

Hybrid Neural Network with Modified Cuckoo Search via Cluster Technique

K.Thinakaran, K.Santhi

Abstract—Levenberg-Marquardt again-spread estimation, as a Feed forward Neural Network (FNN) arranging framework, has numerous impediments associated with over fitting and close to perfect problems. This paper proposed every other meta-heuristic pursue calculation, in light of cuckoo winged animal's on the spot to put together lower back augmentation in conducting expedient get together fee and to sidestep community minima issue. The proposed modified Cuckoo Search Back-Propagation (MCSBP) is separated and PSO-BP estimation, and other cream assortments. The consequences exhibit that the ability of BP making ready technique is updated while united with the Cuckoo search approach.

Keywords—lower back inflicting neural gadget, cuckoo seek tally, Cluster technique, near-by way of minima, PSO, Levenberg-Marquardt.

1. INTRODUCTION

Artificial Neural Network (ANN) provides flexibility to simplify and solve problems in pattern classification. ANN has the aptitude for random nonlinear function approximation and information processing [3,16,14]. The optimal network performance is achieved for training ANNs such as (BPNN) Lower back Propagation Neural network figuring [9]. Be that as it could, the BPNN tally experiences frailty. The weights are mentioned by using a hazard of being gotten in a zone least [21,8]. Essentially more techniques had been utilized to improve the suitability of the again inflicting calculation which include the conjugate inclination plunge technique [7,11]. One constraint of this slope drop approach is that it calls for a differentiable neuron pass paintings.

Distinct estimations were proposed to defeat the burdens of inclination based strategy. These tallies intertwine through and huge pursue structure, as an instance, move breed PSO-BP [25], Evolutionary Algorithms (EA)[24], Particle Swarm Optimization (PSO)[10], Differential Evolution (DE)[5], and genetic algorithms (GA).. To conquer the deficiencies of the normal BP, this paper proposes another figuring, came again to adjusted Cuckoo Search Back Propagation (CSBP) . The slope improves the benefit of the stochastic solicitation figuring. Cuckoo search (CS) is made via Yang and Deb[23] which is precious for normally speakme development to find out answer[22]. The CS calculation has been associated with provide an explanation for a few shape streamlining systems, as an example, the

game plan of springs and welded bar structures. The CS may be modified to present a excessive blending rate to the benefit by way of and massive least value[20]. On this paper, the celebration lead of the modified Cuckoo Search Back Propagation (MCSBP) on XOR datasets is penniless down. The outcomes are separated and PSO-BP estimation and LMBP. The paper is made as looks for after: section II gives making observe on BPNN. Quarter III, clarifies Cuckoo search through p.C. Manner. In area IV, the proposed MCSBP estimation is given, and growth effects are broke down in phase V. The paper is discovered within the phase VI.

Back Propagation Neural Network

The Back Propagation Neural Network (BPNN) is the Directed gaining knowledge of calculation proposed by using Rumelhart, Hinton and Williams in 1986[17]. The propensity drop framework is utilized to figure the stacks to manipulate the yield misunderstanding appreciate. It is a Least mean Squared (LMS) estimation that limits a purpose companions to the overall of the squares of the slip-united states of americabetween the licensed and the precise yields, where the nonlinear blunder signal is

$$e_i = d_i - y_i \quad (1)$$

The gradient descent method is given by

$$W_{ki} = -\mu \frac{\partial E_p}{\partial W_{ki}} \quad (2)$$

Where, w_{ki} is the weight of the i th unit in the k th layer. The back propagation error value is used to update the weights in both the output layer and hidden layers. The weights, w_{ij} are then adjusted using the following formula.

$$W_{ij}(k+1) = W_{ij} + \mu \partial_j y_i \quad (3)$$

Here k is the number of the epoch and μ is the learning rate

2. CUCKOO SEARCH VIA CLUSTER TECHNIQUE

The Cluster approach has been utilized in bunches of hunt calculations [15 , 12]. In Cuckoo seek calculation Cluster strategy is a sizeable difficulty for looking through a familiar extreme well worth. The bearing of a creature has the accompanying skip depending on the reducing edge state and the version plausibility to the subsequent country.

a. Cuckoo Search (CS) algorithm

CS Is a stochastic overall meta-heuristic framework proposed by utilizing Xin-Shen Yang(2007). Its idea starts from the direct of the cuckoo fowl in nature. This considering changed along with instigated by procedures for the cuckoo species. A few host home can keep up direct refinement.

