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OPTIMIZATION OF MODES OF ELECTR POWER SYSTEMS BY GENETIC ALGOROTHMS

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Abstract
In article discusses issues for solving optimization problems based on the use of genetic algorithms. To date, the genetic use algorithm for solving various problems. Which includes the shortest path search, approximation, data filtering and others. In particular, data is being examined regarding the use of a genetic algorithm to solve problems of optimizing the modes of electric power systems. Imagine an algorithm for developing the development of mathematical models, which includes developing the structure of the chromosome, creating a started population, creating a directing force for the population, etc. As well as the presentation, the selected structure should take into account all the features and limitations imposed on the desired solution, as well as the fact that the implementation of crossover and mutation algorithms directly depends on its choice. To solve optimization problems, a block diagram of the genetic algorithm is given.

Key words: *electric network, approximation, chromosome, criterion function, restriction, algorithm of the solution, multiple parameter functions, genetic algorithm.*

Genetic algorithms are currently very popular ways to solve optimization problems. They are based on the use of evolutionary principles to find the optimal solution. The very idea seems quite intriguing and curious to put it into practice, and numerous positive results only stir up interest from researchers. Often, a small change in one of them can lead to an unexpected improvement in the result. The use of genetic algorithms is useful only in cases where for this problem there is no suitable special solution algorithm. These algorithms are based on the principles of natural selection by C. Darwin and were proposed relatively recently - in 1975 by John Holland. They use both an analog of the mechanism of genetic inheritance and an analog of natural selection. At the same time, biological terminology in a simplified form and the basic concepts of linear algebra are preserved

Formally, a genetic algorithm is an algorithm that allows you to find a satisfactory solution to canally insoluble problems through the consistent selection and combination of the desired parameters using mechanisms resembling biological evolution [1].

Genetic algorithms are used to solve the following problems:

- Extreme tasks (finding the minimum and minimum points).
- Shortest path challenges.
- Layout tasks.
- Schedule.
- Approximation of functions.
- Selection (filtering) of input data.
- Set up an artificial neural network.
- Simulation of artificial life.
- Bioinformatics (coagulation of proteins and RNA).
- Game strategies.
- Non-linear filtering.
- Developing agents / machines.

Genetic algorithms are stochastic heuristic optimization methods, the main idea of which is taken from the theory of the evolutionary development of species. The main mechanism of evolution is natural selection, the essence of which is that more adapted individuals are more likely to survive and reproduce and, therefore, bring more offspring than less adapted individuals. Moreover, due to the transfer of genetic information, descendants inherit their main qualities from their parents. Carriers of genetic information of an individual are DNA molecules. When animals multiply, two parent germ cells merge. Their DNA interacts to form descendant DNA. The main way of interaction is crossing over. When crossing over, the DNA of ancestors is divided into two parts, and then exchange their halves. With inheritance, mutations are possible due to radioactivity or other influences, as a result of which some genes in the germ cells of one of the parents can change. Altered genes are transmitted to the descendant and give him new properties. If these new properties are useful, they are likely to remain in this form and at the same time there will be an abrupt increase in the fitness of the species [2].

The first step in developing a mathematical model based on a genetic algorithm is to develop the chromosome structure in which the solution will be stored. The selected structure should take into account all the features and limitations imposed on the desired solution, as well as the fact that the implementation of crossing-over and mutation algorithms directly depends on its choice. Ultimately, the choice of chromosome affects not only the speed, but also the convergence of the algorithm in general.The structure of the chromosome is convenient in that already at the stage of setting the initial data, obviously unsuccessful decisions can be eliminated by blocking the corresponding cells.

At the next step of the algorithm, an initial population is created, the size of which depends on the dimension of the problem and usually amounts to several hundred solutions.

To organize the optimizing process, it is necessary to create a guiding force for the development of the population. The requirement to minimize the objective function or, in terms of genetic algorithms of fitness function, acts as such strength. Usually, an additive optimality indicator is used as it, based on the fines set by each decision for any inconvenient one. The advantage of this choice is the ability to customize the algorithm for a specific task by varying the coefficients and thereby changing priorities when searching for the optimal solution.

Thus, placing the initial population in the artificial environment that we created and implementing the selection, crossing-over, and mutation processes, we obtain an iterative algorithm for finding the optimal solution, at each iteration the following actions are performed:

1. Each individual in the population is evaluated using the fitness function.
2. The best decisions are copied to the new population without change. This principle (the principle of elitism) prevents the loss of the best decisions and provides increased convergence of the algorithm.
3. Based on proportional selection from the current population, two solutions are selected that undergo recombination. For this, the chromosomes of the parents exchange corresponding sites.
4. If a new population is formed, then the old one is removed, and then go to step 1. Otherwise, go to step 3.

The main parameters of GA are:

• probability of mutation;
• accuracy of the result;
• the number of iterations of the algorithm or the number of generations;
• population size.

