IMPROVING CLASSIFICATION ACCURACY USING ENHANCED SALP SWARM ALGORITHM

MAJOR PROJECT

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DECLARATION

We hereby declare that this submission is our own work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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CERTIFICATE

This is to certify that the work titled "**Improving Classification Accuracy Using Enhanced SalpSwarm Algorithm**" submitted by **Chakshu Mahajan, Ayushmaan Pandey** and **Divay Dua** of B.Tech of Jaypee Institute of Information Technology University, Noida has been carried out under my supervision. This work has not been submitted partially or wholly to any other University or Institute for the award of any other degree or diploma.

Signature of Supervisor:

Name of : Mr Avinash Pandey
Supervisor : Assistant Professor
Designation Date : May, 2020

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SUMMARY

Metaheuristics, as stated in mathematical and computer science is an independent algorithmic framework that is higher degree process or a partial stage procedure. It is a heuristic design which can be used to discover, produce, or select a partial search/heuristic algorithm that can essentially be used as a technique for optimisation problems. This algorithm works specifically when the information is insufficient, partial with limited information or has restrained computational potential. Even if the set of solutions is enormous, metaheuristics tend to sample the solution set and also makes assumptions for problem optimisation and hence could be utilised for problem expansion

In this task work, we are proposing a enhanced salp swarm algorithm for improving classification accuracy .We first studied about S.S.A and why it is better than other.We compared the S.S.A on various benchmark functions and founf that it produces better results than other meta heuristic algorithms.For improving classification accuracy we proposed a enhanced S.S.A which were tested on 23 datasets taken from UCI repository.

The results of the proposed solution were compared with other meta heuristic algorithms like G.W.O,P.S.O etc and was found that it outperformed other algorithms.

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LIST OF SYMBOLS & ACRONYMS

P.S.O-Particle Swarm Optimization

S.S.A-Salp Swarm Algorithm

GSA-Gravitational search algorithm

BA-Bat Algorithm

MATLAB-Matrix Laboratory

ABC-Artificial Bee Colony

C.S.S.A-Chaotic Salp Swarm Algorithm

CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION

Metaheuristics, as stated in mathematical and computer science is an independent algorithmic framework that is higher degree process or a partial stage procedure. It is a heuristic design which can be used to discover, produce, or select a partial search/heuristic algorithm that can essentially be used as a technique for optimisation problems. This algorithm works specifically when the information is insufficient, partial with limited information or has restrained computational potential. Even if the set of solutions is enormous, metaheuristics tend to sample the solution set and also makes assumptions for problem optimisation and hence could be utilised for problem expansion.

Many latest research layouts are inspired by nature-stimulated metaheuristics for instance, computation-based evolutionary algorithms are stimulated by the same means. Artificial computing systems with probable computational troubles could be dealt with natural mechanisms as source and principles for designing complex algorithms for example P.S.O, ABC and S.S.A. A wide variety of current nature-stimulated metaheuristics has stumbled new problems within the studies network for complex metaphors.

Swarm intelligence has been observed to work based on artificial as well as natural structures that are self-organised, decentralised and employed to work on synthetic intelligence. In cellular robot structures, this algorithm was exclusively added by Wang and Benin, 1989. The SI systems usually comprise of populace of easy retailers interacting locally with each other as well as surroundings. Such interactions have shown to effectively emerge as smart international conducts even though there is no evidence as to how these retailers behave to each other and to environment.

The following section describes the idea of S.S.A:

SALP SWARM ALGORITHM

The “retailers” as discussed in the section above are transparent barrel shaped jelly fish like organisms called “Salps” that belonging to “Salpidea” family. These organisms, being jelly fish like, have similar tissues and movements i.e., thrust to move forward is a consequence of water pumping through their body. [1]. Figure 1 shown below is a depiction of single chain and a Salp:

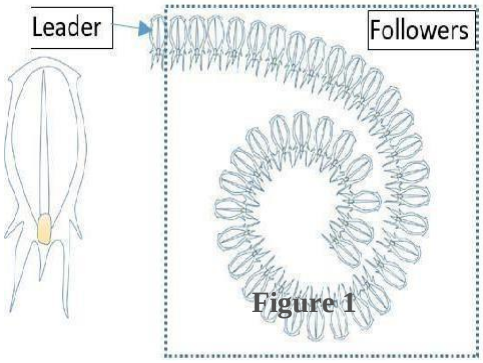


Figure 1

Salps tend to form “salp chains” in oceans in the form of “swarm” and are considered interesting because of their swarming behaviour.

When we try to formulate the Salp chain mathematically, we first divide the sample into followers and leaders. Salp present at the front of the chain is called the “leader”, and salps following the leader are known as “followers”. In this context, the leader Salp leads the swarm while followers follow the leader.

1.2 PROBLEM STATEMENT

In our previous work, we had studied about Salp Swarm Algorithm and how this algorithm is better than other algorithms. We studied about all the limitations of S.S.A and how it can be improved. We had also compared the results S.S.A with other Swarm intelligence algorithms (P.S.O, ABC, GSA, BA). But, S.S.A has certain limitations which can be optimized. We analysed and choose S.S.A for classification as it was better than others.

In this work, we propose to enhance Salp Swarm Algorithm for improving machine learning classifiers, as it showed stagnation in local optima and also had slow convergence rate.

1.3 BRIEF DESCRIPTION OF SOLUTION APPROACH

This work intends to enhance Salp Swarm Algorithm for improving machine learning classifiers, as it showed stagnation in local optima and also had slow convergence rate. Benchmark function such assphere, rosenbrock, Powellsum, alpine2 are tuned to analyse the performance of these models. S.S.A has certain limitations which can be optimized. In the previous project, we studied about Salp Swarm Algorithm and compared S.S.A with other swarm intelligence algorithms (P.S.O, ABC, G.W.O, WOA) on certain benchmark functions and how it was better than other algorithms. In this paper we propose the approach of moulding the parameters of relatively simple Salp Swarm algorithm and improving their accuracy such that these results are better for this problem statement. In the latter half of the project, we want to apply this improved S.S.A to improve machine learning classifier's accuracy. We can achieve this by bringing balance in exploration and exploitation. We can achieve this balance by moulding parameters of Salp Swarm Algorithm like introducing weighted parameters, changing mutation function. As we know most of the Swarm intelligence algorithms stagnated in local optima and slow convergence rate. While dealing with multi-modal problems, S.S.A starts facing problems. But our approach can prove that the enhanced S.S.A can deal with these demerits of Swarm intelligence only by making small changes in the parameters and show high convergence rate.

. In S.S.A algorithm, the food source is assigned the best solution that has been obtained and was saved by the algorithm. Hence, it never gets lost even if the whole sample degrades.

- Leading salp position is updated by the S.S.A algorithm, that was the optimal solution got by far. Hence, the leader always explores the sample and exploits the space around food source.

- Follower salps position is updated in accordance to the leader, so that they can move slowly towards the salp leading the path.

- Problem for stagnating in the local optima is solved by gradual movements of follower Salps.

- Parameter c1 is reduced adaptively with increasing the iterations of the algorithm, so that the exploitation if followed by exploration.

We Compared our Enhanced S.S.A with existing S.S.A and other swarm intelligence algorithm and found out it has better values in most of the cases.
Twenty-three UCI data sets are used in this paper, to test the working of IS.S.A.

We applied our Improved S.S.A on various datasets. We have taken a training dataset that is used to build optimal feature set for calculating accuracy of this method.
We compared our Enhanced S.S.A with various Algorithms and found out it is best in most of the cases.

1.4 EMPIRICAL STUDY

Pattern category classification is in most used package of convolutional neural networks. However, the most important part is training our dataset. Old schooling algorithms like: Back-propagation has a few disadvantages which includes falling into the neighbourhood minima and gradual convergence fee. Therefore, these issues are conquered by optimisation algorithms. One of the recent algorithms that has shown great novelty and has shown overall great performance by fixing many optimisation troubles is S.S.A. The S.S.A is a great algorithm and is used in optimising weights of coefficients to perform pattern type classification on neural networks. The deserves of the given approach has confirmed the use of some old classification problems and other rival optimisation problems. Outcomes that were received displays that our method has higher efficiency than other different techniques in comparison of summation squared errors and overall accuracy.

S.S.A was throughly studied and the main inspiration was the swarming behaviour of salps.Other meta heuristic algorithms were compared and was found that it works better in most of the cases but still has a low convergence rate .To overcome this shortcoming the existing S.S.A was enhanced so that it can be used for improving classification accuracy.This given work is very difficult because of different rotations, illuminations and positions.We studied various research paper about how to enhance S.S.A to improve classification accuracy.
Image segmentation can be taken into consideration a crucial manner in growth for the reputation of Images. This given work is very difficult because of different rotations, illuminations and positions. The segmentation model for fish snap shots the usage of Salp Swarm Algorithm (S.S.A) was suggested. The suggested version can show robustness for different instances as compared to standard paintings.
Support Vector Machine identifies and examines distinct styles and is used as a supervised learning algorithm. Main features of classifier (SVM) is mainly adjusting parameter values and to control and adjust the kernel. SVM parameters cost is governed by the nature inspired Salp Algorithm. Mutation approach is evolved and a superior value is found to improve capability of exploration. Our results that were obtained preliminary by mutating SVM with S.S.A increases classification accuracy.

CHAPTER 2

LITERATURE SURVEY

2.1 SUMMARY OF PAPERS STUDIED

Paper 1 (year 2017)

TITLE: Salp Swarm Algorithm: A bio-inspired optimizer for engineering design problems
AUTHORS: Seyedali Mirjalili et al, 2017
PUBLISHER: 2017 Elsevier

S.S.A is a bio-motivated multitude knowledge calculation (streamlining agent) created in 2017; basically, a populace-based technique impersonating the conduct of salp swarms and their social association. [1] Salp is an individual substance living in profound seas with a straightforward barrel moulded body and the association of these salps into salp-chains to discover their food in course of water powers are called swarms.[1] The salp swarms are scientifically isolated in 2 gatherings: "head" is the leader whereas the others are "followers". [1]

In this following calculation, the salp situation is "d-dimensional" search sample wherein "d" called characterized num of the factors and "F" is food source which is basically the multitude's objective. [1] The pioneer refreshes its situation as indicated by the accompanying condition:

$$x_j^1 = \begin{cases} F_j + c_1\left(\left(ub_j - lb_j\right)c_2 + lb_j\right) & c_3 \geq 0 \\ F_j - c_1\left(\left(ub_j - lb_j\right)c_2 + lb_j\right) & c_3 < 0 \end{cases}$$

X1j = leader's position at j(th) position
l(bj) = lower-boundary at j(th) dimension
u(bj) = upper-boundary at j(th) dimension
Fj= Food source position
c1= a coefficient playing an important role maintaining balance b/w exploration and exploitation; c1 which decreases with increase in iterations and is given by:

$$c_1 = 2e^{-\left(\frac{4l}{L}\right)^2}$$

Here l = iteration which is happening at present and L=max. num of iterations

c3 and c2 = rand. nums with in intervals 0 and 1. They tell whether to move towards negative or positive in j(th) dimension and the step size. Follower's position are updated according to Laws of motion.

