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OPTIMAL ALLOCATION USING SPSO TECHNIQUE AND SIZE REDUCTION OF DISTRIBUTED GENERATED SYSTEM FOR ACTIVE POWER LOSS REDUCTION

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ABSTRACT

Distributed generators (DG) play a critical role in reducing power outages and increasing grid reliability. The range of 0–50% of total load is taken into account for the maximum DG penetration level. The proposed methodology for solving the problem has been built and tested on the IEEE 69 standard bus systems. By contrasting the results of the suggested algorithm's tests with those of the most recent optimization methods, it has been shown that the former performs better. Using the EUROSTAG software, we plan to make a number of enhancements to this paper. Selective Particle Swarm Optimization (SPSO)is used to accomplish the methods presented in this paper. We plan to use the same approach for placing several distributed generators in primary distribution networks in our research paper. To minimize losses in the DG equipment is our primary objective here.

Keywords: Distributed generation, Radial distribution system, Voltage profile, Optimal Allocation, Renewable Distribution Generation, International Energy Agency, etc

INTRODUCTION

"Distributed Generation" (DG) refers to the practice of producing electricity on a small scale and near to the load (usually 1 kW-50 MW). In order to strengthen the system and reduce actual power losses, the locations of DG units are meticulously designed.

Improvements to voltage profiles and load factors are suggested. Distributed generating makes use of both renewable and non-renewable energy sources (DG). Common types of DG include wind power, solar photovoltaics, solar thermal systems, biomass, and even modest-sized hydroelectric dams. When DG units are overused or not properly integrated into the distribution network, they contribute to actual power losses. The goal of optimal DG placement (OPDG) is to improve distribution network efficiency by identifying where and how many DG units may be installed for maximum effect. Many optimization strategies have been presented by the research community to determine the optimal location and size of DGs.

A selective particle swarm optimization (SPSO) approach is developed to address the DG placement problem. This investigation uses type-I DG to solve the problem at hand (which provides only active electricity such as solar, microturbines, fuel cells, etc.). The ideal placement of DGs is calculated using the loss sensitivity factor. Generally speaking, DG is most useful between 0% and 50% of overall system load. The technique is tested on conventional distribution networks with 33 and 69 buses, and the results are shown.

Here is the structure of the rest of the paper: The second part provides a theoretical framework within which to analyse the problem. In Chapter 3, we examine various solutions to the DG placement problem. The results of the simulations run on the test distribution systems employed in this investigation are presented graphically in Section 4. The collected results, together with a brief explanation and comparison to alternative methodologies, are presented here, as is a summary of the findings from the published publications.

Distributed production has become increasingly essential in the power market sector, which previously relied on massive volumes of electricity being created at central power plant locations and transmitted over long distances to consumers. Transmission and distribution of electricity waste a significant amount of energy. Losses in the distribution network can be reduced thanks to the use of dispersed or scattered producing to address this issue. Also, the distribution system's voltage profile is improved. Although DG units only produce a little amount of energy, they are a more practical option in a society where everyone is attempting to lessen their impact on the environment by using renewable energy sources. The CIGRE estimates the range of DG size to be between 50 and 100 MWs, while the Electric Power Research Institute estimates it to be between a few kilowatts and 50 MW. Distributed generation can be seen in a small power plant that is connected to the distribution grid close to the load or at the consumer's meter. The International Energy Agency (IEA) defines distributed generation (DG) as a power plant that does not belong to a utility and instead supplies electricity to end users or provides additional network support. For the most part, it is connected to and incorporated into an already existing distribution network. Some examples of these technologies include solar photovoltaic cells, wind turbines, fuel cells, gas turbines, etc. To use renewable energy sources in a decentralized fashion is known as "renewable distributed generation" (RDG).

OBJECTIVES

A compact and efficient distributed power generation system is the goal.

Use the selective particle swarm optimization (SPSO) method to cut down on line losses.

Boost the voltage profile and cut down on active power loss in the Distributed Generating system.

LITERATURE SURVEY

Distributed Generation (DG) Source Optimization for Electricity Networks, the authors are C. Wang and M. H. Nehrir. This research presents analytical approaches for locating a DG in radial and networked systems where the least amount of power is lost.

