

# Research on New Energy Establishment of Power Generation and Structure Model

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**Abstract**—Traditional power supply system with the method of centralized power generation, and then use electricity transmission network transmit electricity to the user. Research model is the basis of the research on the subsequent issue, how to set up a valid practical problems but not entirely confined to the actual problem and has good adaptability model is valuable to determine whether the results of one of the key. the model is based on the Washington university school of electrical IEEE 30 "power structure as the foundation. New energy in power generation system generally includes wind power, photovoltaic power station and key components such as energy storage power station. This paper will design a reasonable system structure, using universal transmission line structure simplifies the structure of the power supply system; comparative analysis of advantages and disadvantages of various optimization algorithms. The final choice of primal dual optimization algorithm as optimizing kernel algorithm.

**Keywords**-New Energy; Power Generation; Power Structure; Model

## I. INTRODUCTION

Power is the basis of the continuous development of modern science and technology, is the important guarantee of improving human life quality, is the lifeblood of the national economy and security. Traditional power supply system with the method of centralized power generation, and then use electricity transmission network transmit electricity to the user. Electric power development has experienced two important milestones: first, in 1882, Edison in the United States New York Pearl Street Station built the world's first direct current generator driven by a steam engine send electricity system formed by dc, marks the beginning of the era of power; Second, Germany in 1891 established the first by the ac generator power generation, and then through the length of 179 km, the voltage level of 12kv transmission lines transmit power transmission system, a symbol of the modern ac supply system the establishment of the basic patterns[1].

For distributed at home and abroad research achievements of new energy power generation, but those results are mainly limited in the study of unilaterally. For example research power prediction only consider forecasting precision and no effect on the capacity of energy storage device; The energy storage device only consider how to select energy storage device and no late combined with

energy storage devices in the network behavior[2-5]. In addition, the new energy research hotspot focused on its implementation in form, such as the topology of the inverter, harmonic elimination circuit design and the energy of fine management, etc[6-8]. In this paper, design a reasonable system structure, load fluctuation curve and new energy power generation curve, select reasonable optimization algorithm.

## II. SYSTEM NETWORK STRUCTURE

In this paper, we study the model is based on the Washington university school of electrical IEEE 30 "power structure as the foundation, its topology structure as shown in Fig .1. Node 1 is the fossil fuel power generation, its power can be in the upper limit of power generation and power between the lower volatility, on behalf of peaking power plants or rotating standby unit in the system; Node 2 for fossil fuel power generation, its capacity is constant value, represent a base load power generation part of the system; Node 5 for wind power, the electricity changing with wind size; Node for solar power generation, power change with sunlight irradiation intensity; Node 7 for wave load node, the electricity demand changes over time, on behalf of the dynamic load in the system; The rest of the node demand of electricity is constant value, represent a base load part of the system. At the same time, in order to simulate energy storage power station in the system influence and power characteristics, node 5 and 8 respectively is configured with a certain amount of energy storage device[9]. This paper used load data as shown in table 1.

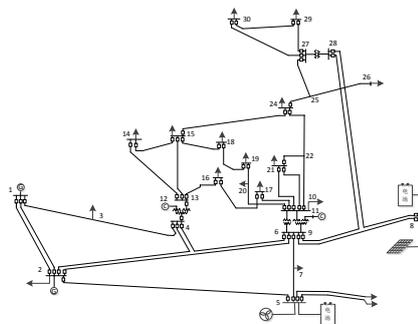


Figure 1. System network topology

TABLE I. NODE LOADS

Node	Load capacity	Node	Load capacity	Node	Load capacity
1	0	11	0	21	17.5
2	21.7	12	11.2	22	0
3	2.4	13	0	23	3.2
4	7.6	14	6.2	24	8.7
5	94.2	15	8.2	25	0
6	0	16	3.5	26	3.5
7	Change	17	9	27	0
8	30	18	3.2	28	0
9	0	19	9.5	29	2.4
10	5.8	20	2.2	30	10.6

Universal model contains  $\pi$  type structure of transmission line, the series impedance for  $Z_s = r_s + jx_s$ ; A parallel structure of capacitive reactance, the capacitive reactance to  $b_c$ ; An ideal phase shifting transformer, the impedance of 0, only phase shift effect, there is no loss of energy. Ideal phase shift change than the value of  $\tau$ , phase-shifting Angle for  $\theta_{shift}$ . The structure schematic is shown in Fig. 2.