The genetic algorithm works according to the following scheme:

1. First of all, in this algorithm for organizing the beginning of the account, an arbitrary initial family is created.
2. Next, the algorithm produces a certain sequence of new families or generations. At each individual step, the algorithm uses certain individuals from the current generation to create the next generation. When forming a new generation, the following actions are carried out in the

algorithm:

• Each member of the current family is flagged by calculating the appropriate fitness value.

• The obtained series of values of the fitness function is scaled, which allows constructing a range of values more convenient for subsequent use.

• Parent values are selected based on their suitability values.

• Some individuals from the parental generation have lower values of the fitness function and which are further selected as elite values. These elite values are passed on to the next generation.

• Child values are formed either by some random changes of a single parent - a mutation or by a combination of vector components of a certain pair of parents - a crossover.

• Replacing the current family with a subsidiary in order to form the next generation.

3.The algorithm is stopped when any stopping criterion is satisfied.

In the electric power industry, genetic algorithms are capable of solving narrow but extremely important optimization problems, for example, the problems of improving the quality of electricity and lowering the cost of its production [4].

The main objects of study are indicators such as voltage deviation, coefficients of harmonic components and voltage asymmetries in the reverse and non-zero sequence.

The basic classical genetic algorithm (also called elementary or simple genetic algorithm) consists of the following steps (Fig. 1):

1) initialization, or selection of the initial population
chromosomes;
2) assessment of the fitness of chromosomes in a population;
3) checking the stopping condition of the algorithm;
4) selection of chromosomes;
5) the use of genetic operators;
6) the formation of a new population;
7) the choice of the "best" chromosome

You can imagine the task as a combination of several functions (costs, capital investments, damage from low quality of electricity), shown in Fig. 2. At the intersection of the three function graphs, the optimal solution to the problem is found, which can be found using a canonical or other GA.

The considered algorithm is not only resistant to local minima, but also due to internal parallelism, expressed in work not with individual solutions, but with entire classes of solutions, provides a relatively quick search for the optimal solution. Research methods basically use an iterative technique to improve results. During one iteration, they look for a solution, the best in the vicinity of the given. If such a solution is found, it becomes current and a new iteration begins. This continues until the increase in the objective function decreases to almost zero or the specified number of iterations is completed. Obviously, such methods are focused on the search for only local optima, and the position of the found optimum depends on the starting point. The global optimum can only be found by chance. To increase the likelihood of finding a global optimum, a multiple experiment with different starting points is used, which significantly increases the search time. [4]