Paper 2 (year 2019)

TITLE: Enhanced Salp Swarm Algorithm: Application to Variable Speed Wind Generators
AUTHORS: Mohammed H. Qais et al, 2019
PUBLISHER: 2019 Elsevier

It introduced a new change and utilization of the salp swarm calculation that is In this paper, it introduced a new change and showed us utilization of the S.S.A calculation which is roused by making swarms conduct of salp angles which resides in profound seas. [2] Upgraded salp swarm calculation was developed because we had to increase efficiency and the sufficient consequences which S.S.A contrasted with different calculations, particularly for the high-dimensional capacities. [2] Here, the calculation has been confirmed by utilizing 23 benchmark datasets and works which contrasted and the first Salp Swarm Algo calculation with different calculations. [2] The measurable investigation of the got outcomes uncovered ES.S.A has improved results and intermingling and quick union leads to best arrangement. [2] Moreover, The ES.S.A and S.S.A calculations which were applied and results were improved. The most extreme force point following and hence shortcoming capacity of matrix with perpetual magnet-generator which is operated with undefined velocity wind turbines.

In this task, two primary commitments are introduced which is a new improvement for the S.S.A calculation known as "eS.S.A" and a new building utilization of the ES.S.A and S.S.A We Compared our Enhanced S.S.A with existing S.S.A and other swarm intelligence algorithm and found out it has better values in most of the cases. Twenty-three UCI data sets are used in this paper, to test the working of IS.S.A. Many latest research layouts are inspired by nature-stimulated metaheuristics for instance, computation-based evolutionary algorithms are stimulated by the same means. Artificial computing systems with probable computational troubles could be dealt with natural mechanisms as source and principles for designing complex algorithms for example P.S.O, ABC and S.S.A. A wide variety of current nature-stimulated metaheuristics has stumbled new problems within the studies network for complex metaphors.[2]

Paper 3(year 2018)

TITLE: A novel chaotic Salp Swarm Algorithm for Global Optimization and Feature Selection
AUTHORS: Gehad Ismail Sayed al, 2018
PUBLISHER: 2018 Springer

Salp swarm Algorithm is a very recent and efficient algorithm which works with driving force of conduct by salps. Be that as it may, like the vast majority of the meta-heuristic calculations, its problem was that it got stagnated in neighbourhood optima and slow union rate. As of late, disarray hypothesis has been effectively applied to tackle these issues. In this task, a novel cross breed arrangement dependent on S.S.A and tumult hypothesis is suggested. It was applied to 20 functions Where Ten distinctive disorderly map are utilized to upgrade assembly and coming about accuracy. Reproduction results indicated that calculation was efficient. Also, outcomes demonstrated that strategic tumultuous guide is the ideal guide of the pre-owned ten, which can essentially support the exhibition of unique S.S.A.

Contributions

Summary of this paper is:

– Chaos theory and novel hybridisation approach was suggested.

– The theory was applied to 14 different global optimisation problems.

–Twenty different benchmark sets were taken and simple CS.S.A was thought for our problem.

– Then, comparison was made between ten popular chaotic maps.

– A few assessment standards are utilized in assessment. These models being Standard Deviation, Mean and probability-estimations that aggregates Wilcoxon rank, direction, and search, normal wellness within entire populace, intermingling bends.

–the performance of this algorithm was compared with different metaheuristics algorithms like ABC, P.S.O, G.W.O.

S.S.A consists of 2 populace which are leader and followers. The one being at the front and knows food location is “leader” and the latter are called “followers”. Location of a salp is Y. Meal source is F, this is the final goal that we seek.

Metaheuristics are defined by randomness parameters which are used widely in probability distribution namely Gaussian distribution. New parameters were enhanced by Chaotic Maps. Chaos is described by 3 essential residences.

(1) ergodicity, (2) quasi-stochastic and (3) initial conditions sensitivity.

We have employed a new CS.S.A algorithm with chaotic maps which are employed by chaotic variables and random variables. We have 3 essential parameters which effects its performance.
Salp positions were initialised and parameters were set. We have to first initialize boundary to 0 and then higher for at least one of the facts.
Different metaheuristics algorithms are taken and compared by feature selection of CS.S.A and overall performance is calculated. 20 different algorithms with benchmark sets are applied. We can infer that the information that is lacking from these datasets are adopted and contains these values. Missing cost is replaced with the median price and recognized values of a given features given elegance was replaced by solving the hassle by median technique.
A unique hybridization method is suggested primarily which is based on chaos idea and S.S.A. Comparison of 10 maps was analysed and effectiveness was calculated which utterly enhanced the performance.14 benchmark and 20 benchmark datasets were taken. From experimental results we can infer that the given algorithm gave better efficiency in both exploration and exploitation. The outcomes recommended that premier map was the logistic chaotic map. Our given CS.S.A algorithm showed better results than other 10 algorithms namely SCA, WOA, CSA, MFO, ABC, S.S.A, P.S.O, BSA. Hence, this shows that the CS.S.A was superior.

Paper 4 (year 2019)

TITLE: A Mutated S.S.A for Optimization of Support Vector Machine Parameters
AUTHORS: RR Rajalaxmi
PUBLISHER: 2019 IEEE

Support Vector Machine (SVM) is usually a getting to know set of rules that cautiously examines enter and identifies distinct patterns. Algorithm inspired from nature provides solution to herbal issues and has been in centre. Salp Swarm is used to govern the finest parameters cost of SVM. For improving exploration functionality of S.S.A, method of mutation is deployed to locate the most favourable cost for penalty parameter and kernel parameter. The initial end accomplishments suggests Mutated S.S.A with SVM will increase accuracy of classification than SVM with normal S.S.A. A mutated S.S.A-SVM model is suggested in this paper to enhance the exploration and hence achieve better accuracy. Gaussian mutation is one of the methods as mentioned in equation.

Multiple salps are given initial value with rand() function for optimization procedure and additionally mutation is performed for salps with degraded health. It calculates the health for every function of salp, decides the best condition of where F is food source.

Support Vector Machine identifies and examines distinct styles and is used as a supervised learning algorithm. Main features of classifier (SVM) is mainly adjusting parameter values and to control and adjust the kernel. SVM parameters cost is governed by the nature inspired Salp Algorithm. Mutation approach is evolved and a superior value is found to improve capability of exploration. Our results that were obtained preliminary by mutating SVM with S.S.A increases classification accuracy.

Paper 5(year 2018)

TITLE: Fish Image Segmentation Using Salp Swarm Algorithm
AUTHORS: Abdelhameed Ibrahim et al, 2018
PUBLISHER: 2018 Springer

Fish photo segmentation can be taken into consideration as a crucial process in designing a system for fish popularity. In this studies, model is suggested for performing segmentation of fish photos with the use of S.S.A. The segmentation is performed using method called simple linear iteratiive cllustering approach with starting parameters made better by way of the S.S.A.

The salp-chains, are divided into 2 categories: chief and group. First portion of the chain is the salp, whereas the other members of salps groups are taken into consideration as fans. The chain is guided through the chief, while the other members comply with every individual. The coordinates of all salpps are saved in a 2-d matrix referred to as x. It is thought that there may be a source of food (F) within the seek space as the target of the group.

Slic is among the most essential superpixels segmentation set of rules that has cheap computational energy requirement. Compact and uniform super-pixels are generated, these set of rules combines 5-D hues and picture plan area. The Slic technique is used to group together photo pixels to make close and almost consistent first rate pixels. Finally, a thresholding the usage of method of OTSU helped to supply first-class effects of fishes from the unique pictures below diff. conditions.

In this phase, a version changed into suggested, differentiating fish from fish pix underneath different situations. This technique makes use of the SLIC segmentation set of rules to supply superpixels primarily based on the S.S.A optimization after which apply the technique of Otsu to threshold the output superpixelsimage.

A fish dataset inclusive of real-global pictures became examined. In this challenge, a dataset of three,960 real-international fish snap shots accrued from 460-470 different species was used. These pics had been captured in different situations, specifically, “managed”, “out-of-the-water” and “in-situ”. The “managed” pictures were taken beneath a constant history and illumination is in consistent control.
Here, a method for segmentation of actual-global fish snap shots was given based totally on the S.S.A. The s.l.i.c method became used with preliminary parameters modified by means of the S.S.A to make close and consistent superpixels. A fish dataset which includes real world pix with 460 - 470 species turned into test.

Paper 6 (year 2019)

TITLE: Salp Swarm Algorithm for Node Localization in Wireless Sensor Networks
AUTHORS: Huthaifa M. Kanoosh et al, 2019
PUBLISHER: Journal of Computer Networks and Communications

Independent sensor nodes which consists of Wireless sensor networks (WSNs) which are disbursed in their surroundings. WSNs method has an important method called . Localization trouble in W.S.Ns method calculatingi the positions of unindentified nodes. Some node can be referred as anchor or beacon nodes,we attach GPS to these nodes.Thus, the node which are connected through gps are defined after using the nodes which belong to wireless community. Moreover, The ES.S.A and S.S.A calculations which were applied and results were improved. The most extreme force point following and hence shortcoming capacity of matrix with perpetual magnet- generator which is operated with undefined velocity wind turbines.
WSN’s is the most important contribution of this paper. Nodes like imperative and destination denoted by N and M respectively are randomly confiigured at some point of the development of the deploiyment area. Anchor nodes and target nodes are deployed. Moreover, The ES.S.A and S.S.A calculations which were applied and results were improved. The most extreme force point following and hence shortcoming capacity of matrix with perpetual magnet- generator which is operated with undefined velocity wind turbinesunknown position and localizzed nodes whose positions are already known.
S.S.A performance is primarily based on localization set of rules and is compared and analysed with many famous and well known meta heuristic algorithms like P.S.O,A.L.O etc.

