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Modeling and managing of micro grid connected system using Improved Artificial Bee Colony algorithm

Kallol Roy [a,*,1], Kamal Krishna Mandal [b,1], Atis Chandra Mandal [c,2]

[a] Department of Electrical Engineering, University Institute of Technology, Burdwan University, India
[b] Department of Power Engineering, Jadavpur University, Kolkata 700098, India
[c] Department of Physics, Burdwan University, India

ABSTRACT

This paper introduces an Improved Artificial Bee Colony algorithm for modeling and managing Micro Grid (MG) connected system. IABC differs from ABC because of its inclusion of Gravitational search algorithm (GSA) in the scout bee phase. Hence, the scout bee phase is substantially improved as the gravitational constant of GSA increases searching accuracy. As already ABC works with memory, IABC tackles drawbacks occur due to memory-less search entertained by GSA. In the proposed technique, optimal MG's configuration is determined based on load demand by reducing the fuel cost, emission factors, operating and maintenance cost. By using the input of MG's configuration such as Wind Turbine (WT), Photovoltaic array (PV), Fuel Cell (FC), Micro Turbine (MT), Diesel Generator (DG) and battery storage and the corresponding cost functions, the proposed method achieves the required multi-objective function. The performance of the proposed method is examined by comparing with other techniques that are recently reported in the literature. The comparison results demonstrate the superiority of the proposed technique and confirm its potential to solve the problem.

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Introduction

For the upcoming generation, Distributed power generation systems are usually supposed to become a crucial electric power supply system [1]. The necessity with regard to more elastic electrical systems, transforming regulatory and also economical predicaments, energy savings and also environmental friendly impact are providing traction for the enhancement associated with Micro-Grids (MGs) [2]. The MG is a part of a power system which in turn contains a number of DG devices effective at working often within parallel using or self-governing from the large service grid, and will be offering incessant power to several loads and also end-users [3–5]. The intake of small-modular residential or industrial devices with regard to onsite assistance is just about the major apps on the MG devices [6].

Any micro grid incorporates a low-voltage submission system along with allocated power resources (DERs) that may perform either interrelated or maybe rural through the main allocation grid like a controlled entity [7–9]. Distributed energy resource (DER) is usually an approach to increase the submission system's a higher level power quality [10]. For working out numerous concerns facing electrics utilities, DER is usually utilized [11]. The fundamental perception of DER should be to provide for the more robust transmission process, restrictions decreased, energy performance improved, electric power quality improved along with boost local stability [12]. Many tips regarding micro grid system are recommended along with figured out simply because possess enable to provide premium quality and/or economical electric power [13].

MGs might consist of lots of different sizes along with types [5]. The particular administration from the MG products needs an exact economical model to explain the actual working cost [14]. To the micro grid operations, Unique protection, control along with energy management systems must be prepared so as to ensure that dependable, safe and inexpensive function along with affordable operate throughout sometimes grid-connected or perhaps stand-alone mode [15]. The particular problem of energy management throughout micro grids consists about finding the optimal (or close to optimal) unit commitment (UC) along with dispatch from the obtainable generators so that specific chosen motives are generally achieved [16]. Thus to diminish the actual operating costs to a minimum level, optimization devices are important.

The study units need to type the system having its a few stages, the particular neutral conductors, the ground conductors and the connections to ground [17]. Such units really should contain firm

* Corresponding author.
  E-mail addresses: kallolroy0181@gmail.com (K. Roy), mandal_atis@yahoo.co.in (A.C. Mandal).
¹ Assistant Professor.
² Associate Professor.

state in addition to active models regarding a variety of types of micro-sources in addition to the interfaces. Designs are usually given to forecast demonstration difficulties in addition to mimic irregular condition [18]. The MG is usually triggered possibly in grid linked mode or maybe in stand-alone mode. Numerous boundaries like the incurable voltage, current, grid voltage, current in addition to fault voltages happen to be administered from unique circumstances subsequent modeling [19].

This paper proposed an Improved Artificial Bee Colony algorithm for modeling and managing Micro Grid (MG) connected system. IABC differs from ABC because of its inclusion of Gravitational search algorithm (GSA) in the scout bee phase. Hence, the scout bee phase is substantially improved as the gravitational constant of GSA increases searching accuracy. As already ABC works with memory, IABC tackles drawbacks occur due to memory-less search entertained by GSA. In the proposed technique, optimal MG's configuration is determined based on load demand by reducing the fuel cost, emission factors, operating and maintenance cost. By using the input of MG's configuration such as Wind Turbine (WT), Photovoltaic array (PV), Fuel Cell (FC), Micro Turbine (MT), Diesel Generator (DG) and battery storage and the corresponding cost functions, the proposed method achieves the required multi-objective function. Rest of the paper sorted by the following: the recent analysis works is usually reviewed throughout Section 'Recent research work: A brief review'; the proposed work elaborate the evidence is usually described throughout Section 'MG architecture model with proposed method'; the suggested techniques approach good results effects as well as the related discussions receive throughout Section 'Results and discussions'; as well as Section 'Conclusion and future work' finishes the paper.

