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RESEARCH ARTICLE

Power Stability Solution using Genetic Algorithm

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Abstract: Power stability is the big issue since the invented electricity we use the classical approach but it is not efficient to take it all over. In this research paper we draw a new approach under the name of genetic algorithm help to control the problem of power stability.

Keywords: transmission lines, disturbances, energy retailer

Introduction: A power system is a structural arrangement of Generators, transmission lines, and distributed systems. Generating stations and a distribution system are interconnected through transmission lines, which also connect one power system to another. Generation station consists of alternators that are run by different types of turbines like steam turbine, hydro-electric turbine, diesel turbine, and nuclear turbines. Basically Nuclear & Hydro-electric stations are used as base load stations. Steam stations are capable of operation both on peak load and base load. Diesel and gas stations are used for peak load only. Remotely generated power has been brought to load centers through transmission lines. There are many ways of power transmission. Ex: DC, AC, EHVAC, EHV DC. Either may be transmitted by using overhead lines or underground cables.

A distribution system can be subdivided into feeders, distr4ibuters, and service mains. Distribution system connects all the loads in a particular area to the transmission lines. Successful operation of a power system depends largely on the engineer's ability to provide reliable and uninterrupted service to the loads. The first requirement of reliable service is to keep the synchronous generators running in parallel and with adequate capacity to meet the load demand. Second requirement of reliable electrical service is to maintain the integrity of the power network, Modern power systems are characterized by extensive system interconnections and increasing dependence on control for optimum utilization of existing resources. The supply of reliable and economic electrical energy is a major determinant of industrial progress and consequent rise in the standard of living.

The increasing demand for electric power coupled with resource and environmental constraints pose several challenges to system planners. The generation may have to be sited at locations far away from load centers. However, constraints on right of way lead to over loading of existing transmission lines and an impetus to seek technological solutions for exploiting the high thermal loading limits of EHV lines.

Power system dynamics has an important bearing on the satisfactory System operation. It is influenced by the dynamics of the system components such as generators, transmission lines, loads and all other control equipment. The dynamic behavior of power systems can be quite complex and a good understanding is essential for proper system planning and secure operation.

Existing Work: The tendency of a power system to develop restoring forces equal to or greater than disturbing forces to maintain the state of equilibrium is known as stability. Instability means a condition denoting loss of synchronism or falling out of step. Power system is also denoted by its capability to recover from planned and random electrical disturbances viz switching operations, faults, and variation in the load demand etc.

The disturbance can divide into two categories

(a) Small

(b) Large

A small disturbance is one which the system dynamics can be analyzed from linearized equations. The small changes in the load or generation can be termed as small disturbances. The tripping of a line may be considered as small disturbances.

However which results in a sudden dip in the bus voltages are large disturbances and require remedial action in the form of clearing the fault has a critical influence on system stability.

Steady state stability is the capability of a power system to remain in synchronism when the power flow is gradually increased where as the steady state stability limit is defined as the limit of maximum power flow beyond which instability occurs and the synchronous generator supplying power through the line losses synchronism.

In case of interconnected systems, synchronism between the ends may be lost once the magnitude of power flow exceeds the steady state stability limit.

Dynamic stability is more probable than steady state instability. Small disturbances are continually occurring in a power system which are small enough not to cause the system to lose synchronism but do excite the system in to the state of natural oscillations. The system is said to be dynamically stable if the oscillations do not acquire more than certain amplitude and die out quickly.

Requirements

- Because we are a lines business and not an energy business (as defined in the Electricity Industry Reform Act 1998, Section 4 and 5) we cannot purchase the energy from your generation. You must have a contract in place with a retailer for the purchase of the energy you generate, or provide evidence that you will be consuming all this energy yourself. You may not simply “lose” the energy in our network.

- You must have a meter in place that complies with the Metering requirements of the Electricity Governance Rules. This may mean that the meter will need to record both import (energy flowing to your generator) and export (energy flowing from your generator) energy or record consumption half hourly.

- The energy business/retailer that you contract with for purchase of exported energy, metering services and data management may charge you for doing so. Ensure that you request a copy of their tariffs and terms and conditions for distributed generation.

Advantage of Distributed Generation

Power reliability is required for

- Life-safety systems, such as emergency lighting or ventilation, which must operate properly to prevent the loss of human life.

- Systems that prevent damage to plant infrastructure (e.g., sump pumps at a wastewater treatment plant), allow monitoring of other systems (e.g., supervisory control and data acquisition, or SCADA, systems), or prevent the loss of vital data during power failures (e.g., at bank data centers) or whose failure to operate could significantly impact public health.

- Processes that would cause sizeable financial losses if power outages occurred. Power outages cause loss of quality control in batch processes—found at microelectronic component manufacturing, food processing, chemical processing, and oil refining facilities—and force owners to discard entire batches. In addition, power losses to processes that operate 24 hours per day, seven days per week—with no openings to recover lost production time—can lead to cancelled orders.

