Portable Microgrid Development with Power Management and Quality Power Capability using PLC for Disasster Mangement

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Abstract:Microgrid is an amalgamation of several generators and grids interconnected by solar photovoltaic systems, diesel generators and grids to provide quality electricity to customers. Portable microgrid technology is designed f or emergencies such as peaceful situations such as landslides. Portable microgrids must manage power gene ration and provide the right power to connected devices. This is the main challenge for good electricity in hy brid electric power generation. This article introduces the accomplishment of a power control strategy using dynamic programming and fuzzy logic system and improving the performance of DSTATCOM technology by developing a control strategy, calculating current information and designing electronic components for ci rcuit operation.

1 INTRODUCTION

Likely disaster is catastrophic actions of climatic, geological and hydrological origin. They are events originating from the environment that cause damage and injury in life. Declaring a disaster depends on the severity of the event, the numeral of sufferers involved, the duration of the event (eg, the suddenness of the event, accommodation and clothing, weather conditions, location, etc.).

Causing human suffering and creating human needs that cannot be solved by the victims, it also causes degradation of energy sources that have been widely used for days to heal old life. (J. A. Michline, 2014) (Angel Fernández Sarabia). A microgrid or power distribution system is a system that distributes resources and loads with the ability to cut and balance local power, including local power, otherwise there may be a power outage in the area. A microgrid configuration combines numerous renewable power sources, such as diesel engines, photovoltaic (PV) panels, with energy storage and distribution grids. Renewable energy is used as the main energy source that can be produced as long as there is wind or solar energy. However, since solar power and wind speed are uncontrollable, energy support is needed to support the management and operation of the microgrid. Traditionally, this work is done with energy storage, such as batteries. State of the art technology must be used to keep production control running smoothly.

Various artificial intelligence algorithms such as expert machines, fuzzy logic, and genetic algorithms have been developed and tested for various energy sources. Artificial intelligence methods provide the operation and control of artificial intelligence

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(Sheila.H, 2010) Clarification of PQ problems ultimately depends on many factors such as what, why, where, time, reality and frequency that affect the end customer. Therefore, the increase in demand for electronic products has revealed a feature that can adjust the load and network changes of dynamic payment systems. Normally used filters cannot respond to changes in the power supply. Therefore, electrical scientists have developed energy-efficient filters to solve electrical problems.

2 DISASTER IN THE KODAGU AREA

Kodagu is most affected by the western cyclone. Rain in August broke all records in living memory; In 2019, the region saw its highest rainfall since records began 118 years ago. On July 9, 2018, five years later, a minor earthquake struck the South Kodagu region, which is on average 10 km inland between Madikeri and Sampaje. Kodagu received 768mm of rain on August 15, 16 and 17, which is almost half of August's total (1,675mm).72 hours of rain made the situation worse. Kodagu. Landslides and flooding occurred in Madikeri and Somwarpet due to heavy rains.

Fig 1: Ground Report of Landslide.

The earthquake damaged 48 villages in the Madikeri and Somwarpet taluks. The waters flowed and the land was abandoned. As a result of earthquakes and floods, new mountains and rivers are formed (H. T. Dinh,2016). Thousands of people, including the elderly and children, walked for miles, afraid of the terrible sounds heard during the earthquake. Thousands of people remain silent on various hills in Kodagu.

The ancient site of Koda was plunged into complete darkness for about a month. The entire Kodagu region is in danger of extinction. The only thought of every family in Kodagu is to save their own life. The Koda ancients valued life more than protecting their property, cars, jewelry, and other material interests. Heavy rains and earthquakes make noise and cause thousands of deaths.

People climbed mountains, crossed rivers, and walked together for miles through forests to reach safety. Even in the pitch black people ran for their lives, taking the youngest and carrying the oldest. When disaster strikes, there is a good relationship between siblings, helping those who need help. Rich and poor liveunder the same roof. In some cases, people risk their lives to help others as best they can.

People mourn animals in dangerous places. Dogs, cows, chickens, pigs and cats are released to escape danger. The people of Kodagu sleep in fear at night. People see the worst things they've never heard or seen before.