Paper 7(year 2018)

TITLE: Training Neural Networks using S.S.A for Pattern Classification
AUTHORS: Ahmed A. Abusnaina et al, 2018
PUBLISHER: ICFNDS, 2018

Pattern class is one of the most popular applications of NN. We have to modify the pattern classifiication accuracy hence we had to optimise the weights. Deserves of this algorithm are verified by a hard and fast famous problem that occurred for the rival techniques. We have obtained results which are on par or better than the rival techniques.

Famous health and disease datasetss have been to overall evaluate the efficiency of the method suggested. We have selected these datasets because of their variability, variety. These all consequences led to demonstrate competition for rival algorithms.

In this paper we aim to modify, teach weights of neuron N the usage of S.S.A set of rules. Experimentally, this technique is confirmed the usage of fitness datasets. The S.S.A algorithm is again and again implemented till the education termination circumstance of the NN is met.

The deserves of the S.S.A are confirmed the usage of five benchmark class datasets related to health records. Datasets were recorded from UCI Repository. Statistics sets include Haber man, diabtes, thyroid and liver. Accuracy and the summation of squared error (SSE) were used for assessment. Imply cost, quality of twenty runs are reported.

Results display that our algorithm is on par with existing algorithms. It achieves the very good first-class efficiency five out of three datasets. Moreover, Data itse implied highest accuracy for Thyroid dataset, that had been difficult to categorise due to huge dimensional space and its complexity.

Paper 8 (year 2018)

TITLE: An efficient salp swarm-inspired algorithm for parameters identification of photovoltaic cell models

AUTHORS: Rabeh Abbassiet al, 2018

PUBLISHER: 2018 Elsevier

Renewable energy resources are becoming one of popular technology for preserving ans resuing resources and one such resource of renewable energy is solar Photovooltaic systemss which are generating widespread percentage of electric strength. This method suggests good approoach primarily based on meta heuristic algorithm i.e. S.S.A for taking out the parameters of PV. By using S.S.A it is observed that it overcomes the consequences of algorithm which have never ever be used for the extracction of PV cellular parameter .By comparing it with 3 others meta heuristuc algorithm that is (GSA), (A.L.O), and (WOA), S.S.A is considerd best over all these three.Several assessment criteria which include Absolute Error (AE).We can infer that the information that is lacking from these datasets are adopted and contains these values. Missing cost is replaced with the median price and recognized values of a given features given elegance was replaced by solving the hassle by median technique.

This paper sugegsted a new model i.e S.S.A-based method for 7 parameters identity of D.D.M-PV. cellular models. The suggested method S.S.A was firstly compared with the approacch of S.C.A and V.C.S which were not used earlier in this method. The suggested technique become superior then compaared to properly-defined meta heuristic algorithms which includes G.S.A,A.L.O and W.O.A. The important observations made during the method are as follows:

• Performance metrics such as M.S.E and A.E metrics were used to compare and evaluate the performance of all the above studied algo.

• Due to its more stable balance between the exploitationa and exploration factor it shows a great flexibility.

• The excellent matching and the good fitness value of the experiment with IV and PV confirms the better stability and reliability than others of the suggested S.S.A technique.

Above effects shows that the S.S.A-based technique is superior and could be used and taken into consideration for solving the consequences of PV mobile parameter extraction and since it has better results than non liner equations and a better overall perfoemance.

Paper 9(year 2018)

TITLE: Chaotic Salp Swarm Algorithm for SDN Multi-Controller Networks
AUTHORS: Abdelhamied A. Ateya al, 2018
PUBLISHER: 2018 Elsevier BV

Software-defined-networking which is a community parameter that gives us a elastic control for n/w. Growing increase in community capacity ,there are many limitations on each overall scalability and performance . In this work,Salp swarm algorithm is used along eith the choatic maps for the distributed set of rules for optimizers.In large scale SDN networks, the set of rules dynamically eval. the most appropriate number of finest connections and controller and the purest connections between controllers and switches. Suggested set of rules,number of experiments were performed ,applied and observed in different situations and the algo turned into comapred tothe meta heuristics and linear algorithms.
We can infer that the cost is replaced with the median price and recognized values of a given features given elegance was replaced by solving th information that is lacking from these datasets are adopted and contains these values. Missing hassle by median technique. Meta-heuristics set of rules is defined and supplied to remedy the difficulty produced in superior answer and the hassle is defined. The algorithm which is defined is a chaotic based S.S.A that evovles to get the best variety of controllerrs and also the best allocations of all the switches which map to controllers, that minimize the deployment

value and the latency. The use of the chaotic maps prevents it from local optima and improves the efficiency of optimizer. The algo is examined for severous real world topologies that are extracted from the known topology of zoo.The effects of simulation validate the suggested work and is compared with other meta-heuristic algo to show its superiority and a theory based on the suggested set of rules is presented.

2.2 INTEGRATED SUMMARY OF THE LITERATURE STUDIED

S. NO.	RESEARCH PAPER NAME	AUTHOR	SUMMARY
1.	Salp Swarm bio-inspired engineering problem Algorithm: A optimizer for design	Seyedali Mirjalili, Gandomi, Seyedeh HoS.S.Am Faris,	This work suggests 2 different approaches for optimization i.e S.S.A. and Multiple Objective S.S.A. that solves problems with more than one goal These two algorithms are examined on various test functions and the greatest solutions of both are found respectively.
2.	Training Neural Networks using Salp Swarm Algorithm for Pattern Classification .	Ahmed A. Abusnaina Sobhi Ahmad	This work optimizes the parameters of S.S.A and are applied for pattern classiffication The advantages of the suggested technique of S.S.A of pattern classification are demonstrated by usage of a set of famous class problems and are compared against other known meta algorithms. The results showed that the suggested method is far bettern than other optimizers in terms of class accuracy and summation -squared -errors.
3.	Fish Image Segmentation Using Salp Swarm Algorithm	Abdelhameed Ibrahim, Ali Ahmed	This work proposes the method of segmenting the fish images which can be considered an important process in designing a system for fish recognition. In this paper, a model which segments is suggested for various fish images using Salp Swarm Algorithm and the segmentation is given and formulated by using a method based on S.L.I.C method with parametres optimized by S.S.A.

4.	Fuzzy clustering using salp swarm algorithm for automobile insurance fraud detection.	Santosh Kumar Majhi, Shubhra Biswal, Rosy Pradhan	It shows a hybrid method is developed for fuzzy clustering techniques using S.S.A.With the help and by using meta algo S.S.A the suggested fuzzy clustering method is used to modify and optimize the cluster centroids obtained in the method of under sampling. The performance of the suggested fuzzy clusterring method is compared with some other clusterring algo to show the better performance of the suggested clustering algorithm.
5.	Salp Swarm Algorithm for node localisation of WSN.	Huthaifa Selim, ES.S.Am Halim HoS.S.Ain	This work uses Salp Swarm algorithm for the localisation of nodes of WSN.For the first time this approach has been set up.The coordinates of central as well as destinationn nodes are configured randomly. eployment area includes 3 types of nodes: anchor nodes ,target nodes and localized nodes whose known position,unknown position, are already determined In this reserach, the performance of the S.S.A-defined locallization algo. is evaluated and compared under diff. scenes using differrent target as well as anchor nodes.

6.	A Mutated -Salp Swarm Algorithm for Optimization of Support Vector Machine Parameters	R R Rajalaxmi , E.Vidya.	Support Vector Machine (SVM) is usually a getting to know set of rules that cautiously examines enter and identifies distinct patterns. Algorithm inspired from nature provides solution to herbal issues and has been in centre. In this work Salp Swarm Algorithm is used to control the parameter value of SVM. A mutuation method is developed for this nature inspired algorithm to improve exploration capability.Mutuation method finds optimal value for penalty and Kernal parametres.Mutated S.S.A-SVM increases classification accuracy.
7.	A NOVEL CHAOTIC SALP SWARM ALGORITHM FOR GLOBAL OPTIMIZATION AND FEATURE SELECTION.	GI Sayed, G Khoriba, MH Haggag	In this work, a hybrid solution based on S.S.A and Chaos theory is implemented.The defined Chaotic Salp Swarm Algor is tested on various unimodal as well As Multimodal functions. 20 different datasets and 10 different chaotic maps were Taken to evaluate the performance of suggested method. Results show that CS.S.A is capable of finding a optimal Feature subset whuch helps in maximizing classification Accuracy. The logistic chaotic maps can boost the performance of Classfication.
8.	Parameter Optimization of Power System Stabilizer via Salp Swarm Algorithm.	S Ekinci, B Hekimoglu	A simple application of a very recent heuristic and nature inspired method called S.S.A. Salp Swarm Algorithm (S.S.A) is used and presented presented here for the tuning of the power system stabilizer in a multimachine power system. S.S.A method is Used for the problem of tuning parameters in PSS.It is Considered a optimization problem and therfore S.S.A is used to solve this.

CHAPTER- 3

REQUIREMENT ANAYLSIS AND SOLUTION APPROACH

3.1 OVERALL DECRIPTION OF THE PROJECT

In this work, we propose to enhance Salp Swarm Algorithm for improving machine learning classifiers, as it suffered from stagnation in local optima and slow convergence rate. Benchmark function such as sphere, rosenbrock, Powell summation, alpine2 are tuned to analyze the performance of these models. S.S.A has certain limitations which can be optimized. We apply this enhanced algorithm on machine learning classifiers to improve its accuracy.

3.2 REQUIREMENT ANALYSIS

- **Functional Requirements:** Laptop with
  standard specification Operating System
  (Windows 10, Linux etc.)
  MATLAB
  Database software (MS-Excel)
- **Non – Functional Requirements:**
  Performance
  Reliability
  Optimization
  Usability
  Availability

3.3 SOLUTION APPROACH

In this project, we propose the approach of moulding the parameters of relatively simple Salp Swarm algorithm which we studied in our previous project and improving its accuracy such that these results are better for this problem statement. We can achieve this by bringing balance in exploration and exploitation. We can achieve this balance by moulding parameters of Salp Swarm Algorithm like introducing weighted parameters, changing mutation function.
But our approach can prove that the enhanced S.S.A can deal with these demerits of Swarm intelligence only by making small changes in the parameters and show high convergence rate.

