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The study of reducing the cost of investment in wind energy based on the cat swarm optimization with high reliability

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ABSTRACT

Wind and solar are the most important source of renewable energy for power supply in remote locations involves serious consideration of the reliability of these unconventional energy sources. We apply the cat swarm meta-heuristic optimization method to solve the problem of wind power system design optimization. The electrical power components of the system are characterized by their cost, capacity and reliability. This study seeks to optimize the design of parallel power systems in which multiple choices of generators wind, transformers and lines. Our plan has the advantage of allowing electrical components with different parameters to be customized in electrical power systems. The UMGF method is applied to allow rapid reliability estimation. A computer program is developed for the UMGF application and CS algorithm. An example is provided to explain.

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1. INTRODUCTION

After accidents of nuclear power reactors to produce electricity, many countries are interested in generating wind. The aim of this study is to reduce investment cost subject to reliability constraints. It has been addressed in a number of studies, e.g. [1, 2]. When applied to power systems reliability is considered a measure of the ability of the system to meet the load demand [3-5]. The problem is to achieve the maximum system reliability. We apply the cat swarm method and Ushakov technique to slove the problem of cost and reliability of exemple [6, 7].

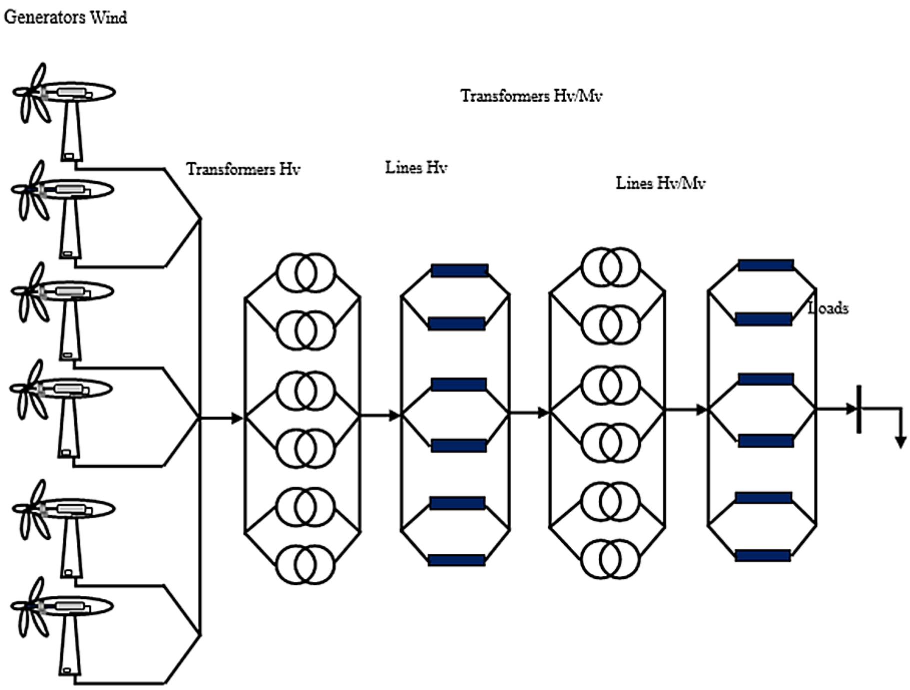
2. PROBLEMFORMULATION

The Figure 1 represented the production of electrical energy by wind. The exemple characterized by performance and cost [8-10]. We use the cat swarm meta-heuristicoptimization method to solve the wind power system problem. The cost of total system can be finding as (1).

$$C = \sum_{i=1}^{n} \sum_{v=1}^{V_i} k_{iv}\, C_{iv} \quad (1)$$

In this study the Ushakov technique introduced in [11-14]. The function is (2).

$$u(z) = \sum_{\mathrm{j}=1}^{J} p_j z^{x_j} \tag{2}$$



Figue 1. Wind power system constructed

3. THE CAT SWARM ALGORITHM

The optimization methods inspired by the nature as ants, birds, bees..., the results for those techniques encouraged researchers for a steady intensification and extension for the field of swarm intelligence and metaheuristics [15, 16]. The history of metaheuristics and swarm intelligence is very much intertwined [17-23]. The problem formulated in this paper is a new meta-method that adapts to the method of optimization from the cat swarm search algorithm to solving a specific problem. Optimization is prevalent in almost all field of science and engineering. In recent years several optimization methods are proposed and used such as swarm optimization algorithm (CSO), Chu et al. [24, 25].

4. THE GSA PRINCIPLE

The cat swarm meta-heuristicoptimization method is derived from cat movements in prey hunting. The method depends on mutation the cats into seeking or tracing modes. A basic flowchart of the CSO algorithm and how it works is shown in Figure 2.