3 DEVELOPMENT OF PORTABLE MICRO-GRIDS WITH ENERGY MANAGEMENT AND PERFORMANCE QUALITY

A. Microgrid Development Figure 2 shows a simulation model of a portable microgrid linked to photovoltaic systems, wind turbines, battery storage systems, diesel generators, grids and loads. Both the photovoltaic generator and the wind turbine are designed to be 100 kW, (C.Byers, 1989) (H.Kakigano, 2013) equipped with a constant voltage closed loop boost converter that increases the voltage of the photovoltaic array from 36V to 48V and connects to the 48V DC bus. LIion battery 180Ah, 48V for charge and discharge controlled energy storage system. It is advisable to keep all the given values.

The rectified voltage is connected to the DC bus via a static transformer to provide power when equipment is connected and the battery does not have enough power to support power. The DC bus supplies 1.5kW at the main load of 500W. This article on microgrids describes modeling and simulation of electrical systems in matlab(r) and simulink(r) using simscape electricity (tm). simscape electricity can be used to schematically represent a single line diagram of microgrids using blocks that represent (compile) different electrical devices.

In this example, DER includes renewable energy sources such as solar power, diesel generators, and energy storage (ESS). Simulate an electricity

distribution or unintentional islanding of a microgrid with load inverters in a building. Because microgrid systems often have inverter control for solar and energy storage, various levels of simulation accuracy can be used to examine microgrid performance. Figure 3 and Figure 4 show the output of the proposed microgrid system. simscape Electricity can be used to simulate phasors or electromagnetic transitions (emts) as shown in Figure 5. Transients occurring at the output indicate that power quality needs improvement.

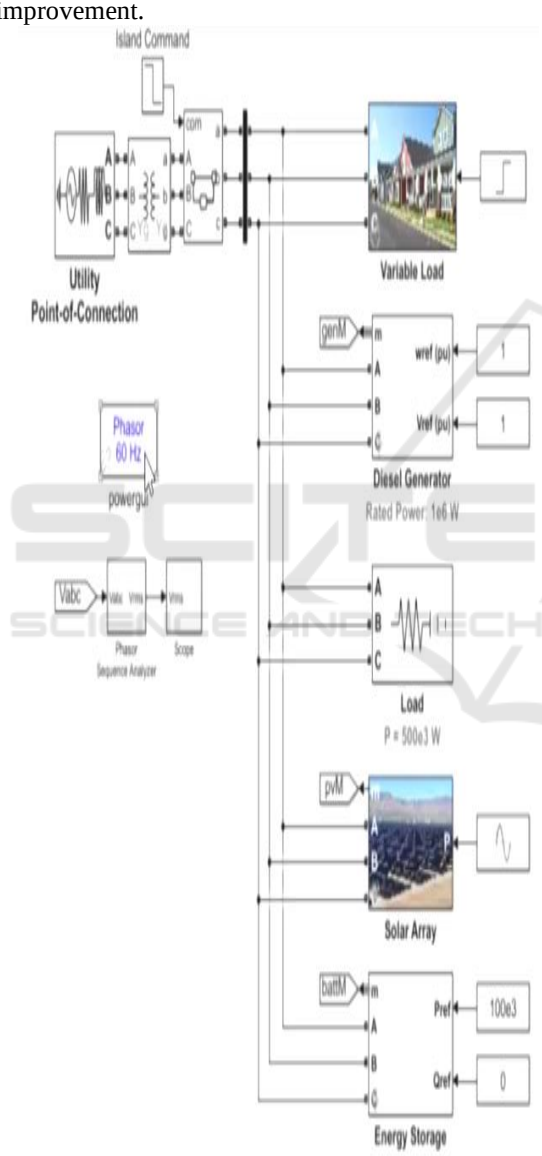

Fig.2. Simulation Model of a Portable Microgrid.

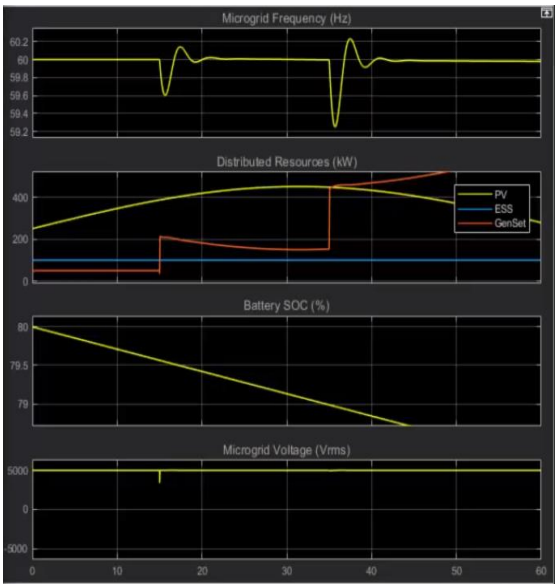

Fig.3. Microgrid Output with Inverter Control.