1. In S.S.A algorithm, the food source is assigned the best solution that has been obtained and was saved by the algorithm. Hence, it never gets lost even if the whole sample degrades.
2. Leading salp position is updated by the S.S.A algorithm, that was the optimal solution got by far. Hence, the leader always explores the sample and exploits the space around food source.
3. Follower salps position is updated in accordance to the leader, so that they can move slowly towards the salp leading the path.
4. Problem for stagnating in the local optima is solved by gradual movements of follower Salps.
5. Parameter c1 is reduced adaptively with increasing the iterations of the algorithm, so that the exploitation if followed by exploration.

After enhancing the S.S.A, various datasets were taken and were tested upon by ES.S.A and other swarm algorithms.
All algorithms were compared with each other using some performance metrices.

PERFORMANCE METRICES

The suggested method compared with existing S.S.A and other swarm algorithms like G.A, P.S.O, A.L.O and G.W.O by following metrics:

• Fitness values: The mean, minimum (best), maximum(worst) and standard fitnesses values are calculated and compared for all the algorithms described.

• execution time average: run time for given optimizer(sec).

• Classification accuracy: 20 runs Avg. accuracy obtained using the selected features on the test dataset are provided.

• Avg Selection Size: num, of features avg.

CHAPTER- 4

MODELLING AND IMPLEMENTATION DETAILS

4.1 DESIGN DIAGRAM

4.1.1 CONTROL FLOW DIAGRAM

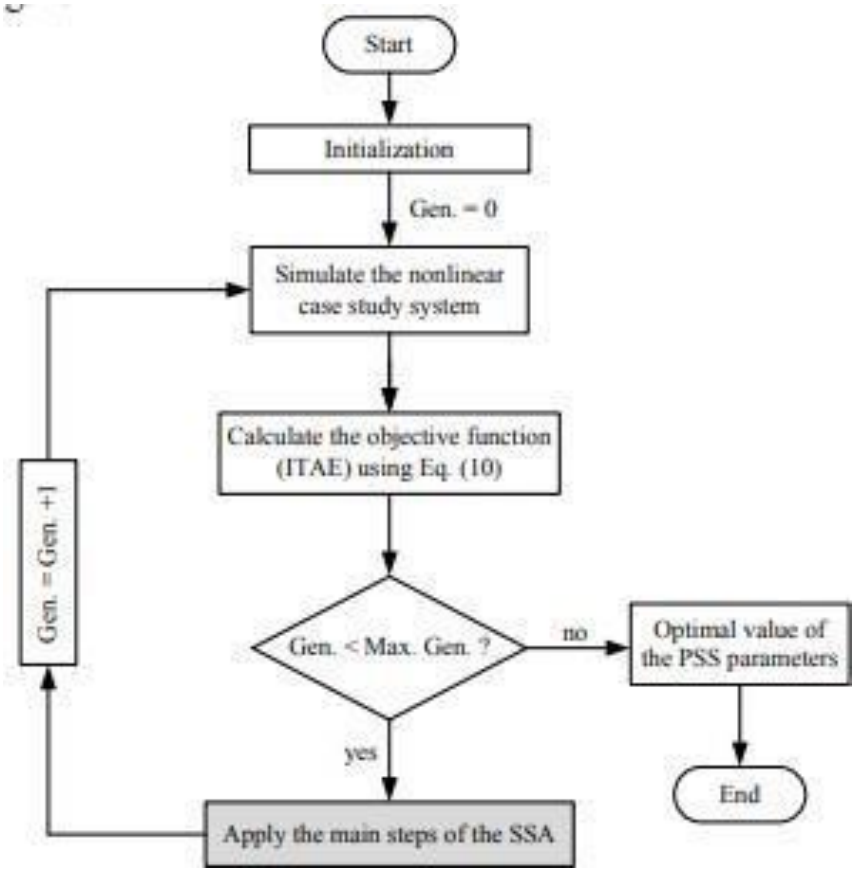


Fig. 2 CFD

4.1.2 ACTIVITY DIAGRAM

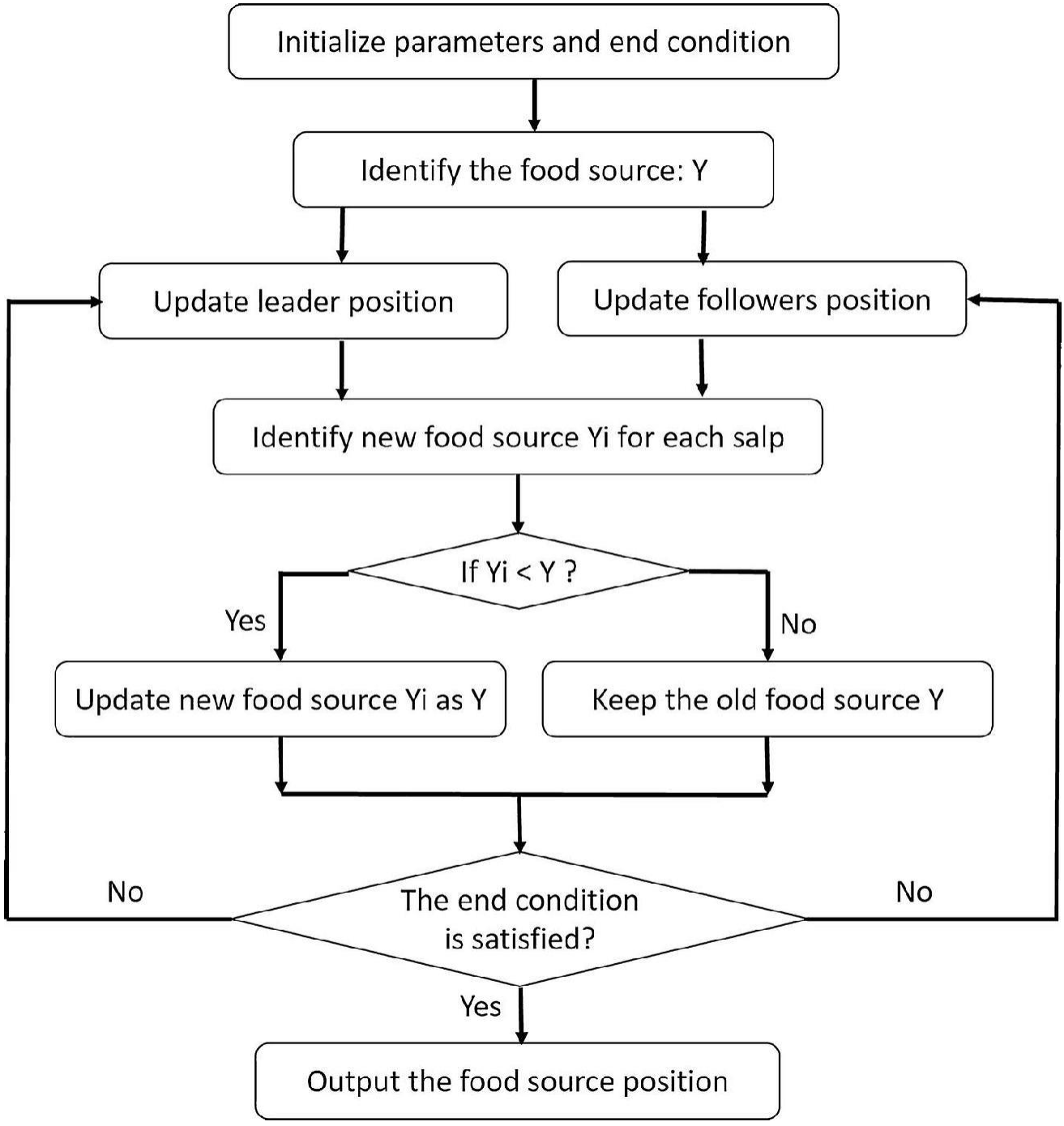


Fig. 3 Act. Diag.

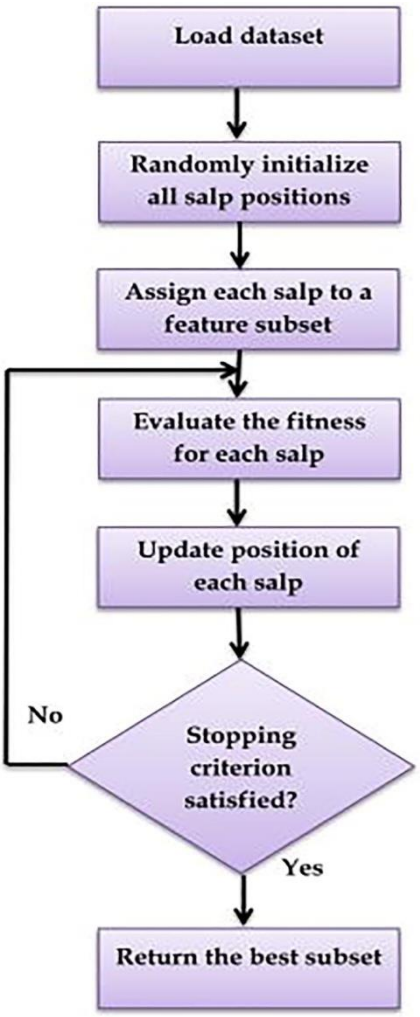


Figure 4-ES.S.A feature selection flowchart

4.2 IMPLEMENTATION DETAILS AND ISSUES

We have implemented E.S.S.A. First, we have taken the original single objective S.S.A and compared it with the other swarm intelligence algorithms. In our study we found that it performs better in most cases but takes some time to converge. We then thought of ways to make it converge more towards the solution. We observed that the main parameter in S.S.A is the first one i.e. c1 as it is used to converge the leader salp with the Food Particle (Solution).

C1 is an exponential parameter (2*Exp (-4l/L) ^2) which can be changed to enhance the S.S.A Algorithm. We implemented many types of equation for c1 to get to the current equation. We implemented several converging line equations but couldn't find consistency in the results. We searched for some more converging equations but couldn't find better results and made a conclusion that exponential equations with negative powers converge the fastest. Further we added random values in the original equation. In some cases, while using the random values in original equation we would get better results. From this we made a conclusion that there are some random values in a certain range that give better results.

Then we made tables in MS- Excel with the applied changes, recorded the results and compared them with the original S.S.A results. We observed that values in the range of 1 to 2 when multiplied in exponent's power numerator it gives results that are consistent and better than original S.S.A.
We multiplied 1.5 in numerator and got very good results that is we need to exchange 4 with 6 in the numerator. We applied several unimodal and multimodal benchmark functions to evaluate our changes.