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* Correspondence Author (s)

Dr. K.Thinakaran, CSE, Saveetha School of Engineering, SIMATS Chennai, India. Thinakarank.sse@saveetha.com

Dr. K. Santhi, CSE, Sreenivasa Institute of Technology & Management Studies, Chittor, India. santhiglorybai@gmail.com

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In the event that an egg is seen by utilizing the host hen as No longer its , it will fling the dull egg. Cuckoos are express inside the copy in shade and instance of the eggs of a few picked have animal categories. This decreases the likelihood of their eggs being given up. The going with benchmarks have been utilized inside the quest for set of standards to execute the ones cuckoo fowl measures: (1) one egg is laid by utilizing each cuckoo in an emotional home and it tends to a firm of answer coordinates,

(2) the incredible eggs (answers) are contained in a bit of the homes and could bring over to the subsequent progression, and (three) the full scale proportion of homes is steadfast and a host cuckoo can discover an outcast egg with a focused on likelihood. In the event that this condition happens, the host cuckoo can dispose of the egg, and another home may be assembled. The CS calculation looks for after three romanticized techniques:

- A. Each cuckoo lays one egg at some arbitrary moment, and put its egg in imprudently picked home.
- B. The marvelous homes with extreme selection of eggs will carry over to the going with ages.
- C. The accessible host homes is fixed, and the egg laid through a cuckoo is found by methodologies for the host fowl with a likelihood $pa \in [0,1]$.

The host fowl can both discard the egg or gather a totally new home. The standard guideline c might be approximated by techniques for the division $pa \in [0,1]$ of the n homes which may be changed by utilizing new emotional plans. Each egg in a street numbers an answer . In light of on these, the Cuckoo Search (CS) can be summarized. When generating solutions for a cuckoo i , a Levy flight performed.

$$y_i^{t+1} = y_i^t + \alpha \oplus \text{levy} \quad (4)$$

The item means get to shrewd duplications. The arbitrary walk by means of Levy flight is green in investigating the pursuit territory. The Levy flight basically offers an arbitrary walk around appeared inside the Equation 4.

$$\text{Levy} \sim u = t - \lambda, \quad 1 < \lambda < 3$$

The new preparations are produced via randomization whose areas are a protracted way from the present arrangement. This will make the framework no longer being caught in neighborhood minima. The code of CS calculation is as in keeping with the following

Step 1: Initialize N host nest.

Step 2: while (fmin < MaxGeneration) or (stop criterion) do the following

Step 3: Set a cuckoo randomly by Levy flights then evaluate its fitness

Step 4: Get randomly a nest j among N.

Step 5: if $F_i > F_j$ Then

Replace j by the new solution.

Step 6: A fraction pa of worse nest are abandoned and new ones are built.

Step 7: Keep the best solutions (or nest with quality solutions).

Step 8: Rank the solutions and find the current best.

b. Levenberg-Marquardt Algorithm

The Levenberg-Marquardt algorithm work for medium sized networks. The working performance of the LM algorithm decreases as the number of network parameters increases. The Levenberg-Marquardt (LM) algorithm can

find a solution of a system of nonlinear equations, $y = \phi x$, by finding the parameters, ϕ , that link variables, y , to variables, x , by minimizing an error of a function of system by using error gradient information for every parameter considered in the system. The LM algorithm finds the appropriate change, $\Delta\phi$, leading to smaller errors. The LM-algorithm depends on error, E , the Hessian matrix H , the gradient of the error, J , a scalar μ which controls the trust region, and I is the identity matrix.

Given below the Levenberg-Marquardt algorithm

1. While $i < \text{Max Iteration}$
2. Output of first layer is calculated as below
3. Output after hidden layer is $X_{Hidden} = f(\text{Net}_{Hidden})$
4. Network output is
5. Error in output layer is
6. Weight vector is
7. Jacobian matrix is

$$\text{Net}_{output} = W_2 \times \begin{bmatrix} X_{Hidden} \\ 1 \end{bmatrix}$$

8. Error gradient is

$$E = \text{Target} - \text{Net}_{output}$$

$$\theta = \begin{bmatrix} W_1 \\ W_2 \end{bmatrix}$$

$$\nabla J = J \times E$$

$$J(\theta) = \begin{bmatrix} f'_{linear}(X_{Hidden}) \\ W_2 \times f'_{logistics}(X_{Hidden}) \end{bmatrix}$$