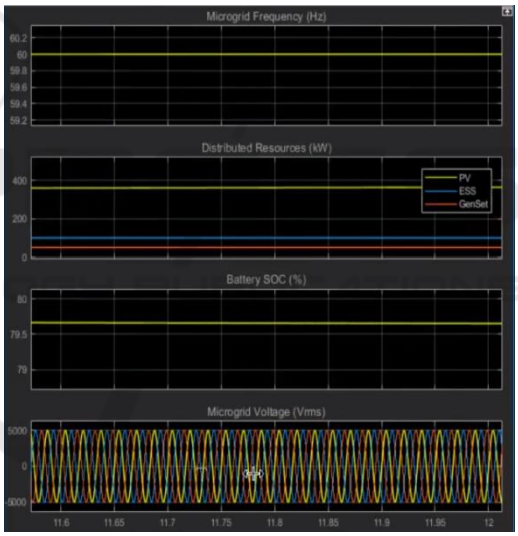

Fig. 4. Microgrid Output with ESS Control.

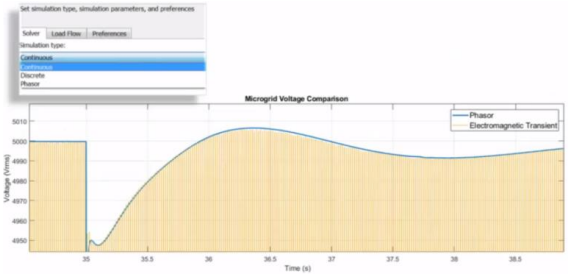

Fig.5. Electromagnetic Transients.

4 DSTATCOM FOR POWER QUALITY IMPROVEMENT

Many metaheuristic algorithms have been developed and many researches have been done in biology. The combination of metaheuristic algorithms is designed to determine the nature of search and search, which is most important in metaheuristic algorithms. To support this, Gandomi proposed the Krill Herd (KH) algorithm in 2012 as a bio-inspired optimization technique for solving multidimensional problems. In the algorithm, krill are small mollusks that form groups by moving quickly in the ocean to protect themselves from attack or to find food. The population framework approach creates an optimization process.

In the HR algorithm, there are three factors to find the best one: a) induced motion, b) spurious motion, and c) physical spread (J.A.MichlineRupa, 2014). The operation of DSTATCOM (OmPrakashMahela, 2016) (Kushal,2014) is based on the injection of harmonics into the grid using filters operating during the harmonics of the grid, which are obtained by injecting this pure sinusoidal voltage waveform. Therefore, power quality can be improved by adding transverse active filters to power distribution systems.

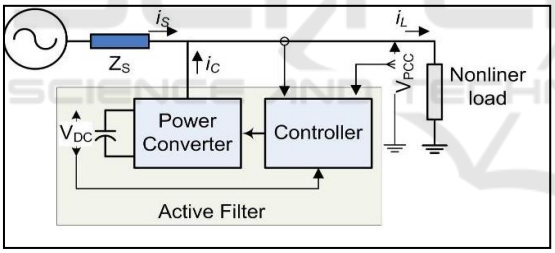

Fig.6. Nonlinear Load with Balanced Supply Voltage.

Figure 6 shows a nonlinear circuit with a balanced power supply. Current is the current that flows through the load with harmonics. To compensate for the compromise in the filter to produce the flow, apply the KCL we get (Kathiravan, 2018),

$$i_S^1 = i_L^1 - i_c^1 \quad (1)$$

The base current and voltage must be known, so the energy that can be used using the load must be sent to the location shown in the equation.

$$i_{SB} = (P_L / V^2) U_B \quad (2)$$

Where

$$V^2 = \frac{1}{T} V_R^2 + V_Y^2 + V_B^2 \quad (3)$$

At balanced condition

$$V^2 = 3V_R^2 \quad (4)$$

Where V_R^1=V_Y^1=V_B^1 - rms value of the phase voltage.