Authors: Reuben S. Al Abri, Fadi El-Saadany, and Yasser M. Atwa. The voltage stability margin of a distribution system can be increased through distributed generation, but only if it is placed and scaled appropriately. This paper intends to provide a technique for locating and sizing DG units to increase the voltage stability margin. Optimization of the location and size of distributed generation (DG) units is performed using mixed-integer nonlinear programming to increase the system's margin of safety.

Hung This is Mithulananthan. Name: Nadarajah Duong Quoc. Reducing losses in primary distribution systems through the use of several, geographically separated generator installations This study recommends the following procedures for improved information analysis (IA). Using IA expressions, this method determines the optimal size for four separate DG kinds and then follows a procedure to find that area. An approach is proposed for maximizing power factor with DG that can provide both active and reactive energy.

METHODOLOGY

For this study, we adopted the usual IEEE 69 bus testing setup. The IEEE 33 bus test system uses line and load data from a reference document. Many methods of load flow analysis, such as Newton Raphson, Gauss-Siedel, and Fast Decoupled, are used in the EUROSTAG Simulation software, which has been studied in depth. Through the use of a power system analysis toolbox, EUROSTAG is able to undertake studies on power systems such as steady-state analysis, load flow analysis, security evaluation, reliability, and protection. In this case, the Newton Raphson technique is used to examine the load flow of the supplied network. The revised margin of error is 0.0001. Devices like DG and DG with STATCOM are employed with the appropriate settings to provide reactive power compensation for this 69-bus test system. Between 10 and 30 percent of the total load power will penetrate the compensating devices. The DG is allowed to experiment with three different power factors to locate the optimum setting for maximum efficiency. When installing DG over the underpowered bus, one of three power factors (0.9 P.U., 0.95 P.U., or 1.0 P.U.) is employed. Specifically, we expect the bus voltage to range between 0.95 V and 1.05 V.

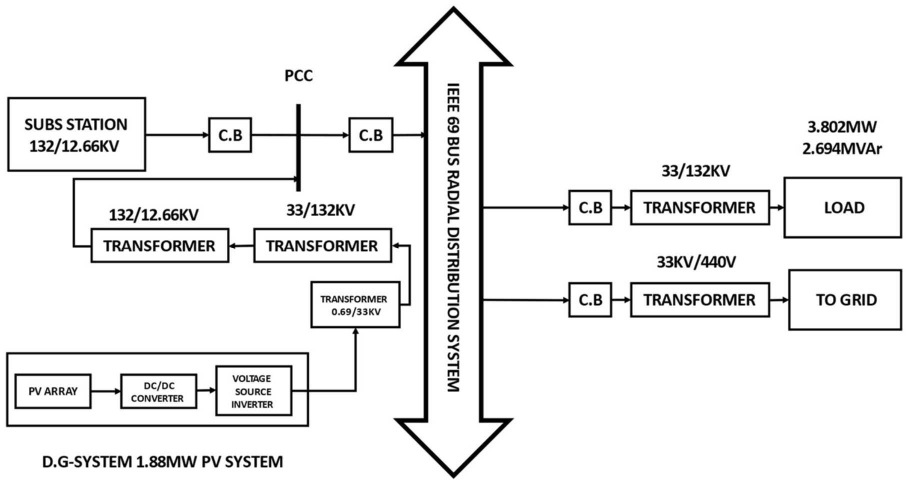

FIGURE 1: BLOCK DIAGRAM SUBSTATION WITH IEEE 69 BUS SYSTEM WITH SOURCE AND DSITRIBUTED GENERATION UNITS

SELECTIVE PARTICLE SWARM OPTIMIZATION (SPSO) TECHIQUE

Recently, "selected particle swarm optimization," an AI-based technique, has been presented for dealing with intractable non-linear combinatorial optimization problems. Selective Particle Swarm Optimization is a variation on Binary Particle Swarm Optimization that is used to limit the search space when solving the network reconfiguration problem. In the SPSO, for each tier of the search space [1, 2,......], [......]. D D D DN We can think of DN as the number of selected positions from the set S S of all feasible positions in dimension D. Whereas standard Particle Swarm Optimization requires a fitness function, Selective Particle Swarm Optimization maps each D-dimensional of the DN position onto the selective space SD, changing the location of each particle from a real-valued point to a point in the selected space.

