HRES system.

Graphical Abstract

An optimal control strategy for the power flow management of the grid-connected hybrid renewable energy system (HRES) is proposed. The proposed control strategy is the joined execution of both the ant lion optimization (ALO) with artificial neural network (ANN) and recurrent neural network (RNN), and hence it is named as ALANN/RNN. ALO is utilized to minimizing the power variations of the HRES units. ANN is used for real power prediction, and RNN is utilized for reactive power prediction.



Keywords

HRES PV WT FC Battery ANN RNN ALO Power flow
Active and reactive power control strategy

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Notes

Compliance with ethical standards

Conflict of interest

Authors declare that they have no conflict of interest.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

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