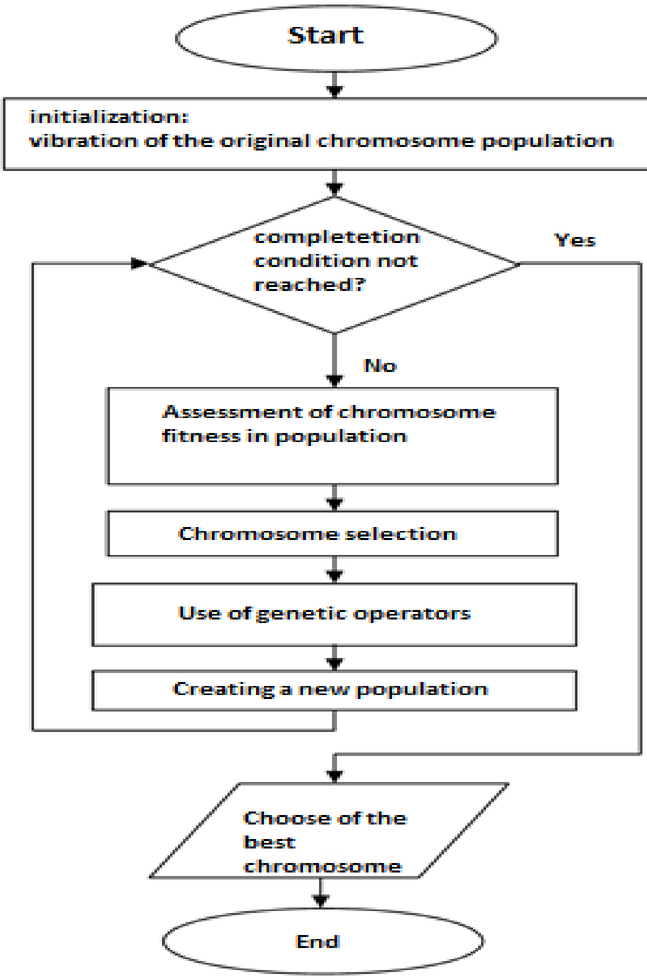

Fig. 1. Block diagram of the genetic algorithm

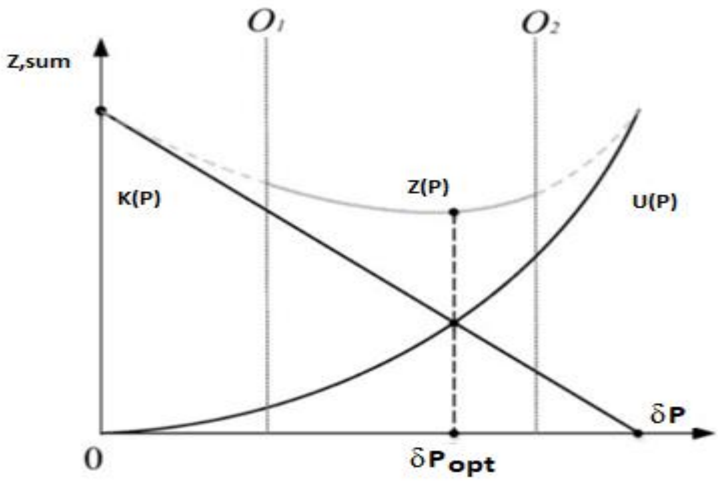

Fig. 2. The nature of changes in cost components in the management of electricity quality
Z (P) - total costs; δPopt - the optimal level of deviations of the quality indicators of electricity; O - technical limitations; O1 - technical capabilities to improve energy quality; O2 - technically permissible level of electromagnetic interference.

Thus, it is of interest to develop algorithms that preserve the advantages of the described methods and are free from this drawback. Such algorithms include genetic algorithms. Genetic algorithms are a universal method for optimizing multi-parameter functions, which allows us to solve a wide range of problems. Genetic algorithms have many modifications and are highly dependent on parameters. Often, a small change in one of them can lead to an unexpected improvement in the result. It should be remembered that the use of GA is useful only in those cases when there is no suitable special algorithm for solving this problem.

References

1. Emilyanov V.V., Kureychik V.M. Teoriya I praktika evolyusionnogo modelirovaniya. - M: Fizmatlit, 2013. – s. 432.
2. Gladkov L.A., Kureychik V.V., Kureychik V.M. Geneticheskiye algoritmi: Uchebnoye posobiye. - 2-e izd. - M: Fiznatlit, 2006. - s. 320.
3. Darrel Whitley "A Genetic Algorithm Tutorial", 2016.-256 p.
4. Tsoy Yu.R., Spistin V.G. Geneticheskiy algoritm/Spisin V.G., Tsoy Yu.R. Predstavleniye znaniy v informatsionnix sistemax: uchebnoe posobie. -Tomsk: Izd-vo TPU, 2016. -146 s.
5. Gayibov T.Sh., Pulatov B.M., Qayumov J.A. Minimization of Losses in Distributed Power Networks by Genetic Algorithms.- International Journal of Advanced Research in Science, Engineering and Technology.-Vol. 6, Issue 2, February 2019.- pp. 8037-8039.
6. Deb K., Multi-Objective Optimization Using Evolutionary Algorithms, John Wiley & Sons
7. AbdellahLaoufi , Collective Intelligence for Optimal Power Flow Solution Using Ant Colony Optimization, Leonardo Electronic Journal of Practices and Technologies, p.88-105,2008.
8. Gayibov T.Sh. Effektivniy algoritm optimizasii rejimov energosistem // Sbornik statey mejdunarodnoy nauchnoy konferensii «Innovasiya-2002». – Tashkent, 2002. – S. 90-91.
9. Rana S.B., Whitley L.D., Bit representations with a twist. – Proc. 7th International Conference of Genetic Algorithms, 1997.
10. Ruderich R., Fuel Cell Principles. Lecture notes. University of Applied Sciences, Ulm, Germany. 2003.
11. Sopov E.A. Probabilistic genetic programming design // Actual problems of informatics and intelligent techniques. - Tambov, 2004. - P. 98 – 99.
12. Larmine J., Dicks A. Fuel Cell Systems Explained, Second Edition. – John Wiley & Sons, Ltd, 2003.
13. Ruban A.I. Metodi optimizasii: Uchebnoe posobie. Izd. 2-oe. Krasnoyarsk NII IPU, 2001. 528 s.
14. Bartolomey P.I., Panikovskaya T.A. Optimizasiya rejomov energosistem: Uchebnoe posobie / Ekaterinburg: UGTU – UPI, 2008. - 164 s.
15. Makoklyuyev B.I. Analiz I planirovaniye elektropotrebleniya. – M.: Energoatomizdat, 2008. - 296 s.
16. Filippova T.A. i dr. Optimizasiya rejimov elektrostansiy i energosistem: Uchebnik; – Novosib. gos. texn. un-t. - Novosibirsk, 2007. - 356 s.
17. Suxanov O.A., Sharov Yu.V. Ierarxicheskiye modeli v analize i upravlenii rejimami elektroenergeticheskix system.– M.: Izdatelskiy dom MEI, 2007. – 312 s.
18. Likin A.V. Elektricheskie sistemi i seti: Ucheb. posobiye. – M.: Universitetskaya kniga; Logos, 2006. – 254 s.

19. Kochura A.V. Geneticheskiye algoritmi v MatLAB: metodicheskiye ukazaniya. – Kursk: Avtorskaya redaksiya, 2010. – 19 s
20. Whitley D.L. Genetic Algorithms and Evolutionary Computing. Van Nostrand's Scientific Encyclopedia 2002..