Recent research work: A brief review

In literature, several associated works are obtainable which based on modeling and managing of micro grid. A few of them are assessed here. To optimize the function of the microgrid, an elegant energy management system (SEMS) has been offered by Chen et al. [20]. The SEMS contains power forecasting module, energy storage system (ESS) management module and optimization module. As energy storage requires to be optimized across multiple-time steps, regarding the power of energy price structures, their economics are mainly complex. As a result, the ESS module was used to find out the optimal operation approaches. The multiple-time set points of the storage tool and cost-effective presentation of ESS are furthermore assessed. Elegant management of ESS, economic load dispatch and operation optimization of distributed generation (DG) were made simpler into a single-object optimization problem in the SEMS. After that, a matrix real-coded genetic algorithm (MRC-GA) optimization module was explained to accomplish a practical technique for load management, together with three different operation policies.

Inside a medium-voltage islanded micro grid, an optimization procedure of which allows for the optimal dispatching associated with distributed generator and storage systems have been provided by Conti et al. [21]. The network has been dreamed to be led through programmable and nonprogrammable generators. Their optimization has been executed by a niching evolutionary algorithm (NEA) of which was able to track down multiple optima and the deviation with the objective function of their neighborhood. NEAs make it possible for alleviating the actual presentation associated with standard algorithms requested for optimal power-flow calculations with electrical power systems through keeping away of dropping directly into local optima. Their particular optimization procedure has been executed using an analyze micro grid and proved through computer simulations. Their particular proposed

mathematical results shows how the solutions might be enhanced the actual micro grid presentations irrespective of the actual network operating conditions with all of the thought to be cases.

A new centralized control system which complements similar operations of dissimilar distributed generation (DG) inverters in the micro grid continues to be which is available from Tan et al. [22]. The particular control design for that DG inverters utilizes a Model Predictive Control (MPC) algorithm that enables faster computational time with regard to significant power systems through optimizing this steady-state as well as the transient control problems individually. In order to synchronize load sharing involving distinct DG units in the course of both grid-connected and islanded operations, a standard energy management system was executed for that micro grid. Under different test predicaments, the plan concept of their particular suggested control system was considered through simulation research. From other suggested micro grid, this bang on the enhanced penetration of DG units within the supply grid was additionally screened. They have got approved which their particular simulation outcomes demonstrate the operations on the DG units into the micro grid may be synchronized effectively.

In the micro grid (MG), an approach based on the cost-benefit study for optimal dimensions of an energy storage system continues to be provided by Chen et al. [23]. With spinning reserve for MG, their particular suggested technique was deemed the unit commitment problem. The time sequence as well as feed-forward neural network techniques was applied for forecasting the actual wind speed as well as photo voltaic radiations correspondingly and the forecasting mistakes ended furthermore deemed. A two mathematical types are already built for the islanded as well as grid-connected types of MGs. The key problem was devised like a mixed linear integer problem (MLIP), which has been pushed throughout AMPL (A Modeling Language for Mathematical Programming). The actual proficiency in their suggested strategy was authenticated simply by case studies the location where the optimal system energy storage ratings for the islanded as well as grid-connected MGs ended up discovered. Regarding the grid-connected as well as islanded MGs, their particular suggested method outcomes display which the optimal size involving BESS subsists as well as fluctuates.

Dasgupta et al. [24] have proposed current control approach inside the a–b–c frame, for a three-phase inverter. Their proposed approach seemed to be used on control the dynamic and reactive electrical power flow through the renewable energy source with a three-phase generalized micro grid system. Within the existence of standard nonlinear loads, their own proposed control system not really manages the grid power flow however diminishes the grid current entire harmonic distortion. This control system kinds the grid current taken into description the grid voltage unbalance, harmonics as well as unbalance in line side inductors. Because of the direct technique of Lyapunov, the constancy on the control system seemed to be making sure that. To develop the presentation on the current controller, a SRC seemed to be also proposed by means of estimating the periodic disturbance on the system. Their proposed control system gives much better overall performance within the traditional multiple proportional-integral and proportional-resonant control techniques on account of the lack of the PARK's transformation blocks together with phase lock loop necessity inside the control structure. To take care of unbalances both with grid voltages and in line side inductors, a novel inverter modeling approach seemed to be moreover presented. They have validated which their own proposed approach result seemed to be effectively.

Mohammadi et al. [25] have got researched about an optimal location connected with adjustable forms of allocated generation seeing that independent private sector in a distribution system underneath pool along with hybrid based electricity market to be