- Equipment and processes for which operation is not time-critical. Operating this type of equipment, such as a cooling system with a large, cool storage tank, can be deferred to off-peak times; switched to an alternate source, such as an engine generator; or switched to an alternate fuel, such as an electric heating system with fuel-oil backup.

There are many ways to increase the reliability of power. Redundant power supplies do not always improve reliability. If two redundant feeders supply power to an industrial facility but originate at the same utility substation and are carried on the same set of power poles, reliability will be lower than if they originate at separate substations and travel to the site on different sets of power poles. The problem with redundant feeders carried on the same set of poles is that a single-point failure (e.g., a weather-related event, pole fire, or traffic accident) could cause simultaneous outages on both sources.

- To improve power reliability by installing standby generation, uninterruptible power supplies (UPS), flywheels, or fuel cells.
- Reliability is the most important feature of electric power distribution system. Quantification of distribution system indices is the best indices of whether the system with distributed generation has increased reliability or not.

A Step Ahead in the name of Genetic Algorithms

Genetic algorithms are modeled on biological processes in which parents pass character traits to their offspring. The next generation contains data inherited from its predecessors and in each generation the fittest members have the greatest potential to survive and send genetic material to the progeny of their population. As children are developed from the best parents, they are likely to introduce an improvement in fitness to the group.

Genetic algorithms mimic this survival of the fittest by randomly generating a population of solutions and then selecting members, with greater possibility of selection given to the fittest, from which to build the next generation. This study used populations of 100 and evolved each trial for 1000 generations. The objective function used in this research was the length of the paths. Shorter circuits were given best fitness consideration by inverting their tour lengths through subtraction from the ceiling of the population's longest tour. The roulette wheel method was employed to choose parent solutions.

Genetic Algorithm and Direct Search Toolbox is a collection of functions that extend the capabilities of Optimization Toolbox and the MATLAB numeric computing environment. Genetic Algorithm and Direct Search Toolbox includes routines for solving optimization problems

What Is Genetic Algorithm?

The genetic algorithm is a method for solving both constrained and unconstrained optimization problems that is based on natural selection, the process that drives biological evolution. The genetic algorithm repeatedly modifies a population of individual solutions. At each step, the genetic algorithm selects individuals at random from the current population to be parents and uses them to produce the children for the next generation. Over successive generations, the population "evolves" toward an optimal solution. Genetic algorithm can be applied to solve a variety of optimization problems that are not well suited for standard optimization algorithms, including problems in which the objective function is discontinuous, non differentiable, stochastic, or highly nonlinear.

The genetic algorithm uses three main types of rules at each step to create the next generation from the current population:

Selection rules select the individuals, called *parents that* contribute to the population at the next generation.

Crossover rules combine two parents to form children for the next generation. The genetic algorithm differs from a classical, derivative-based, optimization algorithm in two main ways, as summarized in the following table. *Mutation rules* apply random changes to individual parents to form children. Here we are showing a comparative classical algorithm and genetic algorithm.

Classical Algorithm	**Genetic Algorithm**
Generates a single point at each iteration. The sequence of points approaches an optimal solution.	Generates a population of points at each iteration. The best point in the population approaches an optimal solution.
Selects the next point in the sequence by a deterministic computation.	Selects the next population by computation which uses random number generators.

Genetic Algorithm Terminology

This section explains some basic terminology for the genetic algorithm, including

- Fitness Functions
- Individuals
- Populations and Generations
- Fitness Values and Best Fitness Values
- Parents and Children

Fitness Function: The *fitness function* is the function need to be optimized. For standard optimization algorithms, this is known as the objective function. The toolbox tries to find the minimum of the fitness function.

Individuals: An *individual* is any point to which you can apply the fitness function. The value of the fitness function for an individual is its score.

An individual is sometimes referred to as a *genome* and the vector entries of an individual *as genes*.

Populations and Generations: A *population* is an array of individuals. For example, if the size of the population is 100 and the number of variables in the fitness function is 3, represent the population by a 100 by 3 matrix. The same individual can appear more than once in the population. For example, the individual (2, 3, 1) can appear in more than one row of the array.

At each iteration, the genetic algorithm performs a series of computations on the current population to produce a new population. Each successive population is called a new *generation*.

Fitness Values and Best Fitness Values: The *fitness value* of an individual is the value of the fitness function for that individual. Because the toolbox finds the minimum of the fitness function, the *best* fitness value for a population is the smallest fitness value for any individual in the population.

Parents and Children: To create the next generation, the genetic algorithm selects certain individuals in the current population, called *parents*, and uses them to create individuals in the next generation, called *children*. Typically, the algorithm is more likely to select parents that have better fitness values.

Using The Genetic Algorithm

There are two ways to use the genetic algorithm with the toolbox:

- Calling the Genetic Algorithm function ga at the command line.
- Using the Genetic Algorithm Tool, a graphical interface to the genetic algorithm.

This section provides a brief introduction to these methods.

Using the Genetic Algorithm Tool

The Genetic Algorithm Tool is a graphical user interface that enables us to use the genetic algorithm without working at the command line. To open the Genetic Algorithm Tool, enter

gatool

at the MATLAB command prompt.

