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ABSTRACT

This work aims to suggest various techniques that can reduce the grid disturbances to the minimum level by utilizing intelligent techniques. These intelligent techniques are implemented at diverse levels of the microgrid operation.

In the first objective, an artificial neural network is utilized for wind speed estimation after processing information received from wind generating stations. Three types of prediction models were utilized for the study namely nonlinear autoregressive models (NAR), nonlinear autoregressive models with external inputs (NARX), and the chaotic time series. The wind station is situated at a height of 100 meters where the model is constructed utilizing the historical data from the similar station. The mean square errors and other error parameters were used for determining the expected wind speeds. The results of the study were compared with those from the chaotic models based on Mackey Glass equation. The generating capacity of the wind stations is computed based on the predicted values of the wind speeds.

One of the most critical issues for a microgrid is to stay stable after being exposed to major disruptions such as short circuit faults and switching of service mode. An important problem for a microgrid in an islanded mode is to keep steady after being exposed to large disruptions such as short circuit faults and switching operating mode; hence suitable methods are needed to monitor the same. However, several techniques have been devised to do the same, but the microgrid still faces issues due to the erratic behavior of

renewable sources. Hence a proper adaptive technique and algorithm is needed to control the microgrid intelligently. During progression from the grid-connected mode to the islanded operation, several mismatches occur between the source and the load, which causes problems in the control of voltage and frequency. Designing a proper control strategy is crucial for maintaining proper stability and quality of power in the microgrid setup. It has been shown in the second objective of this work that the deployment of active filters can smooth out this transition and help in reducing the harmonic distortion, which may otherwise be present in the case of passive filters. This has been implemented on a simulated model of a microgrid comprising many sources and loads.

Interconnected microgrids, when operated in conjunction with each other, share energy. Microgrids with an excess of energy can supply this energy to other microgrids with energy deficit. Game theory can be efficiently utilized for the efficient sharing of energy among these microgrids. Nash bargaining solution is the standard for comparing these energies. Other solutions such as Kalai Smordinsky and Egalitarian are also compared to get the microgrid's best payoff. It was found in the third objective that the Lex-Egalitarian solution is more efficient and fair in its approach to contribute a solution to the division of excess energy. The Lexicographic egalitarian solution depicts an improvement of 0.576% over the Kalai solution and of 4.25% over the Nash solution.

The final objective focuses on DSM modeling with a day-to-day load change approach as a minimization problem. The DSM is modeled as an optimization issue whose solution is achieved through a nature-based adaptive moth flame (AMF) technique. In three demand zones, the formulated work has been tested: residential, commercial and industrial, with different controllable loads. The proposed AMF optimization algorithm offers a comparison of options based on reduced peak demand and operating costs. Finally, it is shown that in the residential and commercial industries, the DSM method based on the AMF method demonstrates better savings than the multi-agent and evolutionary approach. However, the technique of particle swarm demonstrates a better alternative to the proposed technique in achieving cost savings.