International Journal of Applied Electromagnetics and Communication Systems
Volume 1, Issue 01, 2025

An Anfis Controlled Modified Unified InterphasePowerController(UIPC)For Hybrid Grid

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Research Article

Date of Submission: 05-05-2025 Date of Acceptance: 12-05-2025 Date of Publication: 10-07-2025

ABSTRACT

A novel method for controlling the power flow in linked AC-DC microgrids is presented in this paper. A modified unified interphase power controller (UIPC) for power quality improvement that uses three power converters per phase is controlled by an adaptive neuro fuzzy (ANFIS) system. This reduces the number of power converters needed to control power exchange between AC-DC microgrids. Each phase of the updated structure contains a power converter, known as a bus power converter (BPC), and a power converter that controls the DC bus voltage. The LPCs' control mechanism makes use of an adaptive fuzzy logic controller. The efficacy of the suggested power flow control approach of the enhanced UIPC for hybrid microgrids is validated by the results of the MATLAB simulation.

I. INTRODUCTION

Large-scale distributed generation and DC load access issues may be effectively resolved using an alternating current-direct current (AC-DC) hybrid microgrid, which has emerged as the standard for distribution network terminal development. The conventional AC distribution network has been unable to keep up with the need for power system development due to the widespread operation of distributed generation, advancements in power electronics technology, and the high volume of DC load access. Energy transfer and quick control are two benefits of the DC distribution network that may increase system stability and lower the need for power electronic equipment like converters. Thus, cooperative optimal planning between AC/DC hybrid microgrids and AC/DC distribution networks has emerged as a research hotspot in recent years to satisfy the requirement for a high percentage of dispersed generation access and a big quantity of DC load access. However, both local and international researchers are still working on the interconnection structure, operation control, and quick protection of the two hybrid power grids. first stage, and several issues with integrated planning and management must be resolved immediately.

A. Controlofmicrogrids

Microgrid control becomes crucial to guaranteeing dependable microgrid operation. To increase the stability of the system, a number of studies have been carried out, especially on the topics of power management and the control system. Although the hierarchical controls of each AC and DC microgrid are unique, they may be broadly categorized into three levels using the International Society electrical distribution system is managed by the tertiary control, while the primary control is based on the droop method and includes an output-impedance virtual loop. The secondary control permits the restoration of the deviations caused by the primary control.

B. Control Strategy for AC/DC Hybrid Microgrids

C. Through the LPCs, whose DC buses are connected to the AC microgrid, it is connected to the main grid. It can function in either capacitance mode (CM) or inductance mode (IM). Interlink AC/DC bidirectional converters (ICs) are used to connect the AC and DC buses in hybrid AC/DC microgrids. In operational mode, grid-connected mode, and stand-alone mode, the IC should be able to effectively regulate and manage power. More difficulties would arise if the microgrid were operated in stand-alone mode, especially when variable load and DERs produce an imbalance between generation and consumption. Power sharing between AC and DC subgrids has been presented as a way to preserve system stability using a variety of droop control techniques. The IC's control performance may be enhanced by adding an energy storage system, while DC link capacitors help with voltage regulation.

II. SYSTEMCONFIGURATION

Since there are no systematic techniques available to deal with uncertain and poorly specified systems, controlling nonlinear systems using traditional mathematical tools is a challenging challenge. The qualitative components of human knowledge and reasoning processes, on the other hand, may be modeled by a fuzzy inference system using fuzzy if-then rules; nevertheless, it lacks a systematic design approach for using accurate quantitative analyses. Finding patterns in data, learning from the connections, and adjusting to them is how neural networks operate. The results of novel data combinations are then predicted using this knowledge. Specifically, Takagi and Sugeno were the first to systematically develop the fuzzy modeling or fuzzy identification control approach, which has since found many uses in fuzzy control, medical diagnostics, decision-making, and data mining problem-solving. Nonetheless, there are a few fundamental elements of this strategy that need more clarification. More precisely, the absence of a standardized design and optimization method to convert human experience or knowledge into a rule basis and the fuzzy inference system's data base. Interpreting membership function tweaking to decrease output error index and choose the right network topology is challenging.