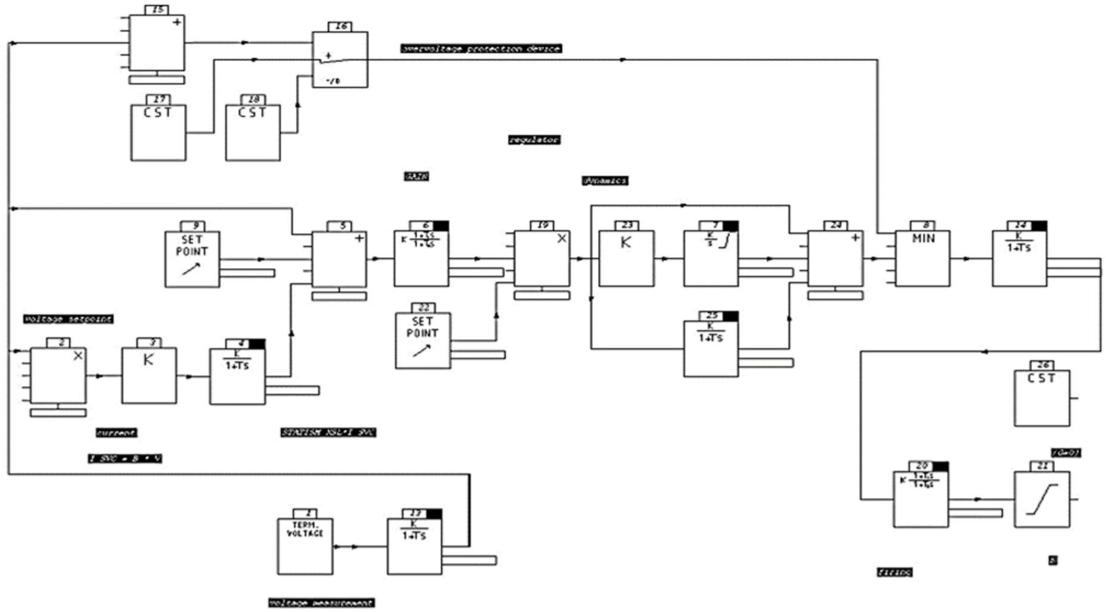

FIGURE 2: MACRO BLOCK MODEL OF SOURCE AND STATCOM COMPENSATED DISITRIBUTED GENERATION UNITS

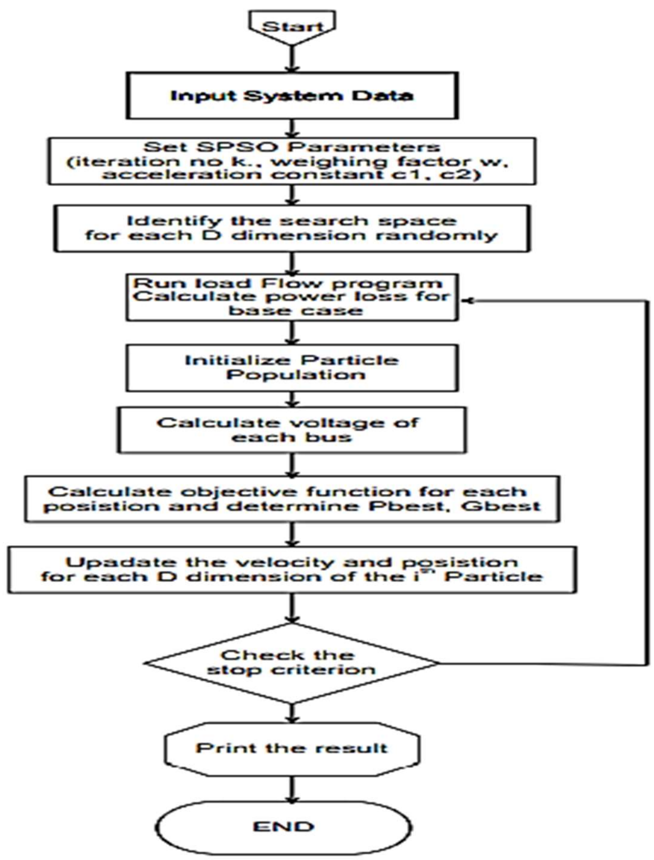

FIGURE 3: FLOW CHART MODEL OF DG PLACEMENT USING SELECTIVE PARTICLE SWARM OPTIMIZATION TECHNIQUE

We consider the IEEE 69 bus radial distribution system as our test system. It has total load of 3.802MW and 2.694MVAr. The base case real power loss is about 99.35KW and minimum bus voltage is 0.943 pu.