9. Hessian matrix is

$$H = J^T \times J$$

10. Updating Hessian matrix

$$H = H + \lambda \times \text{diagonal}(H)$$

11. Weight change is

$$\Delta\theta = H^{-1} \times \nabla J$$

12. New weight vector

$$\theta_{new} = \theta_{old} + \Delta\theta$$

13. New hidden-output layer weights

$$W_{2new} = W_{2old} + \theta_{new}(W_2)$$

14. New input-hidden layer weights

$$W_{1new} = W_{1old} + \theta_{new}(W_1)$$

15. Updating λ

16. Calculating update conditions

$$L = \Delta\theta^T \nabla J + \Delta\theta^T \Delta\theta \lambda_{old}$$

17. New lambda

$$\lambda = \begin{cases} \frac{\lambda}{2} & \text{if } 2N(MSE - MSE_{new}) > 0.75L \\ 2\lambda & \text{if } 2N(MSE - MSE_{new}) \leq 0.25L \end{cases}$$

Check if training conditions are still true. If true, repeat or go to step 10. Otherwise exit training.

Starting weights are adjusted

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by a learning algorithm to reach the desired state with the lowest errors Equation.

3. THE PROPOSED MCSBP ALGORITHM

The Cuckoo search is a populace fundamentally based enhancement calculation. The best approach to choose the amazing source is by means of keeping up the top notch homes, substitute of host eggs with perceive to the nature of the new cuckoo eggs created dependent on randomization and ID of cuckoo eggs by method for the host winged creatures and supplanting in accordance with the best of the adjacent irregular strolls. Inside the principal cycle, the best loads and predispositions are instated with CS and after that those loads are passed to the BPNN. The loads in BPNN are figured and contrasted and top notch arrangement. Inside the following, MCS will supplant the loads. In MCS, the expense of α wound up made to diminish in light of the fact that the quantity of ages expanded. This transformed into executed for a similar reason that the latency predictable is most likely diminished in PSO(Ilonen 2003), which is to empower increasingly confined looking in light of the fact that the vendors, in this precedent the eggs, get toward the appropriate response. The essential change went into to the Levy flight coefficient. A starter cost of the Levy flight coefficient $A = 1$ was settled on and, at every time, another expense is determined utilizing $\alpha = A/G$, wherein G is the period assortment. The second one correction included this hybrid. This changed into did with the guide of changing the state of the arrangement of guidelines. The initial step inside the arrangement of guidelines is host winged creatures disposing of eggs and irregular hereditary transformation in the following innovation of eggs. A Levy flight is completed to produce another egg. On the off chance that the produced egg is of higher wellness than the egg as of now in that home, at that point it replaces it. The pseudo code of the MCSBP calculation is:

- Step 1: MCS introduces the heap and passes the attractive loads to BPNN
- Step 2: Load the preparation measurements
- Step 3: in the meantime as $MAE <$ anticipating principles
- Step 4: Initialize all cuckoo homes
- Step 5: Make recently made groups
- Step 6: decide the fantastic bunch. Presently the develop Cuckoos ought to go toward this point factor for laying their eggs.
- Step 7: Feed forward neural system runs the utilization of the loads instated with MCS
- Step eight: Calculate the mistake in reverse
- Step 9: MCS continues computing the fine conceivable load at each age until the network is merged.

4. EXPERIMENTS AND RESULTS

To test the performance of the proposed MCSBP, XOR were used. The proposed (MCSBP) algorithm is compared with Levenberg Marquardt Back Propagation algorithm (LMBP) And PSO-BP based totally totally on mean squarer error, epochs and CPU time. The variety of hidden nodes is layout of 5 neurons. The log sigmoid characteristic is used because the movement feature. It is stated that Leverberg-Marquardt is one of the fastest and correct getting to know algorithms for medium sized networks. However Hybrid set of rules is faster than Levenberg-Marquardt set of regulations as in step with our observe. From the below table

1 assertion, you could see the time taken to converge in Hybrid set of regulations is less whilst in evaluation to the Levenberg-Marquardt algorithm. This indicates that Hybrid set of rules is quicker than Levenberg-Marquardt set of policies. The LM set of policies does now not perform not well on pattern reputation problems. The benefit of the LM set of regulations decreases due to the fact the amount of parameters will boom.The primary test trouble is the Exclusive OR (XOR) Boolean function of two binary input to a single binary .From the Table 1, we can see that the proposed MCSBP method performs well on XOR dataset. The MCSBP converges to global minima in 94(ms) second of CPU time. While other algorithms fall behind in-terms of MAE, CPU time and accuracy.