To use the Genetic Algorithm Tool, enter the following information:

Fitness function — it is the objective function to minimize. Enter the fitness function in the form @fitnessfun, where fitnessfun.m is an M-file that computes the fitness function.

Number of variables — the length of the input vector to the fitness function.

Enter constraints or a nonlinear constraint function for the problem in the Constraints pane. If the problem is unconstrained, leave these fields blank.

To run the genetic algorithm, click the Start button. The tool displays the results of the optimization in the Status and results pane.

Change the options for the genetic algorithm in the Options pane. To view the options in one of the categories listed in the pane, click the + sign next to it.

Proposed Work: Genetic Algorithm always evaluate from population, so they create the number of parents required to form the population. The most tidies job in GA is to define the fitness function, depending upon the requirement and application we have to define the function and calculate the fitness value of the entire parent, depending upon the fitness value the parent whose fitness value is low has to be replaced by the parent of higher fitness value and thus the population is called mating pool.

From the mating pool obtained select two parent by random and apply the GA operators such as crossover and mutation for hidden weights and output weights by selecting row/column randomly. The newly obtained parent are called child, this process repeats till the number of child produced is equal to the population size. Once we obtained the number of child equal to population, this will form the new generation. The fitness value of this generation is calculated and if 95% of parents have the same fitness value the process stops else taking the newly formed generation as population the process repeat till parents have 95% of same fitness value.

Stepwise Procedure of Classical Approach

1. Select a population.

2. According to fitness value generate the mating pool.

3. Select two parents randomly from pool to produced two children

   I. Apply crossover

   II Apply mutation

4. Check the No of child if No < population size got to step 3, else step 5.

5. Check the fitness value of each child if 95% child having same fitness value terminates the execution else go to step 6.

6. Generated child will form a new population and continue with step1.

A simple genetic algorithm that yields good result in many practical problems is composed of three operators

- Reproduction
- Crossover
- Mutation

Reproduction: Reproduction is a process in which individual are copied according to their objective functional values. In natural population fitness is determined by creature ability to survive predators. To define the fitness function is a in given problem is a tedious job, many criteria has to be considered. The fitness function in the project work is defined as follows

Crossover: Crossover is process, which occurs after reproduction, a simple crossover may proceed in two steps. First, members of the newly reproduced in the mating pool are mated in random. Secondly a crossover point is randomly chosen for two randomly selected individuals (parents). This point occurs between two bits and divides each individual into left and right sections. Crossover then swaps the left (or the right) section of the two individuals. As an example of crossover, consider the two parents

Parent 1: 10101 | 0 1 0 1 0

Parent 2: 10000 | 1 0 0 0 0

Suppose the crossover point randomly occurs after the fifth bit. Then each new child receives one half of the parent's bits

Child 1: 10101 1 0 0 0 0

Child 2: 10000 0 1 0 1 0

How it Works: Objectives

- The main objective of the work is to define a distributed power system with the effective placement of DG over the system so that the power loss will be minimized and the cost of establishment will also improve
- Work is to design a genetic based system to identify the optimal placement of DG over the distributed system.
- The work is about to implement the work in maltab environment

Idea behind Research

We are providing the solution of DG placement in power system with minimum cost and the power consumption using the genetic approach. The proposed system is Genetic approach to optimize the Sequence generation approach for distributed power system. In this present work to perform the optimization on DPX Crossover is implied. The fitness function is defined with the cost specification to minimize the cost of the system. The proposed system is about to optimize the results driven from the Genetic algorithm in case of DPX Crossover.

Proposed Algorithm The proposed GA is described as below:

1. Generate a Distributed Power System with N Number of DGs and relative parameters. Use this Distributed Power System as the population set to genetics
2. Generate the Cost matrix
3. Define the fitness rule to minimize the aggregative Cost over the Distributed Power System
4. For i=1 to MaxItera

   [Repeat steps 4 to 8]
5. Select two random sequence called parents from the population set that follow the fitness rule. Called parent1 and parent2
6. Perform the DPX Crossover on these two parents to generate the child DG

   ChildDG=CrossOver(parent1,parent2)
7. Perform the Random Mutation algorithm.
8. Recombine the obtained value in the population set.

9. Return Optimized Sequence

10. Generate the graph of path sequence.

Conclusion Power system distribution and optimization is always a critical factor. The criticality becomes when we work on a Distributed system. In such case, there is requirement to identify the best placement of DG in the distributed system so that maximum effect will be derived from the system. In this present work an effective approach is defined to perform the location and the sequence of DG placement in the distributed power system. The obtained results from the system shows that the presented work is cost effective it means it the presented system will consume the lesser power and presented system is effective enough to distribute the energy with minimum lost and minimum cost.

Future Scope In this presented work, we have defined an optimized way to identify the best placement of DGs in a distributed power system and to provide the power distribution with minimum cost and with minimum energy loss. The presented system can be extended in different ways. The presented work is performed on 30 Bus System. In future, same kind of work can also be implemented on other bus system types. Here the work is defined for DG placement and sequencing, in future the work can be defined to optimize the size and capacity vectors for DG.

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