ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 2, Issue 2, February 2014

Optimal Reactive Power Planning And Real Power Loss Minimization Using Cuckoo Search Algorithm

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Abstract: Reactive Power planning for the meeting the future demand is necessary for ensuring voltage stability of power systems. New reactive power sources may be installed or VAr output from existing sources may be optimized in reactive power planning. In this work, a new reactive power planning scheme is suggested by optimizing the real power loss and reactive power generation from SVCs in a system. Real power loss minimization results in optimized reactive power flow in the system. This work aims for reactive power planning by optimal reactive power flow and reactive power generation. For optimizing the reactive power, a new nature inspired cuckoo search algorithm (CS) is exploited. The proposed algorithm has less number of parameters and has good convergence quality. The suggested method is tested on the standard IEEE-30 bus system and the results are quite encouraging.

Keywords: Reactive power planning, optimal reactive power flow, Cuckoo search algorithm, Real power loss minimization

NOMENCLATURE

Reactive power planning problem:

$N_L = No\ of\ lines\ in\ the\ system$

$N_B = No\ of\ buses\ in\ the\ system$

$N_{SVC} = No\ of\ SVCs\ in\ the\ system$

$N_T = No\ of\ tap\ position\ in\ the\ system$

$G_K = Condutance\ of\ the\ line\ in\ state\ k$

$Q_K = Reactive\ power\ of\ the\ line\ in\ state\ k$

$P_L = Real\ power\ loss$

$Q_{tot} = Total\ reactive\ power$

$P_{Gi} = Real\ power\ generation \quad for\ i = 1,2, \dots \dots N$

$Q_{Gi} = Reactive\ power\ generation \quad for\ i = 1,2, \dots \dots N$

$P_{Di} = Real\ power\ demand \quad for\ i = 1,2, \dots \dots N$

$Q_{Di} = Reactive\ power\ demand \quad for\ i = 1,2, \dots \dots N$

$V_i, V_j = Sending\ end\ and\ receiving\ end\ voltages$

$\delta_i, \delta_j = Phase\ angles$

$S_i = Transmission\ line\ flow\ limit\ for\ i = 1,2, \dots N$

$T_{pi} = Tap\ position\ for\ i = 1,2, \dots \dots N$

$\blacksquare^{min} = minimum\ value\ of\ a\ quantity$

$\blacksquare^{max} = maximum\ value\ of\ a\ quantity$

I. INTRODUCTION

Power system which operates with a large network of electrical components. In this the reactive power plays a very critical role in power flows of the system and this reactive power flow is a very changeling one for the experts working with the reactive power. Today most of the loads we are using is inductive loads and this can consume large amount of currents at the system condition is over loaded. This over drawn of current from the system in cause the increase in the reactive power flow. Actually the excess reactive power can cause damage to the system and power flow will be reduced. This can also be happen with the low reactive power flow. So to maintain the power system operation as a reactive and the system can operate with a maintained reactive power.

Power networks are becoming increasingly stressed suitable to several reasons, for instance, the high cost of upgrading transmission lines, the difficulty of acquire right of way, and the shift in generation patterns related with economic and environmental concerns. The increased loading of transmission networks has incited power utilities to consider guarding against voltage instability as an additional requirement in the reactive power planning problem. Therefore, the coordinated VAr planning design preserve be defined as determining the minimum reactive compensation plant expansion that satisfies requirements on the voltage profile and voltage stability in multiple operating conditions. This creates an extraordinarily large nonlinear optimization problem since the AC network representation would have to be accounted for twice in each of the operating conditions. The Penalty successive conic programming used to sustain system voltage profile and voltage stability in reactive power operating conditions [1].