The operation of the DSTATCOM is based on the exchange of real and reactive powers between the distribution grid and inverter output of the DSTATCOM (N. Srinivasa Rao, 2015). The equation of P and Q power is given by equations 5 and 6 respectively

$$P=(V_{PCC} V_C \sin \propto)/ X \quad (5)$$

$$Q = V_{PCC} (V_{PCC} - V_C cos \propto)/X \quad (6)$$

Where α -> angle between the bus and inverter voltages, V_C -> inverter output voltage, V_{PCC} -> voltage of coupling, and X->reactance between the coupling point and grid.

5 KRILL HERD-FUZZY CONTROLLER ALGORITHM

A very interesting approach in the meta-heuristic algorithm is the use of a combination of random and local search. Investigations and manipulations are performed in the corps using the Krill Herding Algorithm (KHA)(Amir H,2016). The block diagram of the proposed krill-Fuzzy herd algorithm is shown in Figure 7.

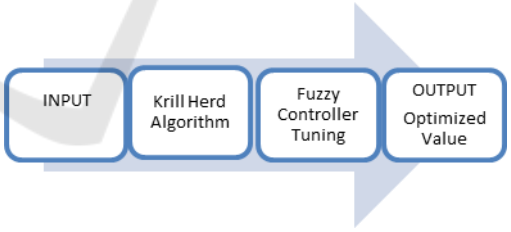

Fig.7. Block Diagram of Krill_Fuzzy.

6 PERFORMANCE OF DSTATCOM USING NOVEL KRILL HERD-FUZZY (KH-F) CONTROLLER

The main objective of this work is to select a technique to enhance the performance of the DSTATCOM and to design the control strategies used to calculate the reference current and the trigger circuit designed to trigger the circuit.

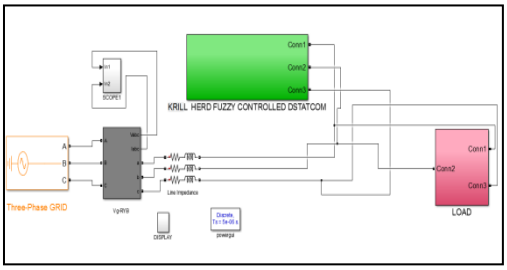

Fig 8: Simulink Model of Grid Connected KH-F Controller.

The search of the krill swarm starts without any information about the optimal solution, the high random search property of the krill reveals the local optimal value of the DC link voltage, which the simulation model shows in Figure 8, and also by setting the optimal value at the lowest amount of the krill swarm The algorithm emphasizes the manipulation of the optimal value using local search. Fuzzy controller (N. SrinivasaRao, 2015) (M. Kumar, 2015) is used with tuner for tuning between investigation and manipulation and therefore gives the best values. The THD is reduced to 0.03% by the combination, as shown in Figure 9. Line voltage and line current applied to the gate signal S1, S2 and S3 applied to the DC voltage source inverter from the KH-F controller and Figure 10 shows Mains voltage and circuit current with load current and injection current waveform.

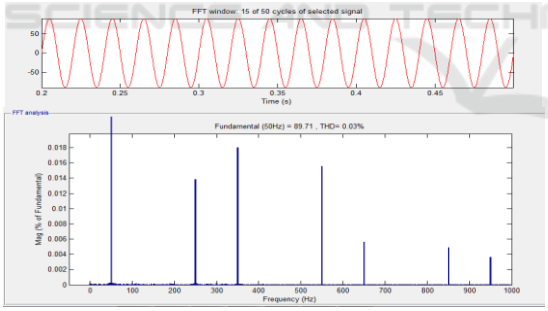

Fig 9: FFT of Source Current with KH-F Controller.

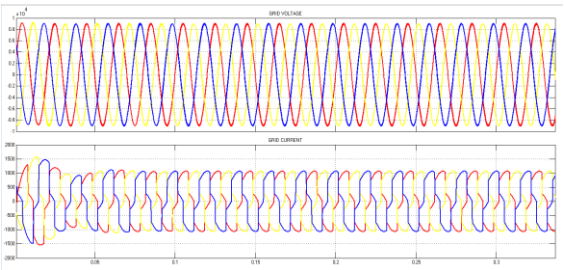

Fig 10: Grid Voltage and Grid Current with KH-F Controller.

7 CONCLUSION

This paper shows the effective implementation of a power management scheme using dynamic programming and a fuzzy logic system and improving the performance quality of the DSTATCOM performance enhancement technique by designing the control strategies used to calculate the reference current and the trigger circuit designed to trigger the circuit.

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