Table 1. CPU time, Epochs and MAE error for XOR dataset

epoch	MCSBP		LMBP		PSO-BP			
	MAE	Time (ms)	epoch	MAE	Time (ms)	epoch	MAE	Time (ms)
20	0.11	16	1	0.99	30	14	0.95	13
480	0.12	31	2	0.5	109	28	0.16	18
840	0.12	47	4	0.44	111	42	0.13	24
1140	0.12	62	6	0.35	114	56	0.10	30
1500	0.11	78	8	0.31	116	70	0.08	34
1860	0.02	82	10	0.27	119	84	0.08	39
2280	0.03	94	12	0.19	122	98	0.07	44

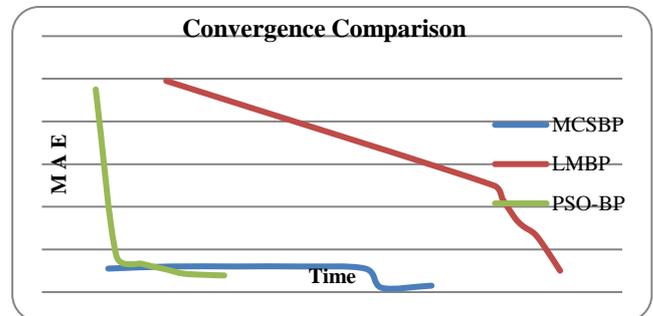


Figure 1. Convergence comparison for LM & Hybrid algorithms

We observe MCSBP calculation in Iris characterization. The correlation is completed in our benchmark suite. The results were given are organized and checked out in desk-3. As you locate within the desk-three MCSBP unites all round swiftly. MCSBP calculation offers higher execution. We look for the precise plan in constructing. To discover the perfect arrangement from the all states is to pick out a few ideal expresses .This system will upgrade the pursuit method. The worldwide best is possible utilizing our calculation. Examination with particle swarm optimization (PSO), LMBP advocated that MCSBP calculation provide regularly strong outcome. Within the diverse applications, a captivating exhibition improvement has been received with the aid of making use of MCSBP search to prepare neural systems



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TABLE 2. MCSBP performance using RMSE, MAE & MSE

Execution Using RMSE			Execution Using MAE			Execution Using MSE		
Time (ms)	Epoch	RMSE	Time (ms)	Epoch	MAE	Time (ms)	Epoch	MSE
13	20	0.974	16	20	0.11	14	20	3.8
18	480	0.409	31	480	0.12	19	480	0.672
23	840	0.364	47	840	0.12	24	840	0.532
30	1140	0.324	62	1140	0.12	30	1140	0.422
34	1500	0.295	78	1500	0.11	35	1500	0.349
39	1860	0.283	82	1860	0.02	40	1860	0.322
44	2280	0.282	94	2280	0.03	44	2280	0.319
49	2700	0.19				49	2700	0.15
53	3125	0.16				54	3125	0.11
59	3500	0.14				59	3500	0.08
64	3897	0.12				64	3897	0.06
68	4398	0.12				69	4398	0.05
73	4821	0.1						

TABLE 3. MCSBP performance comparison with PSOBP in Iris problem

PSO_BP		MCSBP	
Time	MAE	Time	MAE
15	0.512	16	0.411
28	0.433	31	0.333
42	0.473	47	0.333
56	0.233	62	0.333
72	0.218	78	0.078

5. CONCLUSIONS

In this paper, we utilized a Hybrid calculation that is Cuckoo search with Cluster strategy. Nature roused meta-heuristic calculations give subordinate free solution for develop issues. A Cuckoo seek is proposed to prepare BPNN to perform quick assembly rate and to restrict the coaching mistake. The proposed alteration turned into executed by way of changing the route of the irregular stroll of cuckoos closer to the bearing of the base an incentive from the perspective of the cuckoo's region the exhibition of the proposed MCSBP calculation is contrasted and the LMBP and PSO-BP calculations by means of methods for recreation. The effects demonstrate that the proposed MCSBP is advanced to the beyond strategies as some distance as effortlessness, meeting fee and exactness.

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