The MILP (Mixed Integer Linear Programming) are developing to maintain reactive power in power system [2]. The reviews of reactive power planning are considered to Optimal Power Flow (OPF), Security Constrained OPF (SCOPF) and SCOPF in voltage stability [3]. The reactive power is present to dynamic security constrained optimal power flow in voltage stability constraints [4]. The optimal power flow for voltage stability constrained Var planning and voltage stability [5]. The optimization technique

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Vol. 2, Issue 2, February 2014

approach can be combined in non linear programming for probabilistic and adaptive entry techniques [6]. Bender's decomposition employing a three-stage hierarchical advance has been also extensive to provide for voltage profile and stability constraint [9]. The reactive power technique to facilitate handles integer variables is a hybrid SLP genetic algorithm [10].
The result in these entire progressive and uncontrollable declines in voltage is that the system unable to provide the reactive power required supplying the reactive power demands[11]-[25].

II. REACTIVE POWER PLANNING

The reactive power planning problem refers to the resolution for the future locations, types, sizes and times of installations of reactive power sources like capacitors which guarantee a satisfactory system operation, particularly, passable voltage levels throughout the system at a minimum cost. The reductions of the transmission losses as well as the consideration of the system security and capability are other aspects that may also be included in the statement of the problem. Usually the planning problem is divided into operational and investment planning sub problems. In the operational planning problem, the accessible shunt reactive sources and transformer tap settings are optimally dispatched at minimal operation cost. In the investment planning problem, new reactive sources are optimally allocated over a planning horizon at a minimal total cost (operational and investment).

A. Objective function:
The objective function of this work is to find the optimal settings of reactive power control variables including the rating shunt of VAr compensating devices which minimizes the real power loss and voltage deviation. Hence, the objective function can be expressed as:

$$f = min\,(P_L + Q_{tot}) \quad (1)$$

The total real power of the system can be calculated as follows

$$P_L = \sum_{k=1}^{N_L} G_k[V_i^2 + V_j^2 - 2V_iV_j\cos(\delta_i - \delta_j)] \quad (2)$$

$$Q_{tot} = \sum_{k=1}^{N_{svc}} Q_k \quad (3)$$

Where , N_L is the total number of lines in the system; G_k is the conductance of the line 'k'; V_i and V_j are the magnitudes of the sending end and receiving end voltages of the line; δ_i and δ_j are angles of the end voltages.

B. Contingency constrained reactive power planning:
1. Constraints:
The minimization problem is subject to the following equality and inequality constraints
2. Equality Constraints:
Load Flow Constraints:

$$P_{Gi} - P_{Di} - \sum_{j=1}^{N_B} V_iV_{ij}Y_{ij}\cos(\delta_{ij} + \gamma_j - \gamma_i) = 0 \quad (4)$$

$$Q_{Gi} - Q_{Di} - \sum_{j=1}^{N_B} V_iV_{ij}Y_{ij}\sin(\delta_{ij} + \gamma_j - \gamma_i) = 0 \quad (5)$$

3. Inequality Constraints:
Reactive Power Generation Limit of SVCs:

$$Q_{ci}^{min} \le Q_{ci} \le Q_{ci}^{max}; i \in N_{SVC} \quad (6)$$

Voltage Constraints:

$$V_i^{min} \le V_i \le V_i^{max}; i \in N_B \quad (7)$$

Transmission line flow limit:

$$S_i \le S_i^{max}; i \in N_l \quad (8)$$

Tap position Constraints:

$$T_{pi}^{min} \le T_{pi} \le T_{pi}^{max}; i \in N_T \quad (9)$$

III. CUCKOO SEARCH ALGORITHM

A. Cuckoo Breeding Behavior**:**
Cuckoos are fascinating birds, not only because of the beautiful sounds they can make, but also since of their aggressive reproduction strategy. Quite a number of species engage the make necessary brood parasitism by laying their eggs in the nests of other host birds (often other species). There are three basic types of brood parasitism: intraspecific brood parasitism, cooperative breeding, and nest takeover. If a host bird discovers the eggs are not their own, they will either throw these alien eggs away or simply discard its nest and build a new nest elsewhere. Some cuckoo species have evolved in such a way that female parasitic cuckoos are regularly very specialized in the mimicry in colour and pattern of the eggs of a few chosen host species. This reduces the probability of their eggs being neglected and thus increases their reproductively.
In addition, the timing of egg-laying of some species is too amazing. Parasitic cuckoos regularly choose a nest where the host bird just laid its own eggs. In general, the cuckoo eggs hatch slightly previous than their host eggs. Once the first cuckoo chick is hatched, the first instinct action it will take is to evict the host eggs by blindly propelling the eggs out of the nest, which increases the cuckoo chick's share of food provided by its host bird. Studies also show that a cuckoo chick cans also mimic the call of host chicks to gain entrance to more feeding opportunity.