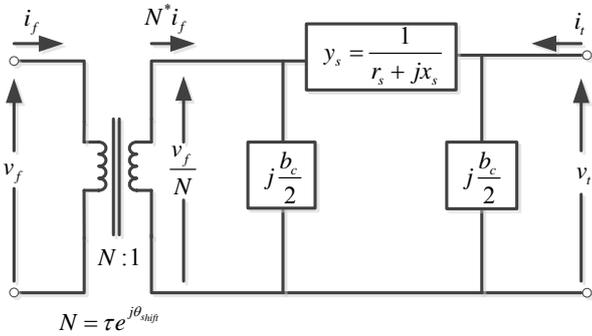


Figure 2. The general model of transmission lines, transformers and phase shifter

In the form of  $i_f$  plural beginning injection current injection current and end  $i_t$ , each variable in the model of solving solution can be obtained using the method of node voltage, the computational expressions can be represented with two order matrix. (1) is for the node admittance matrix, pattern of (2) for the use of the node voltage method to solve the related variables used in the process of equations.

$$Y_{br} = \begin{pmatrix} \left( y_s + j \frac{b_c}{2} \right) \frac{1}{\tau^2} & -y_s \frac{1}{\tau e^{j\theta_{shift}}} \\ -y_s \frac{1}{\tau e^{j\theta_{shift}}} & y_s + j \frac{b_c}{2} \end{pmatrix} \quad (1)$$

$$\begin{pmatrix} i_f \\ i_t \end{pmatrix} = Y_{br} \begin{pmatrix} v_f \\ v_t \end{pmatrix} \quad (2)$$

### III. LOAD FLUCTUATION LOAD CURVE DESIGN

Electric power system in the network users demand for energy is to change all the time, to simulate new energy access to the system after the actual electric network, need to join a dynamic load in the electric network[10]. In the power system load change is conform to certain rules, although it will not be conflict with the actual physical meaning, for example, generally do not appear, such as large pulse load fluctuation trend, but also exist obvious relevant features, such as lamp of peaks and troughs. In order to ensure that the dynamic load curve and actual basic consistent, the design of load curve should contain peaks and troughs and the main characteristics of curve error. This paper adopts the design principle such as shown in (3).

$$f_{load\_v}(t) = g(t, \delta_{peak}, \delta_{valley}, P_{fixed\_mean}, P_{v\_mean}, \delta_{vibration}, per) \quad (3)$$

Type 2.4 and type 2.5 calculation principle for the design process.

$$per = \frac{\delta_{peak/valley}}{P_{fixed\_mean} + P_{v\_mean}} \times 100 \quad (4)$$

$$\delta_{peak} = \frac{per \cdot P_{fixed\_mean} + per \cdot P_{v\_mean}}{100} \quad (5)$$

In order to simplify the analysis, this paper USES the sine wave function to simulate the dynamic load curve, set curve peaks and troughs of volatility percentage is 30%. By (6) shows the average of the sine function, the function of peak and average difference model for, average value and function in the valley of the differential mode for. The above value generation in (4) easy solution for type is shown in (7).

$$f(t) = A \sin(t - T) + A \quad (6)$$

$$A = \frac{per \cdot P_{fixed\_mean}}{100 - per} \quad (7)$$

The parameter values of the dynamic load fluctuation data as shown in table 2.

