Energy Management Micro Grid using Hybrid De Algorithm with Genetic Algorithm

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Abstract—this paper evaluates hybrid differential evolution algorithm and genetic algorithm of LAMG is used to solving the medium scale mixed integer programming problems. Hybrid GA and DE algorithm is implemented in Local place Micro grids. LPMG and the required need of power and choose more power plants with power production with the help of Genetic algorithm. Genetic algorithm can be introduced with the help of local micro grid and select any one of the power plant. In this DEA implemented the local place MG, then survey period is one day. Last calculation shows which time or hour produce more power and sold out power in nearest city area electricity board. DE algorithm determine the one day power survey and Genetic algorithm choose more hour and select any one of the hour for better power production. The hybrid DEA and GA is to maintain choosing and selecting of better power production. So our project aim is choose more hour and select any one of the hour for better power production. This hybrid is use DE and GA to maintain the real and reactive power of any power plant.

Keywords- Local place micro grid (LPMG), Local place energy resources (LPERs), Differential evolution algorithm (DEA), Genetic algorithm (GA) and Electricity (EB).

I. INTRODUCTION

GA is one of the most commonly used evolutionary algorithm for solving optimization problem[1]. But principle of DE is used to find the true value and analysing true value[6]. In hybrid GA and DEA is maintain the best power production in micro grid[12]. GA select more power plants connected in micro grid[2,3]. But DE select best one[6]. Selection[7], cross-over[8], mutations[9] and fitness solutions[10] are included in GA. DE avoid the drawbacks of optimization technique[11].

II. SYSTEM COMPONENTS

A. Solar modelling

At the time of max.output from solar panel, maximum power point output (MPPT) is,

\[ Q_{pv} = V_{mpp} \times I_{mpp} \]  \hspace{1cm} (1)

\[ V_{mpp} = V_{mpp,refr} \times V_{oc,refr} \] \hspace{1cm} (2)

\[ I_{mpp} = I_{mpp,refr} \times I_{sc,refr} \] \hspace{1cm} (3)

let the working temperature of panel Tp given by:

\[ T_{p}(t) = T_{a}(t) + G_{T} \] \hspace{1cm} (4)

Where, \( T_{a} \) is the ambient temperature of panel in (°C), NOCT is the Nominal Operating Cell Temperature for solar irradiation of 500 W/m2 and 20°C temperature, and GT be avg. of daily solar irradiation (W/m2).

B. Wind Turbine

The wind turbines in WE systems are connected to gear box. The gear box is an electrical- mechanical interface. gear box output is given to the permanent magnet synchronous generator (PMSG), which will produces AC output. The theoretical power of wind stream in relationship between the wind power and wind speed \( Q \) is determined by

\[ Q = 0.0P_{av}^{3} \text{ w........} \] \hspace{1cm} (5)

For wind energy subsystem: efficiency be 0.45; height at which wind turbine located in 10m, let Radius be 30m; RHO factor (\( \rho \)) is 1.225 kg/m3; number of wind turbines: 1; height of wind turbine is 60m; for only a single wind turbine roughness factor be 0.15. and the Generated power can be supplied to a load consists 50 domestic consumer in average about 20kWh/day, so the total power demand in avg. would be 1 MWh/day or 365 MWh/year. Size of wind turbine and PV array can be determined based on assumption that each of every 2 units can able to produce more than 50% of the power demand.

C. Fuel Cell

The fuel cells output in DC electricity, which can be regulated using a DC/DC converter. This DC power can then be fed to the DC bus, which can be used to charge UPS or provide power to home using an inverter.

The considered fuel cell stack is a H2/O2 then operated and maximum power and nernst form is written by

\[ Nernst=1.229-.85*10^{-3}(T-293.15)+4.3085*10^{-5}T(lnP_{2}+0.5lnP_{2}) \] \hspace{1cm} (6)

Where \( P \) is the effective pressure in atm. and \( T \) is the temperature in Kelvin.