B. L´evy Flights:
On the other hand, various studies have shown that flight behavior of many animals and insects has established the typical characteristics of L´evy flights. A recent study by Reynolds and Frye shows that fruit flies or *Drosophila melanogaster*, discover their landscape using a series of straight flight paths punctuated by a sudden 90^o twist, leading to a L´evy-flight-style intermittent scale free search pattern. Studies on human behavior such as the Ju/'hoansi hunter-gatherer foraging patterns also show the typical characteristic of L´evy flights. Even light can be related to L´evy flights.

C. Cuckoo Search:
For effortlessness in describing our new Cuckoo Search, we now use the following three idealized rules [10]:
1) Each cuckoo lays one egg at a time, and dumps its egg in randomly chosen nest.
2) The best nests with high class of eggs will carry over to the next generations.
3) The number of available host nests is fixed, and the egg laid by a cuckoo is exposed by the host bird with a

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ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 2, Issue 2, February 2014

probability $p_a \in [0, 1]$. In this case, the host bird can either throw the egg away or abandon the nest, and build a completely new nest. For effortlessness, this last assumption can be approximated by the fraction p_a of the NP nests are replaced by new nests (with new random solutions).

For a maximization problem, the excellence or fitness of a solution can simply be proportional to the value of the objective function. Other forms of fitness can be defined in a similar way to the fitness function in genetic algorithms. For effortlessness, we can use the following simple representations that each egg in a nest represents a solution, and a cuckoo egg represent a new solution, the aim is to use the new and potentially better solutions (cuckoos) to replace a not-so-good solution in the nests. Of course, this algorithm can be extended to the more complicated case wherever each nest has multiple eggs representing a set of solutions. For this present work, we will use the simplest approach where each nest has only a single egg.

When generating new solutions $x^{(t+1)}$ for, say, a cuckoo *i*, a L´evy flight is performed

$$x_i^{t+1} = x_i^{t+1} + \propto \oplus L'evy(\lambda) \quad (10)$$

where $\alpha > 0$ is the step size which should be related to the scales of the problem of interests. In most cases, we can use $\alpha = 1$. The above equation (10) is essentially the stochastic equation for random walk. In general, a random walk is a Markov chain whose next status/location only depends on the current locality (the first term in the above equation) and the transition probability (the second term). The product $\oplus$ means entry wise multiplications. This entry wise product is similar to those used in PSO, but here the random walk via L´evy flight is more efficient in explore the search space as its step length is much longer in the long run.

The L´evy flight effectively provides a random walk while the random step length is drawn from a L´evy distribution

$$L'evy \sim u = t - \lambda, \quad (1 < \lambda \leq 3) \quad (11)$$

This has an infinite variance with an infinite mean. Here the steps effectively form a random walk process with a power law step-length distribution with a heavy tail. Some of the new solutions should be generated by L´evy walk around the best solution obtained so extreme, this will speed up the local search.