TABLE II. DYNAMIC LOAD CURVE DATA

Time Point	Amount of volatility	Time Point	Amount of volatility	Time Point	Amount of volatility
1	0.665355	21	192.8479	50	170.8582
2	2.65413	22	202.7278	51	158.9895
3	5.944536	23	211.7174	52	146.7095
4	10.50052	24	219.718	53	134.1529
5	16.27217	25	226.6421	54	121.4571
6	23.19625	26	232.4138	55	108.7614
7	31.1969	27	236.9698	56	96.20478
8	40.18645	28	240.2602	57	83.92482
9	50.06643	29	242.2489	58	72.05607
10	60.72857	30	242.9143	59	60.72857
11	72.05607	31	242.2489	60	50.06643
12	83.92482	32	240.2602	61	40.18645
13	96.20478	33	236.9698	62	31.1969
14	108.7614	34	232.4138	63	23.19625
15	121.4571	35	226.6421	64	16.27217
16	134.1529	36	219.718	65	10.50052
17	146.7095	37	211.7174	66	5.944536
18	158.9895	38	202.7278	67	2.65413
19	170.8582	39	192.8479	68	0.665355
20	182.1857	40	182.1857	69	0

TABLE III. WIND POWER GENERATION INITIAL CURVE

Time Point	Maximum capacity	Time Point	Maximum capacity	Time Point	Maximum capacity
1	322.998574	21	66.755234	41	96.0747631
2	320.346874	22	53.5819349	42	111.899762
3	315.959667	23	41.5958608	43	128.273044
4	309.885019	24	30.9283336	44	145.015219
5	302.189485	25	21.6962289	45	161.942857
6	292.957381	26	14.0006956	46	178.870495
7	282.289853	27	7.92604759	47	195.61267
8	270.303779	28	3.53883997	48	211.985952
9	257.13048	29	0.88713992	49	227.810951
10	242.914286	30	0	50	242.914286
11	227.810951	31	0.88713992	51	257.13048
12	211.985952	32	3.53883997	52	270.303779
13	195.61267	33	7.92604759	53	282.289853
14	178.870495	34	14.0006956	54	292.957381
15	161.942857	35	21.6962289	55	302.189485
16	145.015219	36	30.9283336	56	309.885019
17	128.273044	37	41.5958608	57	315.959667
18	111.899762	38	53.5819349	58	320.346874
19	96.0747631	39	66.755234	59	322.998574
20	80.9714286	40	80.9714286	60	323.885714

TABLE IV. PV POWER GENERATION INITIAL CURVE

Time Point	Maximum capacity	Time Point	Maximum capacity	Time Point	Maximum capacity
1	0	21	192.8479	41	170.85821
2	0	22	202.7278	42	158.98946
3	0	23	211.7174	43	146.7095
4	0	24	219.718	44	134.15287
5	0	25	226.6421	45	121.45714
6	0	26	232.4138	46	0
7	0	27	236.9698	47	0
8	0	28	240.2602	48	0
9	0	29	242.2489	49	0
10	0	30	242.9143	50	0
11	0	31	242.2489	51	0
12	0	32	240.2602	52	0
13	0	33	236.9698	53	0
14	0	34	232.4138	54	0
15	0	35	226.6421	55	0
16	134.152871	36	219.718	56	0
17	146.709503	37	211.7174	57	0
18	158.989464	38	202.7278	58	0
19	170.858213	39	192.8479	59	0
20	182.185714	40	182.1857	60	0

New energy curve design including wind power and photovoltaic power generation curve. Also adopt the method of summary on the related data for the reasonable design of curve, the difference is need combined with the actual situation to modify the related curve. Photovoltaic power generation of night, for example, should be revised to 0, wind power output volatility and volatility of photovoltaic power output is not the same, and so on. This paper set up the initial volatility of photovoltaic power generation was 10%, the average for the system as a whole load of 0.3 times; Wind power fluctuation was 20%, the average for the whole load of 0.4 times. Need of special note is, there is only an initial curve, the design of the curve is not the end of the simulation curve, the related parameters can combines the actual conditions of the specific problems in the application or the emphasis of the research problem appropriately modified. New energy power generation of the initial curve output data as shown in table 3 and 4, the graph to Fig .3.