5. STDY EXAMPLE

The system study is designed with: Generated from the wind units, HT transformers lines HT, transformers HT/MT, lines MT. We reserve information in UMGF computer program and CS algorithm to find solutions. The cumulative load levels shown in Table 1.

Table 1 Parameter of cumulative load

Load (MW)	Duration (h)
30	830
20	1520
15	5680
8	750

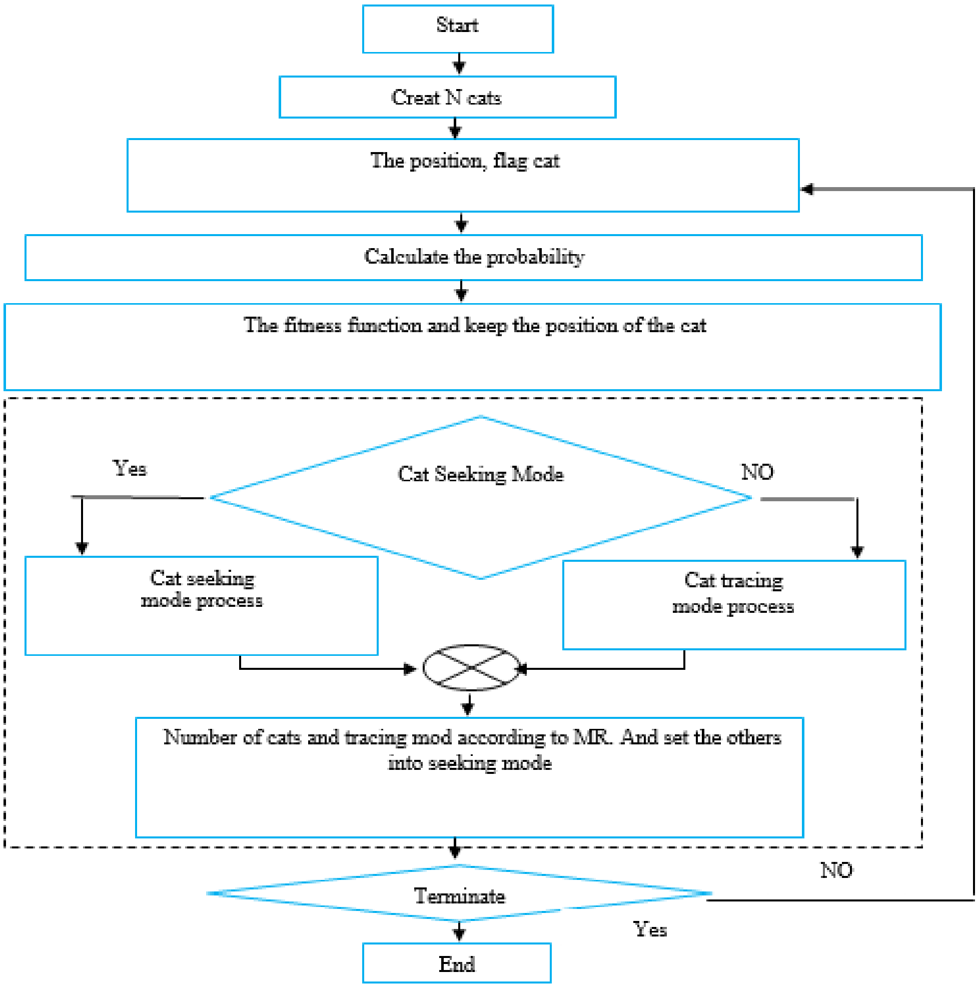


Figure 2. Diagram CSO

6. RESULTS AND DISCUSSION

In this section, the results obtained by algorithm are: The Optimal solution Capacity and reliability of power unites shown in Figure 3. The Optimal solution Capacity and reliability of HT Transformers shown in Figure 4. The Optimal solution Capacity and reliability of HT/MT lines shown in Figure 5. The Optimal solution Capacity and reliability of MT Transformers shown in Figure 6. The Optimal solution Capacity and reliability of MT Lines shown in Figure 7. The best and the optimal availability is 0.998 for load of 30 Mw and cost constraint equal to 81 mln $.