A.AdaptiveNetworkbasedFuzzyInferenceSystem

A neural network method for solving function approximation issues is represented by the data-driven adaptive network based fuzzy inference system (ANFIS). Clustering a training set of numerical samples of the unknown function to be approximated is usually the foundation of data-driven processes for the synthesis of ANFIS networks. Since their inception, ANFIS networks have shown effective in solving categorization jobs, pattern recognition, rule-based process management, and related issues. The fuzzy model put out by Takagi, Sugeno, and Kang to codify a methodical approach to producing fuzzy rules from an input-output data set is part of this fuzzy inference system. Structure of ANFIS For the sake of simplicity, it is assumed that the fuzzy inference system in question consists of one output and two inputs. The fuzzy if-then rules of Takagi and Sugeno's kind are included in the rule base as follows: If x is A and y is B, then z is f(x,y), where z = f(x,y) is a crisp function in the consequent and A and B are the fuzzy sets in the antecedents. The polynomial f(x, y) is often a function of the input variables x and y. However, it might also be any other function that can roughly characterize the system's output inside the antecedent-specified fuzzy area. A zero order Sugeno fuzzy model is created when f(x,y) is a

Developing the First Fuzzy Model Finding the best fuzzy model for the training data simplifies to a linear least-squares estimate issue in ANFIS-based system modeling given a collection of rules with defined premise parameters, as previously explained. S.L. Chiu presented a quick and reliable way to identify fuzzy models from input-output data. This approach combines the cluster estimation technique with a least squares estimation algorithm to identify the key input variables while creating a fuzzy model from data. There are two phases in the method: i) The first stage is to use a cluster estimate approach that incorporates all potential input variables to generate an initial fuzzy model from input output data. ii) The relevance of each variable in the original fuzzy model is tested in the next stage to determine the key input variables.

Learning Algorithm of ANFIS Neuro-adaptive learning approaches provide a way to learn about a data set via the fuzzy modeling process. It calculates the parameters of the membership function that best enable the tracking of the input/output data by the connected fuzzy inference system. As learning progresses, the parameters linked to the membership functions shift [19]. To address real-world issues more effectively, the learning algorithm's goal for this The goal of the design is to adjust every adjustable parameter such that the ANFIS output corresponds to the training data. The hybrid network may be trained using a hybrid learning algorithm that combines the gradient descent approach with the least squares method to increase the pace of convergence. With the premise parameter determined, the best values for the consequent parameter on layer 4 may be found using the least squares approach. For a given set of parameters, the gradient vector gives an indication of how effectively the fuzzy inference system is modeling the input/output data. Any of a number of optimization techniques may be used to modify the parameters and lower various error measures once the gradient vector is created. The search space expands and the training process converges more slowly when the premise parameters are left unfixed. A forward pass constant. This model may be thought of as a specific instance of the Mamdani fuzzy inference system [144], in which a fuzzy singleton specifies each rule consequent. A Sugenofuzzy model of the first order is created if f(x,y) is assumed to be a first order polynomial. The two rules of a first-order Sugeno fuzzy inference system may be expressed as follows: Rule 1: f1 = p1x + q1y + r1 if x is A1 and y is B1. Rule 2: f2 = p2x + q2y + r2 if x is A2 and y is B2. Takagi and Sugeno's type-3 fuzzy inference technique is used here. Each rule's output in this inference system is a linear combination of the input variables plus a constant term. The weighted average of each rule's output is the ultimate result.

The corresponding equivalent ANFIS structure is shown in Fig.

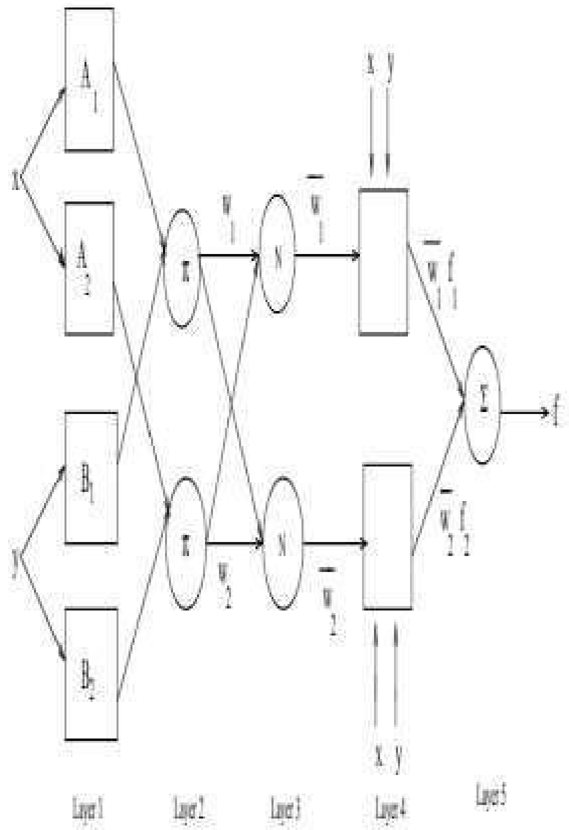


Fig.1Type-3ANFISStructure

(LSM) plus a backward pass (GDM) make up the hybrid algorithm. The backward pass begins once the best consequent parameters have been determined. In the backward pass, the gradient descent approach is used to update the premise parameters corresponding to the fuzzy sets in the input domain while propagating mistakes backward. ANFIS estimates the membership function parameter by combining back-propagation with least squares estimation.