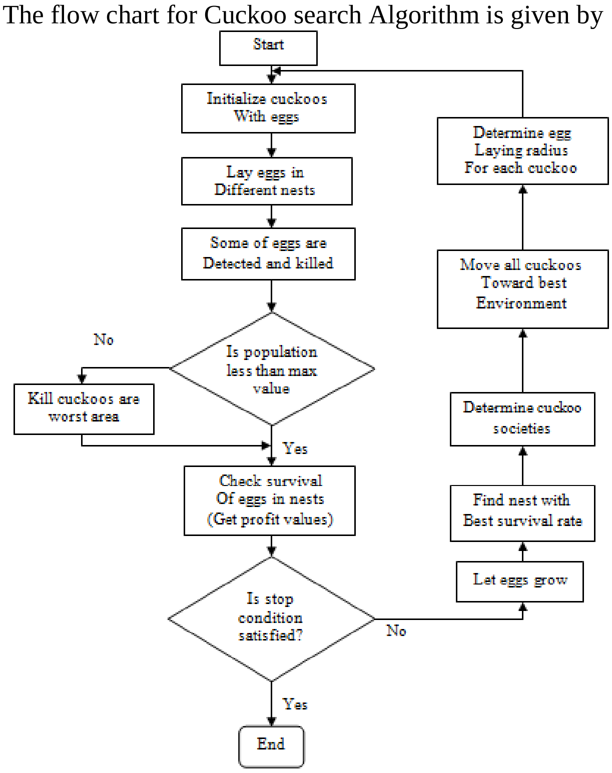
However, a substantial fraction of the new solutions should be generated by extreme field randomization and whose locations should be extreme enough from the current best solution, this will make sure the system will not be trapped in a local optimum From a quick look, it seems that there is some comparison between CS and hill-climbing in combination with some large scale randomization. But there are some significant differences. Firstly, CS is a population-based algorithm, in a way similar to GA and PSO, but it uses some sort of elitism and/or selection similar to that used in synchronization search. Secondly, the randomization is more efficient as the step length is heavy tailed, and any large step is feasible. Thirdly, the number of parameters to be tuned is less than GA and PSO, and thus it is potentially more generic to adjust to a wider class of optimization problems. In addition, each nest can represent a set of solutions; CS can thus be extended to the type of meta-population algorithm.

The Algorithm for Cuckoo Search Algorithm is given by

Step 1: Initialize the population number.

Step 2: Get a Cuckoo randomly through L’evy flights.

The flow chart for Cuckoo search Algorithm is given by



3.1 Flowchart for Cuckoo Search Algorithm

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 2, Issue 2, February 2014

Step 3: Fitness Evaluation (F_i).
Step 4: Choose a nest among 'n' nests randomly (F_j).
Step 5: Check if($F_i > F_j$), yes go to next Step or else go to step 7.
Step 6: Assume j as the best solution.
Step 7: Replace by the next solution.
Step 8: Abandon a division of worst nests and build a new one at new locations.
Step 9: Keep the best.
Step 10: Verify for the maximum condition and keep the recent best else go to step 1.

IV. SIMULATION RESULT

A. Optimal reactive power planning

The Cuckoo search algorithm tool was programmed in MATLAB 2010Ra running on a PC with Intel core i3 1.90 GHZ PC and 4 GB of RAM. The tool was tested in IEEE 30 BUS system.

```
BESTOBJ =

  110.8774

BESTSIZE =

    1.0624    1.0414    0.9935    1.0110    0.9582    1.0651    0.9437    0.9587
1.0442    0.9965    2.5824   12.1727

BESTLOC =

    1    2    5    8   11   13   11   12   15   36   10   24

BESTLOSS =

    9.6122

BESTTOTQ =

   14.7551
```

Fig 4.1 MATLAB output of ORPF

In the result the BESTOBJ which describes the best object of the System which is the best cuckoo, the best cuckoo gives the best solution of the system which is the Loss and corresponding total reactive power of the system. The size specifies the cuckoo in total population and this location (LOC) gives the nest location of that particular cuckoo corresponding to the size. The Loss shows the real power loss of the system and the total reactive power shows that the total reactive power demands for SVC.