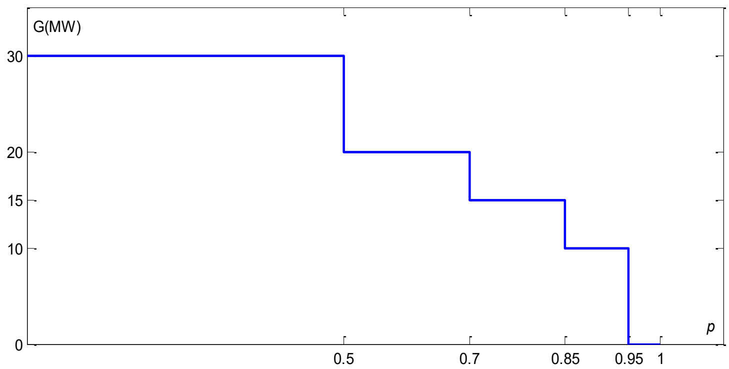


Figure 3.Capacity and reliability of power unites

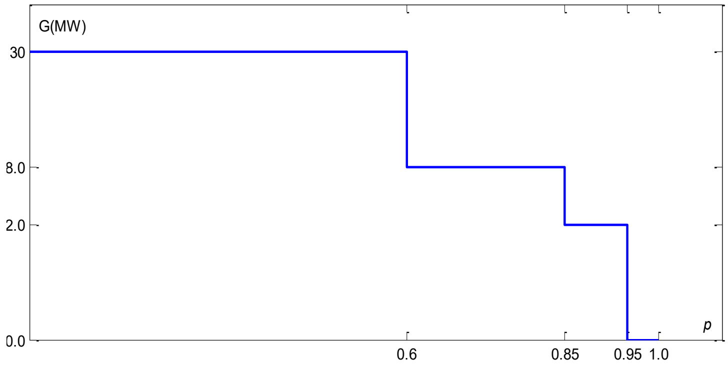


Figure 4. Capacity and reliability of HT transformers

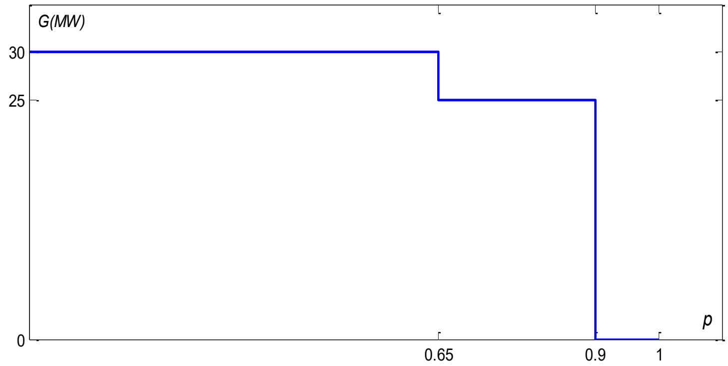


Figure 5. Capacity and reliability of HT/MT lines

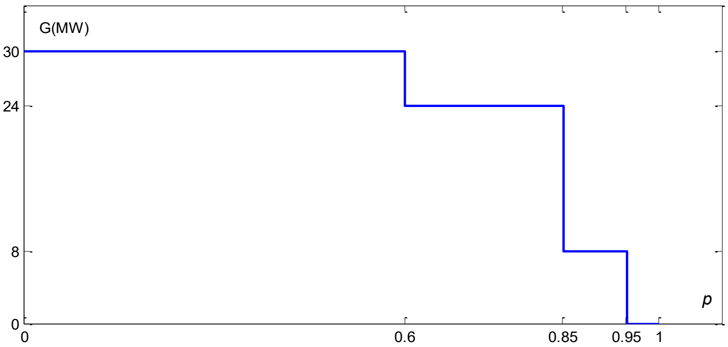


Figure 6. Capacity and reliability of MT transformers

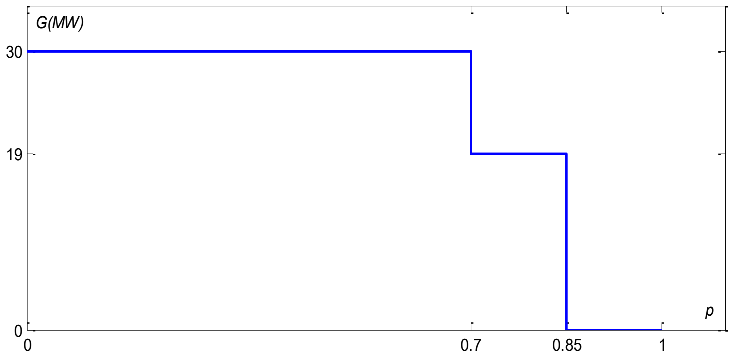


Figure 7. Capacity and reliability of MT lines

7. CONCLUSION

The method used in this research consists of a mixture of UMGF and cat swarm meta-heuristic optimization functionality. In this paper shows the relationship between cost and system availability. The realization of the algorithm by my computer Intel i7 and the running time for each optimization case did not exceed 1 mn. In future works, compared the results with other methods.

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