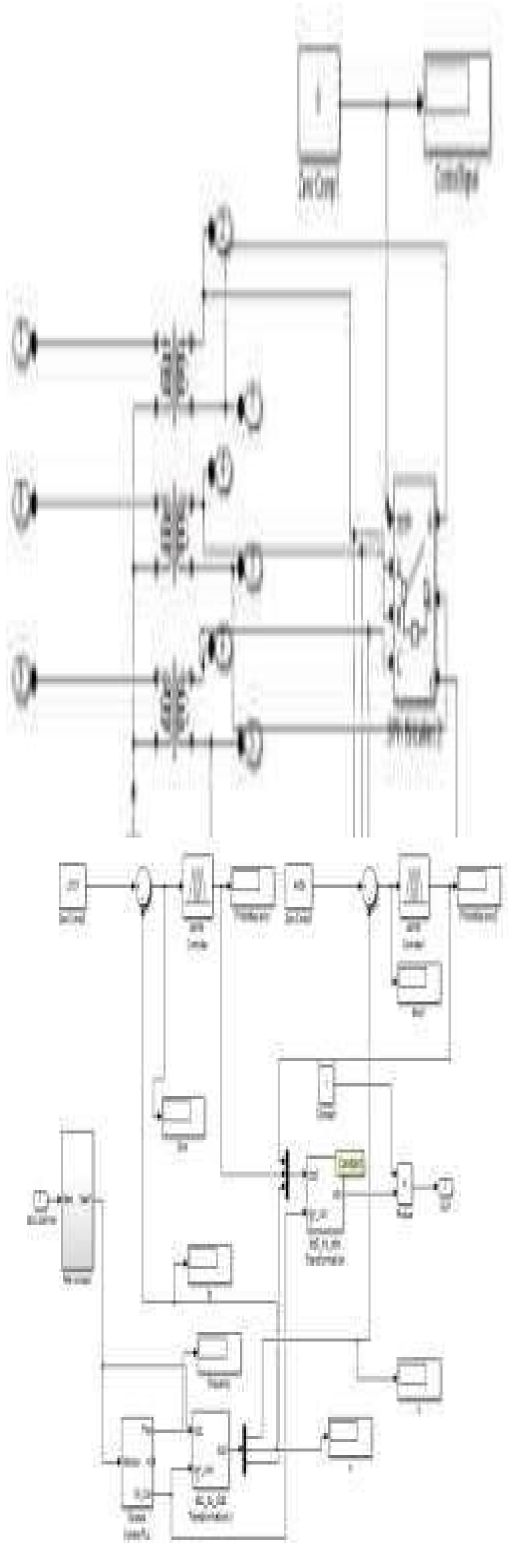
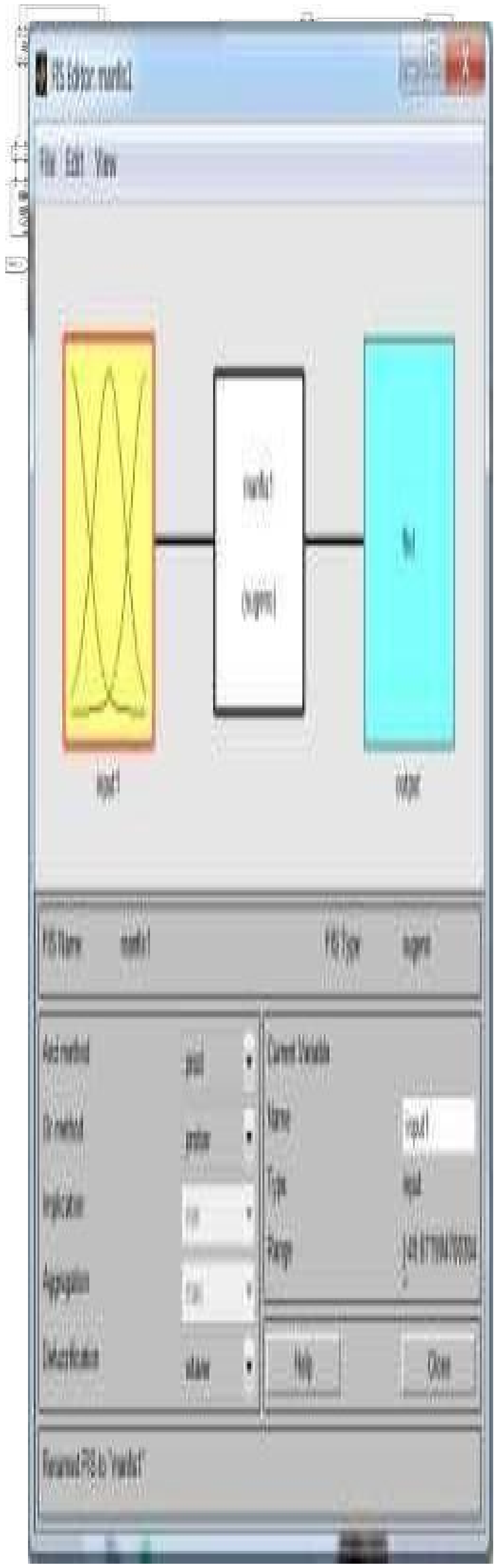