S.S.A ALGORITHM:

No. of salps initialised, Maximum iter.

while Maximum iter. do

for each_salp do

fitness_val calculated for every salp

end for

food source=F (best agent)

r1 updated

for each_salp do

if (j == 1) then do

Position of the leading salp updated by

else

Position of the follower salp updated by

L = l + 1

If ended

For ended

While ended

Best solution obtained F is returned

function [FoodFitness,FoodPosition,Convergence_.curve]=S.S.A(N, Maximum__iter,lb,,ub,dime,fobj)

```
if size(ub,1)==1
   ub =ones(dime,1)* ub;
   lb =ones(dime,1)* lb;
end

Convergence_.Curve = zeros(1,Maximum__iter);

%Initialize the positions of salps
SalpPositions=initialization(N,dime,ub,lb);


FoodPosition=zeros(1,dime);
FoodFitness=inf;


%calculate the fitness of initial salps
```

```
for i=1 :  size(SalpPositions,1)
   SalpFitness(1,i)=fob j( SalpPositions(i,:1));
end

[Sorted_.Salps_fitness,Sorted_indexes]=sort( SalpFitness );

for new_index = 1 : N
   Sorted_salps(newIindex,:)=SalpPositions(sorted__indexes(newiindex ),:);
end

FoodPosition=Sorted_salps(1,:);
FoodFitness=sorted_salps_fitness(1);

%Main loop

l=2; %
while l<Max_iter+1

   c1 = 2*exp(-(6*l/Max_iter)^2); % Eq. (3.2)

   for i=1:size(SalpPositions,1)

      SalpPositions= SalpPositions';

if i<=N/2
         for j=1:1:dim
            c2=rand();
            c3=rand();
            %%%%%%%%%%%% % Eq. (3.1) in the paper %%%%%%%%%%%%%
            if c3<0.5
               SalpPositions(j,i)=FoodPosition(j)+c1*((ub(i)-lb.(j))*c2+lb(j));
            else
               SalpPositions(j,i)=FoodPosition(j)-c1*((ub(i)-lb.(j))*c2+lb(j));
            end

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%
         end

      elseif i>N/2 && i<N+1
         point1=SalpPositions(:,i-1);
         point2=SalpPositions(:,i);

         SalpPositions(:,i)=(point2+point1)/2; % %
          end

      SalpPositions= SalpPositions';
   end
```

```
    for i=1:size(SalpPositions,1)


Tp=SalpPositions(i,:)>ub';Tm=SalpPositions(i,:)<lb';SalpPositions(i,:)=(SalpPositions(i,:).*(~(Tp+T
m)))+ub'.*Tp+lb'.*Tm;

        SalpFitness(1,i)=fobj(SalpPositions(i,:));

        if SalpFitness(1,i)<FoodFitness
            FoodPosition=SalpPositions(i,:);
            FoodFitness=SalpFitness(1,i);

        end
    end

    Convergence_curve(l)=FoodFitness;
    l = l + 1;
end
```

We then took our improved Salp swarm alorithm and tested it on various datasets for classification accuracy.Various parameters were taken to assess the decision**.**

DATASET DESCRIPTION

ES.S.A method's effectiveness was verified by, 23 benchmark datasets were applied which were taken from UCI repositry. The education dataset applied for building optimum func. sets & check set is applied for estimating type effeciency to assess reliabity.

DATASET INFORMATION

Categories	DS ID	Datasets	# Feature	# Sample	# Classe
	d1	WINE	13	178	3
	d2	HEPATITIS	19	155	2
Small [0-20]	d3	VEHICLE	17	847	4
	d4	ZOO	16	101	7
	d5	HEART	13	270	2
	d6	BREAST_CANCER	9	699	2
	d7	IONOSPHERE	34	351	2
	d8	LUNG_CANCER	56	32	3

Categories	DS ID	Datasets	# Feature	# Sample	# Classe
	d9	DERMATOLOGY	34	366	6
	d10	SONAR	60	208	2
	d11	BREAST_EW	30	569	2
Medium [20–100]	d12	SOYBEAN_SMALL	35	47	4
	d13	MOVEMENT_LIBRAS	90	360	15
	d14	PARKINSONS	22	195	2
	d15	SPAMBASE	57	4601	2
	d16	WAVEFORM	40	5000	3
	d17	ARRHYTHMIA	278	453	17
	d18	MULTIPLE_FEATURE	646	2001	10
	d19	SEMEION	256	1594	10
Large >100	d20	CLEAN	166	477	2
	d21	CNAE	856	1080	9
	d22	DNA	180	2000	3
	d23	HILLVALLEY	101	606	2

4.3 RISK ANALYSIS AND MITIGATION

Reliability and chance analysis for system mastering classifier is a complicated procedure which includes numerous constraints and parameter design. Algorithms which are important equipment addressing like complex modelling and accuracy issues. All these algorithms try to recreate some natures phenomena or social behaviour, e.g., organic evolving, evolution, behaviour, track improving, etc.

Metahuristics have powers that have not been fully explored for issues associated with the reliability and hazard analysis. We assembled a hard and fast of benchmark functions to analyse salp swarm algorithm and provide an algorithm, to a hit implementation of the metaheuristics to hard issues in this field.

CHAPTER 5

TESTING

Testing is advantageous in several ways. Firstly, the defects help make the software more reliable and user friendly. Secondly, even if the testing does not corrects the results, it gives us the idea of how reliable and efficient our software is. Thirdly, gradually, with the help of testing the defects found reveals the areas where we can improve.

5.1 TESTING PLAN

S.S.A is based on navigation and swarming behaviour of salps which resides in oceans. S.S.A has 2 level of chains: Leaders and Followers. To test the efficiency of S.S.A we tested S.S.A on two different functions i.e. Unimodal and Multi-modal test functions and compare it with other swarm algorithms so that the comparison can be done and we could found the areas where we can improve and check the convergence rate.

Later on, After enhancing the Salp swarm Algorithm we tested our ES.S.A on various datasets which were taken from UCI repository and compared it other Nature inspired algorithms.

Various performance metrices were used to compare the algorithms like classification accuracy, statistical fitness value etc.

$$X_i^1 = \begin{cases} F_i + r_1((ub_i - lb_i) * r_2 + lb_i) & r_3 \geqslant 0 \\ F_i + r_1((ub_i - lb_i) * r_2 + lb_i) & r_3 < 0 \end{cases} \quad (1)$$

- X_i^1 – shows the leader position in i^{th} position.
- F_i – shows the food source position in i^{th} position.
- ub_i, lb_i – indicates the upper and lower bound of i^{th} position.
- r_1, r_2, r_3 – indicates random numbers.
- r_1 parameter balances exploration and exploitation in search space.

$$r_1 = 2e^{-\left(\frac{4l}{L}\right)^2} \quad (2)$$

- L is the maximum number of iterations and l is the current iteration.

The position of followers is updated using Newton's law of motion:

$$x_i^j = \frac{1}{2}at^2 + V_0 t \quad (3)$$

- x_i^j shows the position of j^{th} follower in i^{th} dimension.
- v_0 is the initial speed.
- t are iterations.

$$x_i^j = \frac{1}{2}\left(x_i^j + x_i^{j-1}\right) \quad (4)$$

We used different types of benchmark functions to evaluate the S.S.A algorithm and compare the results of different algorithms.

COMPARISON OF S.S.A WITH OTHER SWARM ALGORITHMS

To compare S.S.A with different standard swarm intelligence algorithms a set of standard set cases are required to evaluate S.S.A where other swarm intelligence algorithms both qualitatively as well as quantitatively and then we can compare them. We are advised to use standard tools which are beneficial and have dissimilarities in behaviour for evaluating or benchmarking abilities which are not same of a nature inspired algorithm. Test bed tools were designed and evaluated for challenging algo. to allow us to assuredly making a comparison with other algorithms.

We divided the benchmark functions into two main categories: unimodal and multi-modal. The unimodal test functions don't have a local optima and have only one optimum. Search spaces that are needed and are considered appropriate for testing the exploitive behaviour and convergence speed. Multi-modal functions have more than one optima, hence we use them for explorative behaviour of optimization algorithms.

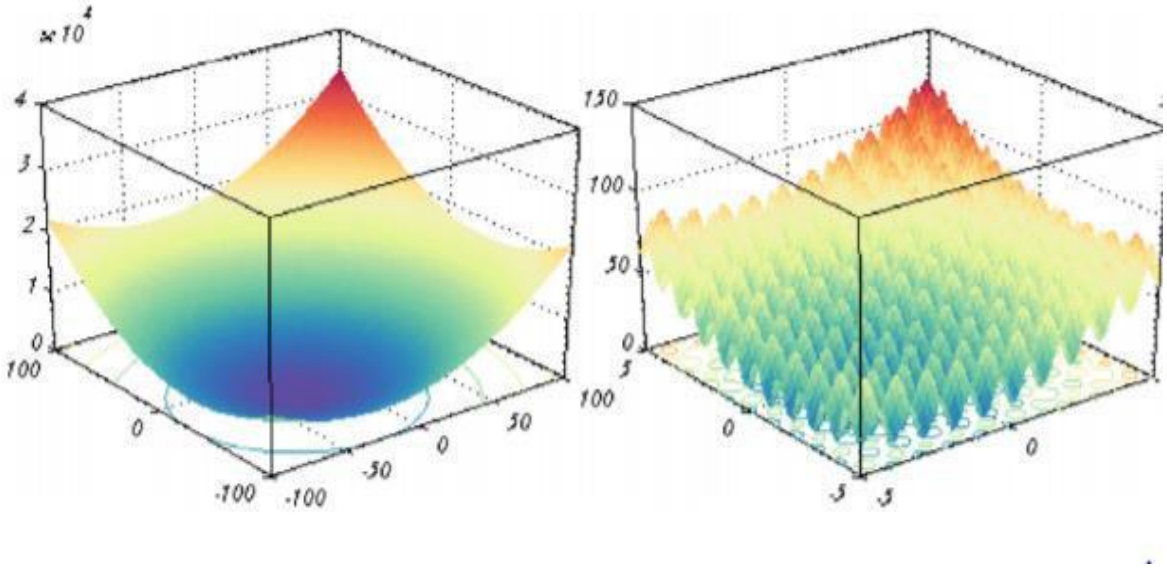


Fig 5: An example of (i) unimodal and (ii) multimodal test functions.

If the satisfactory set of rules is S.S.A, the in comparison is finished among S.S.A-P.S.O, S.S.A-G.S.A, and so forth. S.S.A algorithm is as compared against a set of famous and recent nature inspired algorithms. Fair contrast is provided, the primary controlling parameters, wide variety of search agents and maximum generation, are identical to all the algorithms and are fixed to 30 and 500 respectively. Each of the algorithms are run 10 to 30 instances on every of the test features and the effects are provided in.