Case1-Without DG

As per our test results derived from the given test system the power loss is 99.35KW and minimum bus voltage is 0.943 p.u.

Case 2-With DG

According to our study of test data generated by the specified test equipment, the DG size in bus 61 is 1360KW, and in bus 64 it is 1880KW. It has an efficiency of 0.98 p.u. at the bus and a power loss of 36 kW at the least. Compared to the no DG scenario, the actual power loss is reduced by 64%.

COMPARATIVE BUS VOLTAGE PROFILE FOR 69 BUS SYSTEM WITH AND WITHOUT DG PLACEMENT.

Several established procedures are compared to the SPSO approach proposed here. Examples include the Harmony search algorithm, bacterial forage optimization, improved bacterial forage optimization, integrated vector management, selective particle swarm optimization, and particle swarm optimization based on a genetic algorithm. When using HSA, the minimum bus voltage per unit is 0.9619 volts, the total DG size is 1844 kW, and the power loss is 51.3 kW. MHBMO calculates a minimum bus voltage of 0.9429p.u., a total DG size of 2700KW, and a power loss value of 85.22KW from these parameters. Minimum bus voltage at 0.9875p.u., power loss at 84.375KW, and total DG size at 2020KW are all achievable with the BFO technique. Using the MBFO technique, the minimum bus voltage is 0.9797 p.u., the power loss value is 83.25 kW, and the overall DG size is 1870 kW. Using the GA-PSO technique, the smallest possible value for bus voltage is 0.9969p.u., while the largest possible value for the DG is 2988KW, with a power loss value of 81KW. When using the IVM technique, the required minimum bus voltage is 0.9685p.u., the power loss value is 80KW, and the total size of the generating set is 1832KW. A minimal bus voltage of 0.980p.u. is achieved using SPSO, and 1880kW of DG capacity with a 36kW power loss value is achieved. According to these findings, it is clear that the proposed strategy, when applied to the context of the placement of many DGs, has the potential to yield good outcomes. Maximum power loss reduction and voltage profile improvement can be achieved with smaller DGs in the best possible locations.

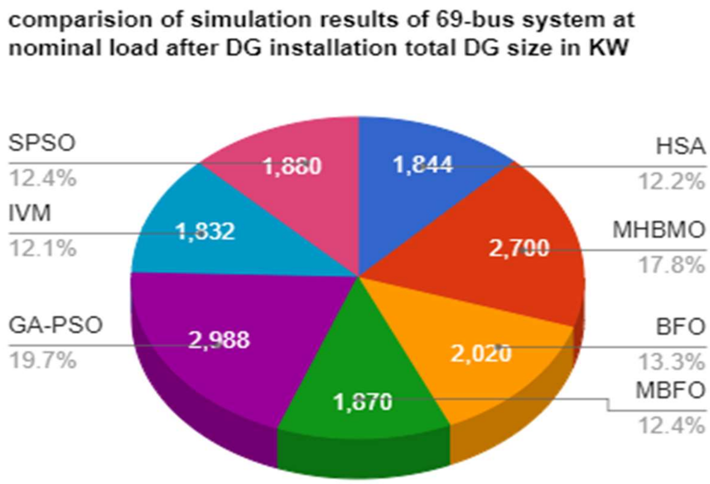

FIGURE 4: PIECHART OF COMPARISION OF SIMULATION RESULT OF 69 BUS SYSTEM AT NOMINAL LOAD AFTER DG INSTALLATION TOTAL DG SIZE IN KW