Fig.2Simulation model



NFIScontrollerforclosedlooppowerflow controller.

Fig.5ANFIScommandwindow

The membership function assigned for our ANFIS control system. It shows final grid voltage and current waveform by ANFIS controller

IV. CONCLUSION

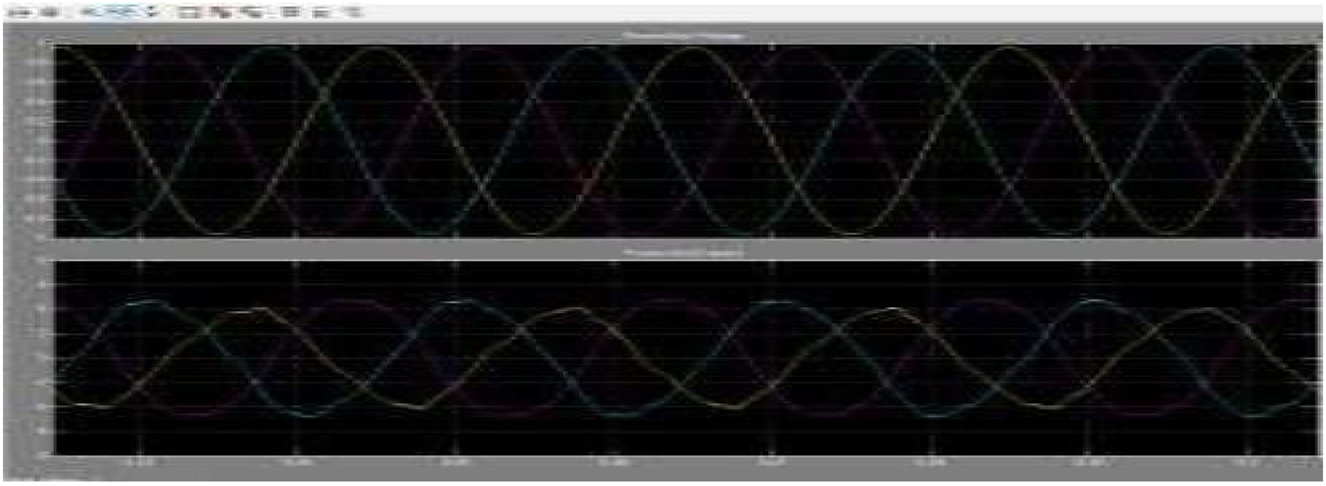


Fig.6GridOutputVoltage

The hybrid microgrid structure is the most probable option in the future smart grids to gather together the renewable resources as well as AC/DC loads. This is due to the fact that this structure has the merits of both AC and DC microgrids simultaneously. One conventional problem with this structure is the power exchange control between interconnected AC and DC microgrids. In this work, an ANFIS controlled UIPC solution has been proposed as a superior alternative to the parallel-connected power converters which have brought many problems. A modified structure of the UIPC has firstly been proposed and then effective control strategies have been introduced for the modified UIPC. The simulation results validated the modified model as well as the power exchange control performance between AC and DC microgrids.

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