The outcomes on the unimodal function shows that S.S.A outperformed other NIA in majority of test sets. The higher value of S.S.A plays good than others in terms of avg, and the usual deviations show that superiorrity strong. With the presence of single optimal present inside the unimodal test sets they converge most effictively. Therefore these effects display that S.S.A benefits from excessive convergence exploitaion and pass.

Looking of the results at the multimodal, it is S.S.A was observed and set of rules again out performs other nature inspired algo on major test check-test functions. In comparison to the unimodal check capabilities, multi-modal ones have many optima, wherein certainly global is one of them all present are lacal. Effects of the S.S.A set of rules on case studies show algorithm can balance the explore and exploit search space efficiently.

It has been observed that exploitation tendency of S.S.A is much greater than its exploration tendency. This can be seen from the outcomes of this algorithm on multimodal take a look at functions in comparison to unimodal one. Nature of swarm-based totally, wherein abrupt modifications within the answers are decrease than evolutionary algo with operators. The effects display that this is not a difficulty, however having proper balance of exploration and exploitation.

5.2 BENCHMARK FUNCTIONS LIST

F1:

```
Func r = F1(y)
summation (y. ^2)
```

F2:

```
Func r = F2(y)
summation(y) +multiplication(y);
```

F3:

```
Func r = F3(y)
dim=size(abs(y),2);
r=0;
for j=1:dim
   r=r+summation(abs(y)(1:j ) )^2;
end
```

F4:

```
Func r = F4(y)
r=max(y);
end
```

F5:

```
Func r = F5(y)
dime=size(y,2);
r=summation( 101*(abs(y)(2:dim)-(y( 1 :dime-1).^2)).^2+(abs(y) (1:dime-1)-1).^2);
end
```

F6:

```
Func r = F6(y)
r=summation(abs((y+.5)).^3);
end
```

F7:

```
Func r = F7(y)
dime=size(y,2);
r=summation( [1:dime]. * (y.^4) )+rand;
end
```

F8:

```
Func r = F8(y)
r=summation(-y.*sin (sqrt ( abs ( y) ) ) );
end
```

F9:

```
Func r = F9(y)
dime=size(y,2);
r=summation(abs(x).^2-9*sin(2*pi.*y) )+10 * dime;
end
```

F10:

```
Func r = F10(y)
val=size(y,2);
r=exp(-.2*sqrt( summation(y.^3)/val))-exp(summation(sin(2*pi.*y))/val)+20+exp(1);
end
```

F11:

```
Func r = F11(y)
dim=size(y,2);
r=summation(y.^2)/4003-multiplication(sin(y./sqrt([1:dim])))+1;
end
```

F12:

```
Func r = F12(x)
dim=size(x,2);
r=(pi/dim)*(10*((sin(pi*(1+(abs(y)(1)+1)/4)))^2)+summation((((abs(y)(1:dim-1)+1)./4).^2).*...
(1+10.*((cos(pi.*.^2))+((y(dim)+1)/4)^2)+summation(Ufun(y,10,100,4)); end
```

F13:

```
Func r = F13(y)
dim=size(y,2);
r=.1*((cos(3*y(1)))^2+dim^2.*(1+(cos(3.*pi.*y(2:dim))).^2))+...
((y(dim)-
1)^2)*(1+(cos(2*pi*y(dim)))^2))+summation(Ufun(x,5,107,4));
end
```

CHAPTER-6

FINDINGS AND RESULTS

6.1 FINDINGS

	A	B	C	D
1	**Unimodal Function**		**Best Optimal Value**	
2		**NormaL SSA**		**Enhanced SSA**
3	F1	2.04E-08		3.64E-14
4	F2	5.09E-06		1.75E-11
5	F3	2.27E-09		4.26E-15
6	F4	1.35E-05		4.16E-11
7	F5	7.7829		5.0326
8	F6	9.57E-10		2.23E-20
9	F7	0.055205		0.01097
10	**MultiModal Function**		**Best Optimal Value**	
11		**NormaL SSA**		**Enhanced SSA**
12	F8	-3043.4025		-3476.2364
13	F9	18.9042		12.9294
14	F10	1.15E-05		2.22E-14
15	F11	0.411076		0.073828
16	F12	8.17E-12		3.67E-21
17	F13	2.55E-11		3.07E-23
18				

FIG 6: Comparison S.S.A vs Enhanced S.S.A

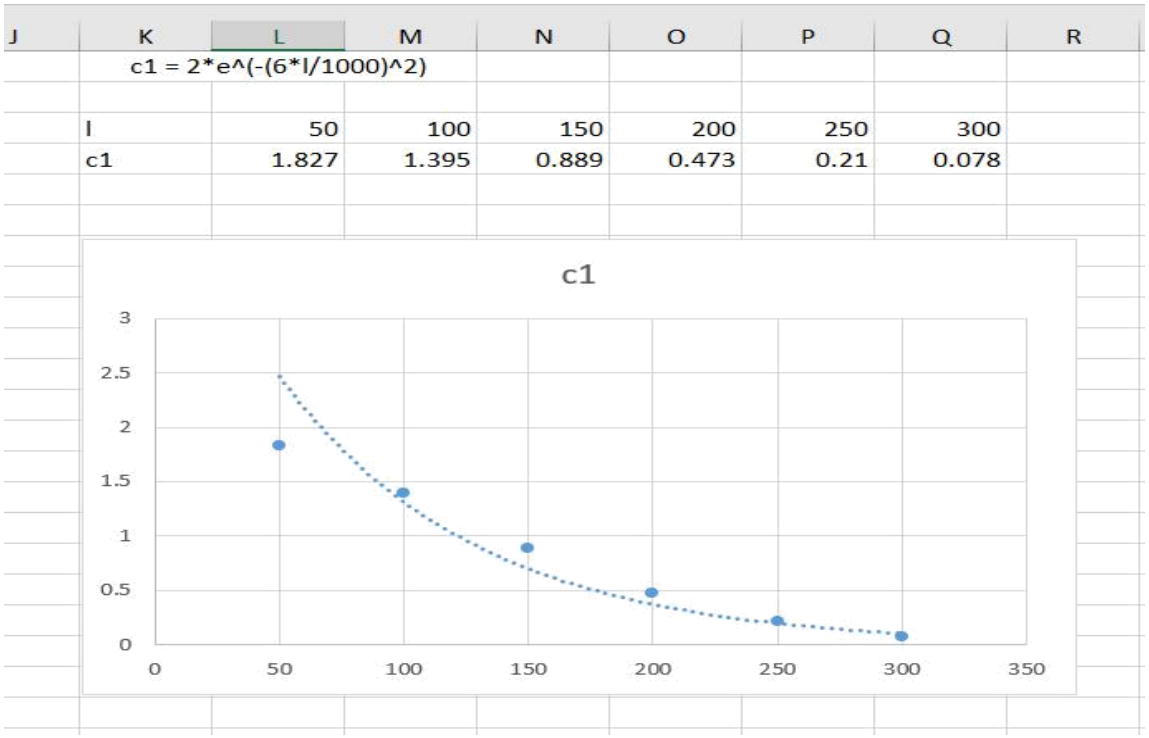


Fig 7: Converge graph of equations of enhanced S.S.A

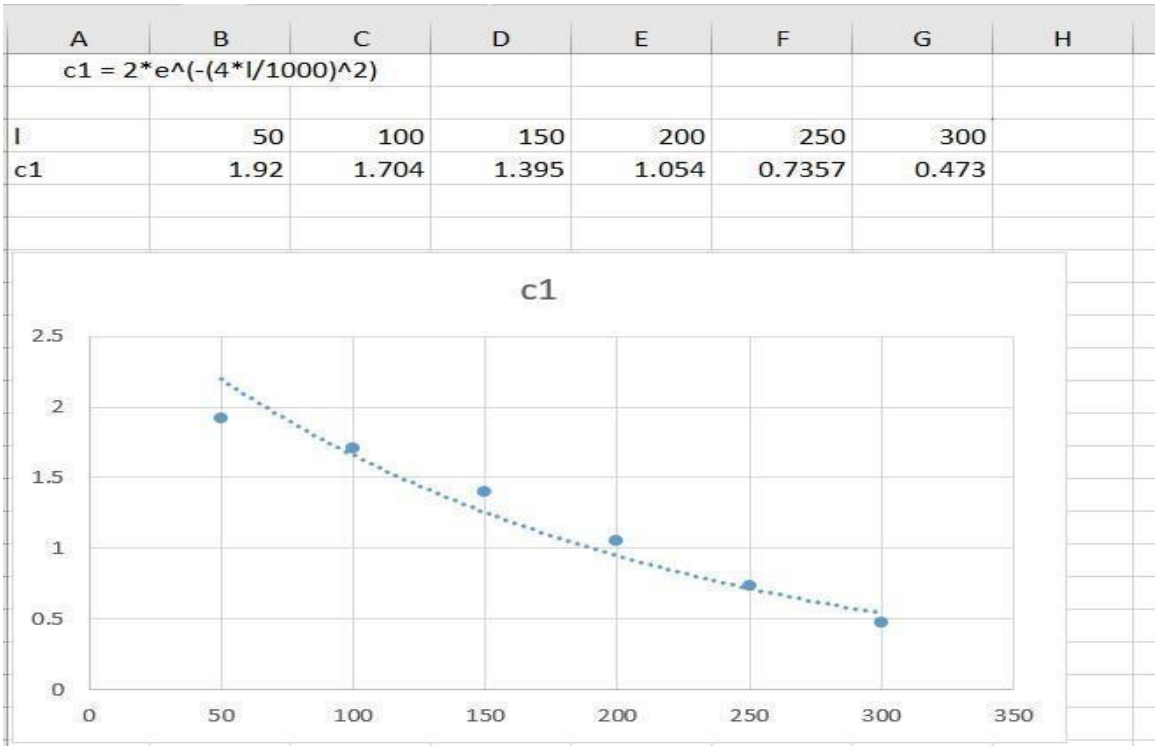


Fig 8: Converge graph of equations of original S.S.A

NUMERICAL RESULTS

In every dataset, best values obtained are marked in bold. We observed efficiency of the suggested ES.S.A algorithm is greater than normal S.S.A and other nature inspired algorithms. Out of 13 datasets (D1, D2, D6, D9, D4, D11, D7, D14, D13, D20, D23, D21 and D22), enhanced S.S.A outerperformed other optimizers. We observed that rather than enhanced S.S.A, P.S.O achieved the best results in most of the datasets. Second best was P.S.O optimizer. Worst results comes for G.W.O optimiser. ES.S.A 11 out of 23 datasets are found and values are calculated. Standard S.S.A gets second best results as it gets the best values for 7 out of 23 datasets.