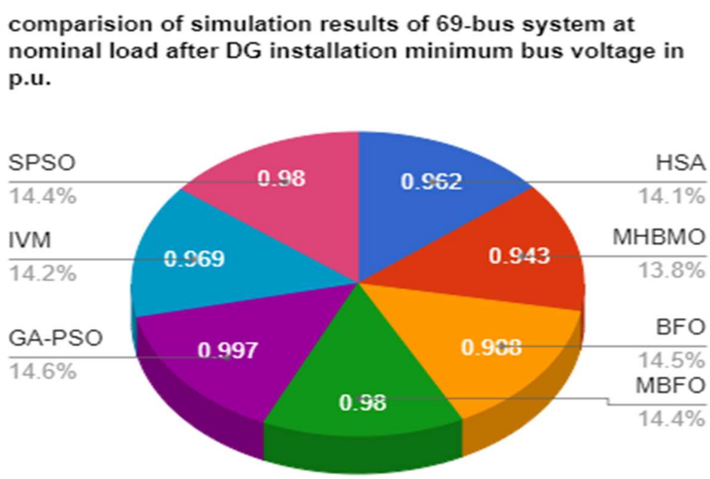

FIGURE 5: PIECHART OF COMPARISION OF SIMULATION RESULTD OF 69 BUS SYSTEM AT NOMINAL LOAD AFTER DG INSTALLATION MINIMUM BUS VOLTAGE IN p.u.

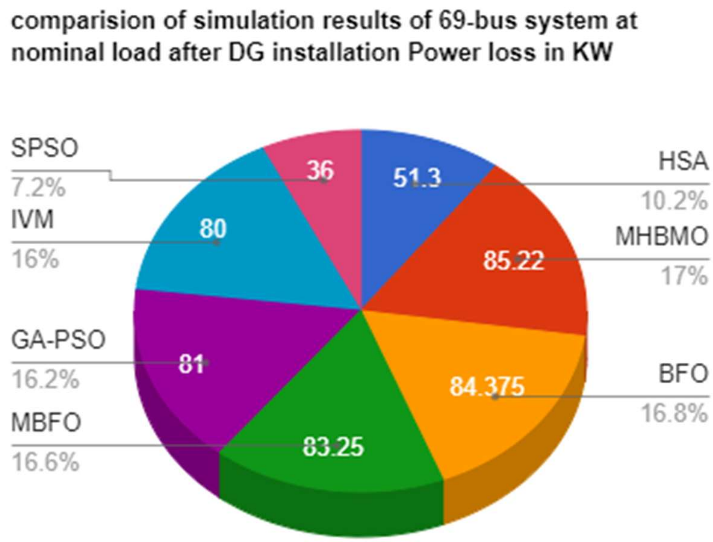

FIGURE 6: PIECHART OF COMPARISION OF SIMULATION RESULTD OF 69 BUS SYSTEM AT NOMINAL LOAD AFTER DG INSTALLATION POWER LOSS IN KW

Figure 4 shows how the nominal load simulation results of a 69 Bus system relate to those obtained after DG installation, giving an estimate of the total DG size in kilowatts. The use of SPSO or IVM to shrink DGs is recommended. Figure 5 shows the results of a simulation comparing the minimum Bus voltage in p.u. with and without DG installation for the 69 Bus system. The pie chart suggests that SPSO and IVM are the most promising approaches for reducing Bus voltage". In Figure 6, we compare the power loss in kilowatts predicted by the SPSO approach alone with the power loss predicted by the IEEE 69 Bus system at nominal load after DG installation. Hence, the application of SPSO in our project leads to a reduced size of the DG infrastructure, improved utilization of DG resources, less power losses, and a more consistent voltage across the grid.