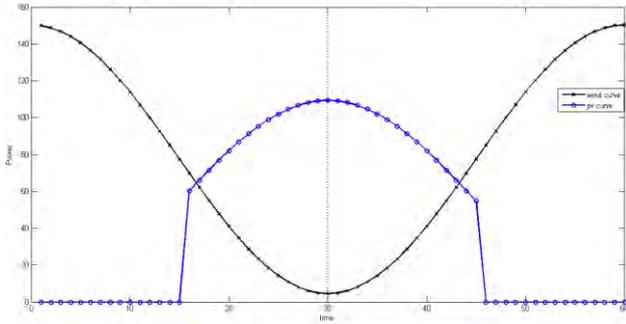


Figure 3. The initial generation power curve of new energy power

#### IV. THE SELECTION OF OPTIMIZATION ALGORITHM

New energy grid runtime through some optimization algorithm controls the size of the capacity of the new energy power generation access networks, so as to make the new energy power generation in power supply system to achieve a best balance between the stability of the economy and safety. Looking for system optimal equilibrium is the essential connotation of the system of optimal power flow. The concept of optimal power flow first put forward by John casteen pentier French engineer in the early 1960 s, its core content is in the guarantee system of various constraint conditions under the condition of established, many of the variables in the control system by some means value target of the system to achieve the desired minimum or maximum. As a result of the optimal power flow including content is numerous, widely involved economic optimal control and scheduling of the system operation safety, power grid planning, etc; Optimal power flow, therefore, have been proposed since got rapid development, many excellent algorithms have been proposed.

The original dual method belongs to an important branch of interior-point method, it has strong practicability and appealing. The basis of the algorithm framework is established by a Meiddo, Monterior and others, then promotion by Kojima, etc to the complementary problem. The original-dual algorithm can easily be applied to nonlinear convex programming, nonlinear complementarity, variational inequality, semidefinite optimization and second-order cone optimization problems such as field, has a similar approach in the best polynomial complex boundaries. This article will adopt this kind of method, which is the core of the system optimization research method, algorithm detailed steps as follows:

extreme-value proposition of the objective function, set up the constraints in the problem domain;

$$\begin{aligned} & \min f(X) \\ \text{s.t.} \quad & G(X) = 0 \\ & H(X) \leq 0 \end{aligned} \quad (8)$$

The inequality constraints of constraints into equality constraints, and modify the objective function. The core idea of this step is to put into Lagrange extremum problem with

constraint condition equation form optimization inequality forms of extreme value problem.

$$\begin{aligned} & \min \left[ f(X) - \gamma \sum_{m=1}^n \ln(Z_m) \right] \\ & G(X) = 0 \\ & H(X) + Z = 0 \\ & Z > 0 \end{aligned} \quad (9)$$

First optimality conditions. Appropriate transformation of the partial differential equations in (9), and obtain the equations of first-order optimality conditions for 0.

$$F(X, Z, \lambda, \mu) = \begin{bmatrix} f_x^T + G_x^T \lambda + H_x^T \mu \\ [\mu]Z - \gamma e \\ G(X) \\ H(X) + Z \end{bmatrix} = 0 \quad (10)$$

#### V. CONCLUSION

This paper introduces the design of new energy power supply structure based onstructure of IEEE30 power supply network, according to the inherent characteristics of PV and wind power generation simulation curve design of photovoltaic power generation, wind power generation simulation curve andsimulated load curve; using universal transmission line structure simplifies the structure of the power supply system; comparative analysis of advantages and disadvantages of various optimization algorithms. The final choice of primal dualoptimization algorithm as optimizing kernel algorithm.

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