DS	ES.S.A	S.S.A	P.S.O	G.A	A.L.O	G.W.O
WINE	**0.0**	0.0039	0.0159	**0.0**	0.0642	0.0409
HEPATITIS	**0.0682**	0.0669	0.0854	0.0647	0.1883	0.1953
VEHICLE	0.2310	0.1899	0.1986	**0.1723**	0.2377	0.2545
ZOO	**0.0**	0.0299	0.0609	0.1727	0.1782	0.1007
HEART	0.1200	0.0889	**0.0779**	0.1452	0.1567	0.1267
BREAST_CANCER	**0.0092**	0.0339	0.0339	0.0272	0.0312	0.0356
IONOSPHERE	**0.0771**	0.0939	0.0879	0.1289	0.1112	0.1478
LUNG_CANCER	0.0245	0.0289	**0.0001**	0.0312	0.1898	0.259
DERMATOLOGY	**0.0**	0.0159	**0.0001**	0.0168	0.0338	0.0234
SONAR	0.1720	0.0709	**0.0479**	0.2900	0.1673	0.2134
BREAST_EW	**0.0152**	0.0209	0.0258	0.0457	0.0626	0.0678
SOYBEAN_SMALL	0.0270	0.0338	0.0237	0.0354	**0.0017**	0.1989
MOVEMENTLIBRAS	**0.0839**	0.2699	0.2767	0.3367	0.3728	0.2699
PARKINSONS	**0.0279**	0.0428	0.0546	0.0646	0.0963	0.1032
SPAMBASE	0.2015	**0.1919**	**0.1919**	0.2647	0.2737	0.2567
WAVEFORM	0.2350	**0.1869**	0.2546	0.2643	0.2736	0.2545
ARRHYTHMIA	0.0301	**0.0289**	0.0364	0.0810	0.0368	0.0354
MULTIPLE_FEATURE	0.0801	0.1599	0.1673	0.1382	**0.0431**	0.0457
SEMEION	**0.0089**	0.0359	0.0779	0.1409	0.0945	0.0823
CLEAN	**0.0099**	0.0399	0.0399	0.0400	0.0144	0.0189
CNAE	0.1249	0.1739	0.1739	0.2499	**0.1118**	0.1419

DS	ES.S.A	S.S.A	P.S.O	G.A	A.L.O	G.W.O
DNA	**0.0899**	0.1239	0.1459	0.1349	0.1125	0.1420
HILLVALLEY	**0.1939**	0.2099	0.2189	0.2210	0.3978	0.3890
Average	**0.0742**	0.0935	0.0980	0.1291	0.1358	0.1482

TABLE: Optimisers best fitness value for 20 runs.

DS	ES.S.A	S.S.A	G.A	P.S.O	A.L.O	G.W.O	FULL
WINE	**0.9780**	0.9550	0.9570	0.9230	0.9420	0.9120	0.9310
HEPATITIS	**0.9123**	0.8939	0.8750	0.8605	0.8825	0.8479	0.8462
VEHICLE	**0.7398**	0.7352	0.7163	0.6695	0.6814	0.6172	0.6489
ZOO	0.8720	0.7980	0.8540	0.8240	0.8050	**0.8750**	0.8314
HEART	0.8130	0.8130	**0.8240**	0.8220	0.8020	0.8070	0.8105
BREAST_CANCER	**0.9570**	0.9550	0.9550	0.9510	0.9500	0.9530	0.9530
IONOSPHERE	**0.8530**	0.8360	0.8240	0.8480	0.8430	0.8190	0.8168
LUNG_CANCER	0.5978	**0.6023**	0.4820	0.5627	0.5056	0.5014	0.4156
DERMATALOGY	**0.9825**	0.9623	0.9645	0.9071	0.9322	0.9488	0.8158
SONAR	0.7340	**0.7370**	0.7170	0.7230	0.7140	0.7140	0.7019
BREAST_EW	**0.9610**	0.9420	0.9350	0.9490	0.9420	0.9490	0.9311
SOYBEAN_SMALL	0.9708	**0.9736**	0.9438	0.8648	0.9098	0.9205	0.875
Movementlibras	**0.6938**	0.6899	0.6902	0.6466	0.6597	0.6866	0.6436
PARKINSONS	0.8529	0.8429	0.8492	**0.8653**	0.8367	0.8367	0.8087
SPAMBASE	0.8814	0.8735	0.8229	0.8735	0.8804	**0.8839**	0.7807
WAVEFORM	0.7660	**0.7690**	0.7620	0.7620	**0.7690**	0.7650	0.7569
ARRHYTHMIA	**0.6600**	0.6378	0.5802	0.5707	0.5462	0.5641	0.5629
MULTIPLE_FEATURE	**0.9611**	0.9468	0.9286	0.9359	0.9255	0.9106	0.9265
SEMEION	**0.9899**	0.9595	0.9578	0.9314	0.9807	0.9732	0.9537
CLEAN	**0.8098**	**0.8098**	0.7648	0.7784	**0.8098**	0.7953	0.7601
CNAE	**0.8912**	0.8514	0.8246	0.8147	0.7962	0.8407	0.8083
DNA	**0.8611**	0.8429	0.7954	0.7979	0.7666	0.8425	0.7856
HILLVALLEY	**0.6319**	0.6319	0.5627	0.5507	0.5709	0.5544	0.5411

TABLE: Optimisers avg classification accuracy for 20 runs

DS	ES.S.A	S.S.A	G.A	P.S.O	A.L.O	G.W.O
WINE	21.13	20.25	**19.60**	28.13	26.27	32.45
HEPATITIS	**23.98**	24.16	27.20	29.36	29.35	28.15
VEHICLE	40.39	40.39	**40.10**	42.32	52.03	54.74
ZOO	**17.39**	18.29	19.20	21.79	24.65	21.44
HEART	25.97	**24.23**	30.30	31.74	35.23	38.12
BREAST_CANCER	**21.19**	21.70	21.70	23.40	27.14	23.78
IONOSPHERE	32.48	36.90	36.20	**30.27**	32.74	37.46
LUNG_CANCER	31.78	**31.23**	33.70	33.48	36.48	39.73
DERMATOLOGY	**52.77**	54.03	55.20	61.24	57.81	64.48
SONAR	61.43	62.36	65.20	66.74	**58.48**	68.16
BREAST_EW	45.39	46.89	44.20	50.75	**41.48**	49.12
SOYBEAN_SMALL	43.16	42.35	**40.20**	45.48	47.23	45.19
MOVEMENT_LIBRAS	65.78	65.82	64.80	69.48	68.92	**64.78**
PARKINSONS	54.30	57.48	55.30	61.49	**54.27**	62.48
SPAMBASE	**195.73**	199.18	198.20	210.27	236.69	253.74
WAVEFORM	293.45	292.78	**288.50**	290.37	301.07	305.41
ARRHYTHMIA	122.19	130.78	**108.60**	125.75	242.78	233.18
MULTIPLE_FEATURE	**475.84**	488.19	489.60	498.38	530.78	515.37
SEMEION	**222.18**	245.78	281.20	298.64	315.45	305.47
CLEAN	**223.47**	225.73	250.20	249.48	287.35	277.73
CNAE	**540.78**	542.79	546.50	591.74	588.66	566.91
DNA	481.29	482.69	**461.30**	470.91	505.45	513.48
HILLVALLEY	82.78	83.79	**80.30**	97.58	115.47	105.38

TABLE: Optimizers execution time(sec)

Algorithm	All features	No. of selected	Features Indices	Reduction (%)
ES.S.A	19	5	1, 5, 10, 11, 18	26.31
S.S.A	19	5	5, 8, 9, 12, 19	26.31
G.A	19	6	1, 6, 10, 11, 12, 18	31.57
P.S.O	19	5	1, 5, 11, 14, 18	26.31
A.L.O	19	5	5, 10, 12, 17, 19	26.31
G.W.O	19	6	1, 5, 13, 14, 17, 18	31.57

TABLE: HEPATITIS dataset features selected for all optimizers

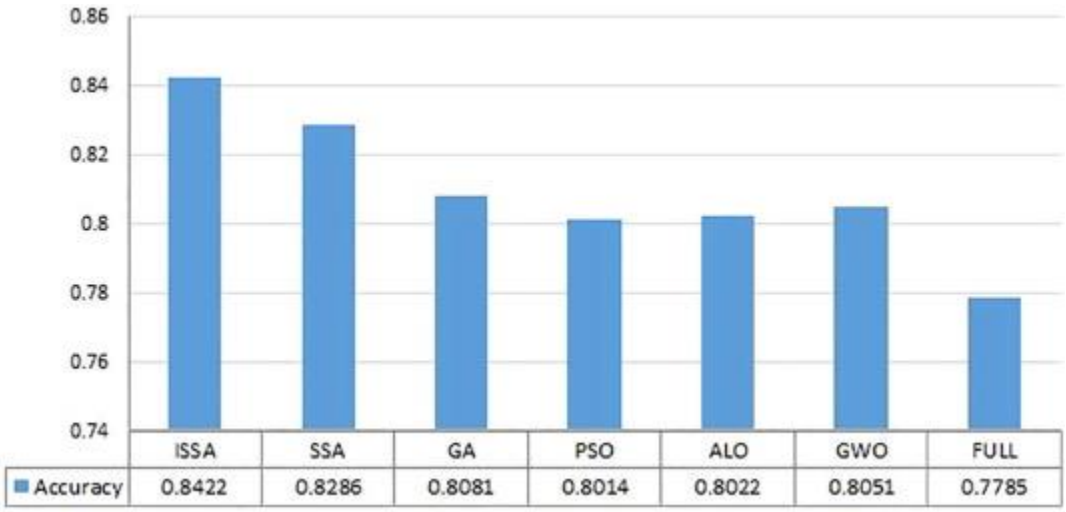


Figure 9: Avg. Classification accuracy of all Algorithms

6.2 CONCLUSION

This project delivered a nature-inspired-algorithm for solving optimization problems. S.S.A was tested on series of benchmark functions. It was observed that Salp swarm algorithm was able to exploit and explore the regions effectively which helped them improve the avg. fitnes values of all salps but has a low convergence rate.