The consumption of hydrogen during a period of one hour at rated power \( P_{fc} \) kW is given by.

\[ H_{fc} = (Q_{fc} * 3600) / (2V_{fc} * F) \] \hspace{1cm} (7)

where,

\[ H_{fc} = \text{the amount of hydrogen consumed by FC} \]

\[ Q_{fc} = \text{output power of FC} \]

\[ V_{fc} = \text{voltage output of FC} \]
III. MG ARCHITECTURE CELL MODELLING

LPMG is a integration of various units. It consists of DG unit energy, storage units, controller unit and conventional loads. DG unit again comprise of various micro generating devices. LPMG modelling varies from one. Configuration to other depending on the components used.

LPMG Small scale ranging from 4kw-10000kw.In this LPMG solves many problems existing power systems network. LPMG has maintain the demand supply balance and lack of reliability

LPMG energy management, system expression is

\[ \text{min} \sum_{t=1}^{T} \left( E + R_{DG} + D_{t} + \sum_{d=1}^{D} D_{dt} \right) \]  (8)

Where,

\[ D_{gt} = a_{g} U_{gt} + b_{g} P_{gt} + c_{g}^{sup} + d_{g}^{sup} + e_{g}^{sdn} Z_{gt} \]  (9)

\[ R_{qt} = \sum_{q \in Q} \sum_{k \in K} C_{g} g_{q} k R_{gkr} \]

\[ D_{t} = \sum_{w \in W} f_{w} P_{wt} + \sum_{v \in V} f_{v} P_{vt} \]  (10)

\[ D_{dt} = \sum_{n=1}^{N} D_{dn} \]  (11)

Genetic algorithm is the one of the most commonly used evolutionary algorithm for solving optimization problem. Principle of GA is natural evolution. Our aim of this natural evolution is to maximize the resources and select best[1]. So we are getting best solution.GA require good knowledge about problem being solved. In this GA is implemented easily and GA ability to capture multiple optimal solution in single run. Population size of Control parameter of

GA is 50-100. Generation of GA[1] is 20-200. Cross over probability[7] is 0.6-0.7 and mutation probability[8] is 0.001-0.01. The core of GA is create more energy, formulation of fitness function is used to determine individual power sources with respect to the problem. The main aim this paper indicate GA is applied for DE.

C. Objective Function

Objective function DEA and GA maintain which hour which plant produce best solution of power. So the consumer getting the power in needed time.

The real power of LPMG is denoted by the following equation

\[ A = V_{1}^{2} \cos Q - B_{1} \cos (P + Q) \]  (12)

The Reactive power of LPMG is denoted by the following equation

\[ B = B_{1}^{2} \cos Q - B_{1}^{2} \sin (P + Q) \]  (13)

To apply GA and DE for coding problem is a objective function. Every hour produce many possible solution of power production and take best solution[11]. The basic thing of hybrid GA and DE select them fitting them and used better solution. The hybrid GA and DE is a optimization problem and best objective is minimize the cost, maximize the profit, choose more and select one. Another way of hybrid operation of GA and DE is meeting the demand in electrical energy at minimum fuel cost, Design of electrical works and component with minimum manufacturing cost. In this hybrid operation is not affected by less no parameter in DE and large no parameter in GA.Faster manner convergence character of DE and shorter convergence character of GA is not affected for hybrid operation[6]. Because DE is simplified algorithm of GA.
Table 1. Total cost for 1-12 hour power calculation