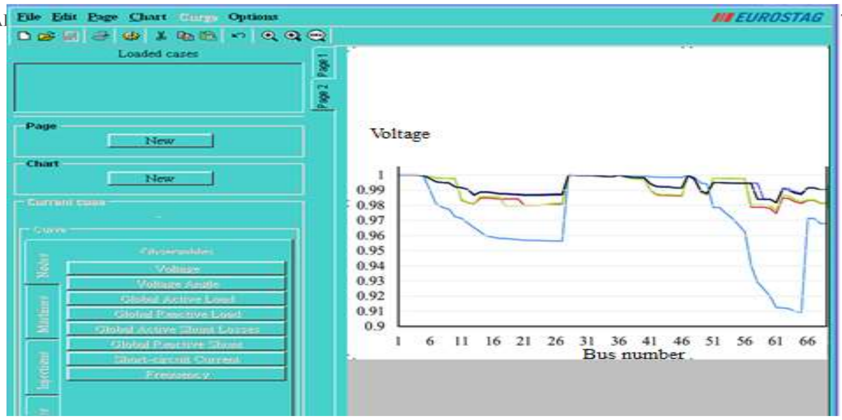

FIGURE 7: SIMULATION RESULT OF COMPARISION OF VARIOUS TECHNIQUES USED IN OPTIMAL ALLOCATION OF DG

Figure 7 is a representation, across methods, of where optimal DG allocation occurs: only with the SPSO method (dark navy blue). Use of SPSO techniques leads to optimal allocation of DG and size reduction of DG, as shown by the fact that the technique's ideal number is between the two extremes. Thirty percent of the system's overall load can be reduced with DG's help.

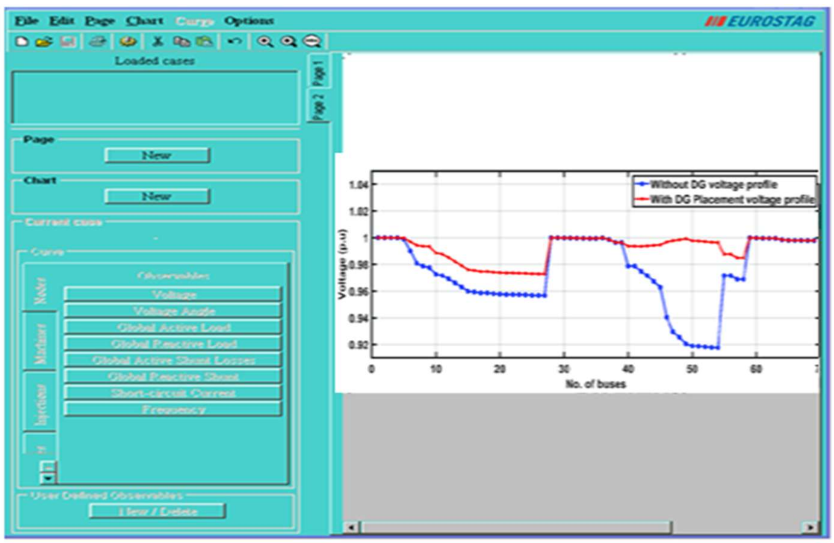

FIGURE 8: SIMULATION RESULT OF COMPARISION OF VOLTAGE PROFILE WITH AND WITHOUT DG

Figure 8 compares the voltage profile with and without DG to show how the system's voltage profile suffers when DG is not present. The actual and ideal voltage profiles differ greatly. By maintaining a constant voltage, as shown in the graph, DG's incorporation into the power system improves the voltage profile.

CONCLUSION

Distributed generators (DG) play a critical role in reducing power outages and increasing grid reliability. The range of 0–50% of total load is taken into account for the maximum DG penetration level. The proposed methodology for solving the problem has been built and tested on the IEEE 33 and 69 standard bus systems. By contrasting the results of the suggested algorithm's tests with those of the most recent optimization methods, it has been shown that the former performs better. Using the EUROSTAG software, we plan to make a number of enhancements to this paper. Selective Particle Swarm Optimization is used to accomplish the methods presented in this paper (SPSO). We plan to use the same approach for placing several distributed generators in primary distribution networks in our research paper. To minimize losses in the DG equipment is our primary objective here.It is significant to Concentrate more in mitigating power quality problems using distributed generation systems in the power system by various renewable sources.The size reduction of DG will help in the design and construction of DG in various aspects so that it will lead in a hike in usage of renewable energy in power systems.Size reduction of distributed generation system and optimal allocation is achieved using SPSO technique. The total size of DG is reduced from 2988KW to 1880KW.Power loss in the system is also reduced from 81KW to 36 KW. Minimum bus voltage also lies at the ideal value (0.98 p.u.).Thus, my Project work is focused on the voltage profile enhancement, power loss reduction, optimal allocation and size reduction of distributed generation systems (DG) in IEEE 69 radial distribution test system is successfully implemented and results are verified using the EUROSTAG tool. SPSO technique is used then the total size of DG is 1880KW with power loss value of 36KW and minimum bus voltage of 0.980p.u.

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