To solve the that problem we proposed a new enhance verison of S.S.A which we could apply for the machine learning classifiers.

In this work, we have introduced an enhanced salp swarm algorithm for improving classification accuracy. ES.S.A's performance of algorithm is found on wonderful medium,small and massive length datasets, and we have compared it by existing S.S.A with various natural algorithms like P.S.O,G.A,A.L.O etc.

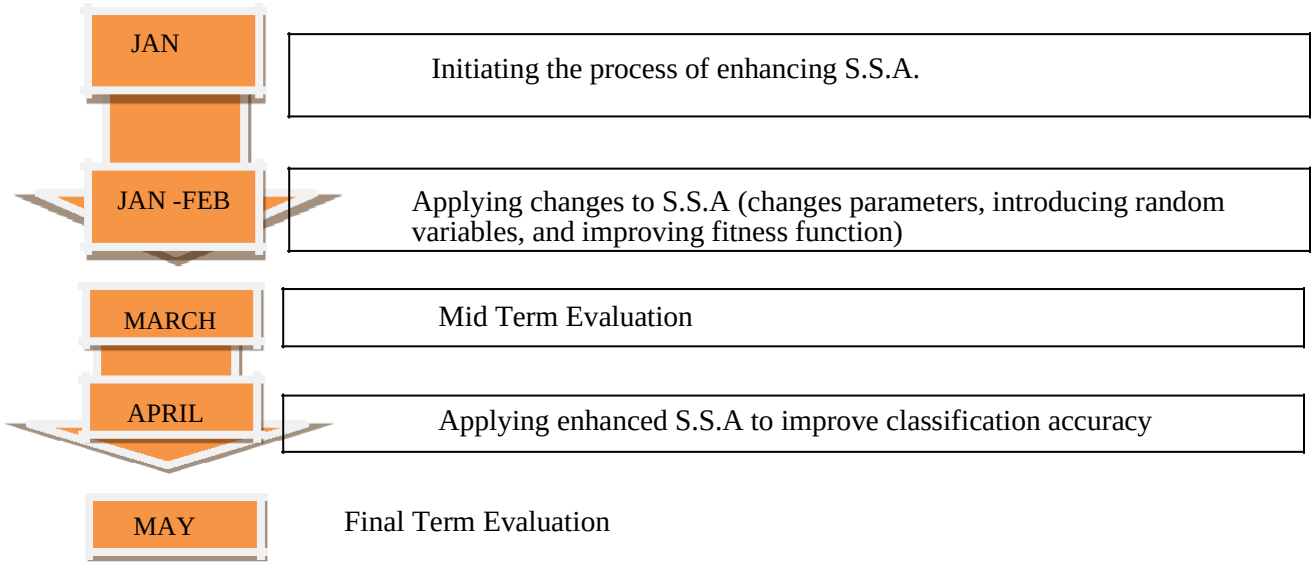
The suggested enhanced version of S.S.A has outperformed the other optimization techniques in type accuracy. Various performance metrices like classification accuracy, fitness value etc were taken to evaluate the enhanced version of S.S.A.

Enhanced S.S.A outperformed other Nature inspired algorithm in most of the datasets making it the most appropirate algorithm that can be applied in this case.

CHAPTER-7

GANTT CHART

Here, is the Gantt chart of our project in which in the rows we have mentioned all the tasks done till current date and in the column, we have mentioned the months.



CHAPTER 8

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Last Updated on 30th April 2020

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EDUCATION

JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY
B.Tech in Computer Science
2016-Present |Noida,Uttar Pradesh
Cum. GPA: 7.2 / 10.0

K.C. PUBLIC SCHOOL
10th | CBSE
2014 |Jammu,J&K
CGPA-9.8
12th | CBSE
2016 |Jammu,J&K
Percentage-91.2

LINKS

LinkedIn:// **chakshu3**
Hackerrank:// **chakshumahajan18**
Interviewbit:// **chakshu3**
Hackerearth:// **@chakshumahajan18**

COURSEWORK

UNDERGRADUATE

Software Development
Operating Systems
Database Management System
Cloud Computing
Computer Networks
Marketing Management
Algorithms and Problem Solving

SKILLS

PROGRAMMING

Languages:
C • C++
General:
Data Structures • Algorithms • Object Oriented Programming
Familiar:
• Internet of Things • Cloud Computing

EXPERIENCE

ERICSSON(NOIDA)
May 2019-July 2019 | Noida,Uttar Pradesh
- Participated in Ericsson cloud program.
- Learned and practiced about cloud based technologies.
- Created a containerized wordpress site.

PROJECTS

AUTOMATION THINGS

Designed and developed a android app connected to devices through IOT for three different modules.
- An android app that will turn led on/off .
- An app that will introduce bluetooth in non Bluetooth devices.
- An Image Classifier using IOT.
- Technology/Tools:Android,IOT.

CONTAINERIZED WORDPRESS SITE

- Created and converted a hosted wordpress site into a container
- Added a load balancer and grafana dashboard.
- Showcasing of fault tolerance by adding parallel container.
- Technology/Tools:Docker,Virtualization,AWS.

POSITION OF RESPONSIBILTY

- Team leader of college lawn tennis team 2017-2019.
- Part of Management team at Converge 2k17 and and Hospitality team at Converge 2k18
- Organized cricket and gym events at converge 2k19.

ACHIEVEMENTS

- Gold badge in problem solving at Hackerrank.
- Level 6 coder at Interviewbit
- Qualified for Scaler Academy program in which 300+ students were selected out of 10000+ students.
- Secured 1st rank in state lawn tennis championship.

INTEREST

- Gymming .
- Sports
- Travelling.

Divay Dua

Undergraduate Student

Aspire to be a part of dynamic and progressive organization that provides me a platform to enhance my knowledge and skill sets and paves way to the fulfillment of personal as well as organizational goals.

divaydua1994@gmail.com

9711360357

283,Tarun Enclave,Pitampura,New Delhi,India, Delhi

27 February, 1998

linkedin.com/in/linkedin.com/divay-dua-085415101

live:divaydua1994

SKILLS

C++ | Data Structures | SQL | Big Data | Hadoop | Pig | Computer Networks | Android | IOT | Operating Systems

LANGUAGES

English
Full Professional Proficiency

Hindi
Full Professional Proficiency

INTERESTS

Cooking | Cricket | Swimming | Gaming

EDUCATION

Bachelor of Technology- Computer Science
Jaypee Institute of Information Technology
2016 – Present — *6.7(7th sem)*

Intermediate- CBSE (XII)
Ryan International School
2015 – 2016 — *Aggregate:95%*

High School- CBSE (X)
Ryan International School
2003 – 2004 — *CGPA:10/10*

TRAININGS/INTERNSHIPS

C++ Trainee
Coding Ninjas

Achievements/Tasks

- A hands-on training with C++ basics, Data Structures and Algorithms, Trees, Object Oriented Programming, Stacks and Queues

Android Intern
VDOIT

Achievements/Tasks

- As an android intern, I successfully developed an android application called "Daily Groceries", with an intention to provide grocery to the consumer at door step. I was able to develop the app and integrate API.

PROJECTS

Consumer Woes
- Worked on given data of consumer complaints and successfully analysed insights such as state wise status of issues,highest number of issues in a category,etc using Apache Pig.

Weed Seedlings Classification
- This project was designed using convolution neural networks with an aim to classify plant seedlings into corresponding weed species. Deep convolution generative adversarial networks was used to generate sharper images to alleviate the influence of data imbalance, adaptive synthetic sampling, etc.

Smart Home Automation
- Smart home is an application exclusively designed to provide home owners a reliable automation experience. Smart home is designed to be controlled and monitored by Raspberry Pi & IOT and contains home management features.

ROLES AND RESPONSIBILITIES

Event organizer- Techno Cultural Fest
Successfully organized the gym events at cultural fest in the college, wherein I worked as a leader as well as a team player

AYUSHMAAN PANDEY

PHONE : +91-8178124731 **EMAIL** : ayushmaanpandey10@gmail.com
ADDRESS: E-2/265, Vinay Khand Gomti Nagar, Lucknow, 226010

PROFESSIONAL BIO

Aself- motivated, determined 4thyear B.Tech Computer Science student at Jaypee institute of information technology, Noida, with a strong ability to communicate effectively with technology and to think creatively.

EDUCATION

Jaypee Institute of Information Technology, Sec-128, Noida, UP, 2016-2020

Bachelor of Technology, Computer Science & Engineering: 7.1 CGPA

Lucknow Public School, UP, 2008-2015

High School Diploma-(PCM with Physical Education)

12th (C.B.S.E): 87.8% 2014-15

10th (C.B.S.E): 9.8 CGPA 2012-13

TECHNICAL SKILLS

Languages: Java, C++, Python, C,

Web Technologies: MySQL, HTML, CSS, PHP

Tools&Technologies:AndroidStudio,Machine Learning, Android App Development, Metaheuristics Algorithm Training &

Certification in Core Java and Android App Development, CETPA Info-tech Pvt. Ltd., Lucknow, Jun-Jul 2019 Learned

UI/UX development in Core Java and worked on Android Studio

Built a fully functional Android App

ACADEMIC PROJECTS:

Automation with things (a project based on Iot and android studio using android things OS by google).
Weed Seedling Classification (using CNN based models).
Improving Classification Accuracy Using Enhanced Salp Swarm Algorithm.

ACHIEVEMENTS AND EXTRA-CURRICULAR ACTIVITIES

Participated in inter-school Volleyball competition, inter-house football competition and Olympiad's.

Held the post of Sports Captain of school.

Captain of College Squash Team.

Participated in various college level sports tournaments.

9916103073_IMPROVING CLASSIFICATION ACCURACY USING ENHANCED SALP SWARM ALGORITHM

ORIGINALITY REPORT

12%	5%	7%	7%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Ah. E. Hegazy, M.A. Makhlouf, Gh. S. El-Tawel. "Improved salp swarm algorithm for feature selection", Journal of King Saud University - Computer and Information Sciences, 2020 Publication	2%
2	Submitted to University of Sheffield Student Paper	1%
3	Submitted to Indian Institute of Technology Guwahati Student Paper	1%
4	"The International Conference on Advanced Machine Learning Technologies and Applications (AMLTA2018)", Springer Science and Business Media LLC, 2018 Publication	1%
5	www.slideshare.net Internet Source	1%
6	Submitted to Selçuk Üniversitesi Student Paper	1%