B. Convergence curve

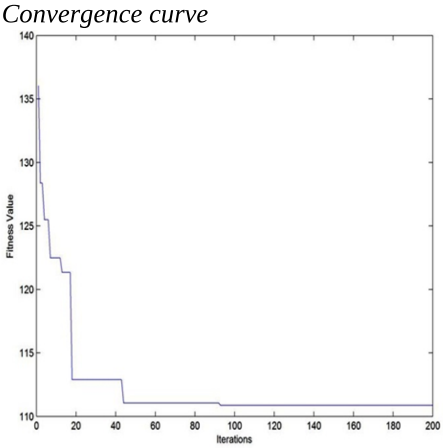


Fig 4.2 Fitness Values and Iterations

V. CONCLUSION

In this paper, recently developed cuckoo search algorithm is used to explain the problem of reactive power planning with the voltage constraints. The reactive power planning is completed during the adjustment of control variables similar to tap setting of transformer and adjustment of SVC and the reactive power planning is achieved through the real power loss minimization. The formulation of the problem was successfully performed to form the planning of reactive power for future use. The simulation result shows the robustness of the cuckoo search algorithm in solving the reactive power planning problem.

REFERENCES

[1] Rabih A. Jabr, *Senior Member, IEEE*, Nelson Martins, *Fellow, IEEE*, Bikash C. Pal, *Senior Member, IEEE*, and SamiKaraki "Contingency Constrained VAr Planning Using Penalty Successive Conic Programming" IEEE Trans on Power Syst, vol. 27, Feb 2012.
[2] Haifeng Liu, *Member, IEEE*, Licheng Jin, *Member, IEEE*, James D. McCalley, *Fellow, IEEE*, Ratnesh Kumar, *Fellow, IEEE*, Venkataramana Ajjarapu, *Fellow, IEEE*, and Nicola Elia, *Member, IEEE*, "Planning Reconfigurable Reactive Control for Voltage Stability Limited Power Systems",vol.24, no.2, May. 2009.
[3] W. Zhang, F. Li, and L. M. Tolbert, "Review of reactive power planning: Objectives, constraints, and algorithms," *IEEE Trans. Power Syst.*, vol. 22, no. 4, pp. 2177–2186, Nov. 2007.
[4] E. Vaahedi, Y. Mansour, C. Fuchs, S. Granville, M. D. L. Latore, and H. Hamadanizadeh, "Dynamic security constrained optimal power flow/VAr planning," *IEEE Trans. Power Syst.*, vol. 16, no. 1, pp. 38–43,Feb. 2001.
[5] E. Vaahedi, J. Tamby, Y. Mansour, L. Wenyuan, and D. Sun, "Large scale voltage stability constrained optimal VAr planning and voltage stability applications using existing OPF/optimal VAr planning tools", *IEEE Trans. Power Syst.*, vol. 14, no. 1, pp. 65–74, Feb. 1999.
[6] P. J. Macfie, G. A. Taylor, M. R. Irving, P. Hurlock, and H.-B.Wan, "Proposed shunt rounding technique for large-scale security constrained loss minimization," *IEEE Trans. Power Syst.*, vol. 25, no.3, Aug. 2010.
[7] H. Liu, L. Jin, J. D. McCalley, R. Kumar, V. Ajjarapu, and N. Elia, "Planning reconfigurable reactive control for voltage stability limited power systems," *IEEE Trans. Power Syst.*, vol. 24, no. 2, pp.1029–1038, May 2009.
[8] R. A. Jabr, "Optimal power flow using an extended conic quadratic formulation," *IEEE Trans. Power Syst.*, vol. 23, no. 3, pp. 1000–1008,Aug. 2008.
[9] D. Chattopadhyay and B. B. Chakrabarti, "Reactive power planning incorporating voltage stability," *Elect. Power Energy Syst.*, vol. 24, no.3, pp. 185–200, Mar. 2002.
[10] J. Urdaneta, J. F. Gómez, E. Sorrentino, L. Flores, and R. Diaz, "A hybrid genetic algorithm for optimal reactive power planning basedupon successive linear programming," *IEEE Trans. Power Syst.*, vol.14, no. 4, pp. 1292–1298, Nov. 1999.
[11] Govindaraj Thangavel ,"Low Frequency Axial Flux Linear Oscillating Motor Suitable for Short Strokes" *International Journal ISRN Electronics* ,2013
[12] T.Govindaraj, Debashis Chatterjee, and Ashoke K. Ganguli,"Development, Finite Element Analysis and Electronic Controlled Axial Flux Permanent Magnet Linear direct Oscillating Motor drive suitable for short strokes", *Proc. International Conference on Control, Automation, Communication and Energy Conservation, INCACEC- 2009, Kongu Engineering College, India* Jun. 4–6, 2009, pp.479– 483.
[13] Dr.T.Govindaraj, and T.Keerthana," DFC And DTC Of Special Electric Drive Using PI And FLC, " *International Journal Of Advanced and Innovative Research*.ISSN: 2278-7844, Dec-2012 ,pp 475-481.
[14] Govindaraj T, Debashis Chatterjee, and Ashoke K. Ganguli, "Development, Analysis and Control of an Axial Flux Permanent Magnet Linear Oscillating Motor suitable for Short Strokes", *Proc. 2009 IEEE International Symposium on Industrial Electronics, IEEE ISIE 2009*, Seoul Olympic Parktel, Seoul, Korea, July 5-8 2009.