|       | 1 am | 2am | 3am | 4am  | 5am  | 6am  | 7am  | 8am  | 9am  | 10am | 11am | 12am |
|-------|------|-----|-----|------|------|------|------|------|------|------|------|------|
| Real power of wind (kw) | 1.1111 | 1.2111 | 1.3111 | 1.42123 | 1.5432 | 1.687765 | 1.7765 | 1.87654 | 1.98765.987 | 2.111 | 2.5654 | 3.987 |
| Real power of solar (kw) | 0 | 0 | 0 | 0 | 0.111 | 0.2432 | 0.3876 | 0.487765 | 0.8876 | 1.876 | 5.9999 |
| Real power of fuel cell (kw) | 5.212 | 5.876 | 5.987 | 5.098 | 5.9998 | 5.8765 | 5.99876 | 5.987 | 5.987 | 5.987 | 5.987 | 5.9999 |
| sold | 1 | 1 | 1 | 1 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.6 | 3 |
| cost (1/h) | 2 | 2.10 | 2.20 | 2.30 | 2.40 | 2.50 | 2.60 | 2.70 | 2.80 | 2.90 | 3 | 5 |
| purchase power (kw) | 3.1 | 3.05 | 3.05 | 2.9 | 3.0 | 3.0 | 3.0 | 2.5 | 2 | 2 | 0.8 |
| purchase cost (1/h) | 5 | 5.10 | 5.05 | 5 | 4.9 | 4.7 | 4.5 | 4.3 | 4 | 3 | 1.9 |
| Total cost (1/h) | 2 | 3 | 4 | 4 | 5 | 5.5 | 6 | 6.5 | 6.7 | 6.9 | 7.1 | 9 |

Table II. Total cost for 12-24 hours power calculation

|       | 1pm | 2pm | 3pm | 4pm | 5pm | 6pm | 7pm | 8pm | 9pm | 10pm | 11pm | 12pm |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| Real power of wind (kw) | 10.9999 | 8.8888 | 2.777 | 2.6666 | 2.5555 | 1.11111 | 0.334 | 4.666 | 1.7777 | 27.776 | 3.5555 | 2.555 |
| Real power of solar (kw) | 5.9999 | 5.1111 | 4.9999 | 4.1111 | 3.999 | 2.88 | 0.111 | 0 | 0 | 0 | 0 | 0 |
| Real power of fuel cell (kw) | 50 | 50 | 50 | 50 | 50 | 49.999 | 49.999 | 49.999 | 49.9999 | 49.9999 | 49.9999 | 50 |
| sold | 55.56 | 54.88 | 52.88 | 56.0001 | 52.66 | 50.33 | 29.9987 | 28.9987 | 24.876 | 20.876 | 19.9999 | 19.8765 |
| power (kw) | 10 | 11.1 | 11.6098 | 12.876 | 6.765 | 5.9876 | 4.99987 | 4.1111 | 3.6785 | 3.7765 | 4.543 | 3.6654 |
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| purchase | power | 45.0098 | 43.987 | 45.876 | 46.8765 |
|----------|-------|---------|--------|--------|---------|
| (kw)     |       | 56.9999 | 43.77765 | 13.9876 | 15.9876 |
|          |       | 11.7654 | 10.654 | 10.654 | 7 |

| purchase | cost | 3.5 | 3.00001 | 2.9999 | 3.8765 |
|----------|------|-----|---------|--------|--------|
| (1/h)    |      |     | 1       | 1      | 2.654  | 2.987  | 3.9876 | 3.5432 |

| Total    | cost(1/h) | 50.8876 | 51.8876 | 52.432 | 53.654 | 54.5432 | 54.875 | 55.76654 | 56.8765 | 56.8765 | 56.765 | 55.9876 | 52.8765 |

| Fig (1) |

RESULT FOR PROPOSED SYSTEM

| Time for power production | 11"o clock | 12"o clock | 1"o clock |
|---------------------------|------------|------------|-----------|
| GA selection              | ✓          | ✓          | ✓         |
| DEA selection             | -          | ✓          | -         |

IV. CONCLUSION

If the Differential evolution algorithm is used for calculate which time LPMG generate more power. In this DEA choose three time is selected. In this DEA determine 11”o” clock, 12 "o” clock and 1 "o” clock power generation is better for LPMG. GA is used to maintain the any one of the better time of power production. But the combination DEA and GA choose maximum power production time. In the 12 "o” clock better time for power of LPMG GA choose the best power of solar, wind and fuel cell power production

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