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
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[15] Dr.T.Govindaraj, and S.Deepika, "Hybrid input Boost converter Fed BLDC Drive," *International Journal Of Advanced and Innovative Research*. ISSN: 2278-7844, Dec-2012, pp 444-451.

[16] Govindaraj T, Debashis Chatterjee, and Ashoke K. Ganguli,"Development, Control and Testing of a New Axial Flux Permanent Magnet Linear Oscillating Motor using FE Magnetic Field Analysis Simulation Models", *Proc. 2009 International Conference on Mechanical and Electronics Engineering, ICMEE 2009, International Association of Computer Science and Information Technology, IACSIT*, Chennai, India, July 24-26, 2009

[17] Govindaraj T, Debashis Chatterjee, and Ashoke K. Ganguli,"FE Magnetic Field Analysis Simulation Models based Design, Development, Control and Testing of An Axial Flux Permanent Magnet Linear Oscillating Motor",*Proc.The International Conference on Electrical and Electronics Engineering, ICEEE2009, International Association of Engineers, World Congress on Engineering 2009*, London, United Kingdom.1-3, Jul 2009

[18] T.Govindaraj, Rasila R,"Development of Fuzzy Logic Controller for DC – DC Buck Converters", ***Int J. Engg Techsci*** Vol 2(2), 192-198, 2010

[19] Dr.T.Govindaraj, and T.Srinivasan, " An Hybrid Five-Level Inverter Topology with Single-DC Supply fed Special Electric Drive," *IJAIR* , Dec-2012, *pp* 542-548.

[20] T.Govindaraj, Debashis Chatterjee, and Ashoke K. Ganguli, "A Permanent Magnet Linear Oscillating Motor for Short Strokes," *Proc. International Conference on Electrical Energy Systems & Power Electronics in Emerging Economies ,ICEESPEEE- 2009, SRM University, India*, April 16-18, 2009, pp. 351- 355

[21] Govindaraj Thangavel," Finite Element Analysis of the Direct Drive PMLOM" In book: *Finite Element Analysis - New Trends and Developments Chapter:6,InTech - Publisher*, Oct 2012

[22] Dr.T.Govindaraj, and M. Gunasegaran," PV Micro inverter System based Electric Drive , " *International Journal Of Advanced and Innovative Research*.ISSN: 2278-7844, Dec-2012, pp 458-467.

[23] Govindaraj Thangavel, Debashis Chatterjee, and Ashoke K. Ganguli," Modelling and Simulation of Microcontroller based Permanent Magnet Linear Oscillating Motor,"***International Journal of Modelling and Simulation of Systems***, Vol.1, Iss.2, pp. 112-117, 2010

[24] Govindaraj Thangavel," Design, Development, Analysis and Control of an Axial Flux Permanent Magnet Linear Oscillating Motor suitable for short strokes using Finite Element Method," *International Journal of Electronic Engineering Research* Volume 2 Number 3 pp. 419–428, 2010

[25] Dr.T.Govindaraj, and B.Gokulakrishnan, "Simulation of PWM based AC/DC Converter control to improve Power Quality,"International Journal of Advanced and Innovative Research, Dec-2012, *pp* 524- 533.

BIOGRAPHIES

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