

AN OVERVIEW OF ADVANCE OPTIMIAZATION TECHNIQUES

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Science degree in Mathematics (B.sc Mathematics)

By

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SCHOOL OF SCIENCE AND HUMANITIES**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work of **Arunachi.k**
(39060003) who have done the Project work who carried out the project entitled
"AN OVERVIEW OF ADVANCED OPTIMIZATION TECHNIQUES" under our
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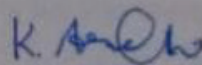
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DECLARATION

I **Arunachi.k (39060003)** hereby declare that the Project Report entitled **An overview of an advanced optimization techniques** done by me under the guidance of **DR.S.Maheswari** (Internal) and _____ (External) at **Sathyabama Institute of Science and technology** is submitted in partial fulfillment of the requirements for the award of **Bachelor of Science degree in Mathematics.**

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ABSTRACT :

This Project mainly discussed about the recent updates and development of advanced optimization Techniques. The various sub-disciplines of (OR) yield both analytic and computational tools that allow for mathematical modelling and efficient problem solving. Operations research is the discipline of applying advanced analytical methods to help make better decisions. It aims to provide rational bases for decision making by seeking to understand and structure complex situations and to use this understanding to predict system behaviour and improve system performance. Operations research (OR) is the mathematical study of resource allocation problems, decisions, games, uncertainty, scheduling and optimization.

KEYWORDS:

Genetic algorithm, Particle swarm optimisation, Differential evolutionary algorithm, Hybrid algorithm, Artificial immune algorithm, Bio geography based optimisation, Artificial bee colony algorithm.

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CHAPTER-1

INTRODUCTION

1.1 Operation research

Optimization is central to any problem involving decision making, whether in engineering or in economics. The task of decision making entails choosing between various alternatives. This choice is governed by our desire to make the "best" decision. The measure of goodness of the alternatives is described by an objective function or performance index. Optimization theory and methods deal with selecting the best alternative in the sense of the given objective function. The area of optimization has received enormous attention in recent years, primarily because of the rapid progress in computer technology, including the development and availability of user-friendly software, high-speed and parallel processors, and artificial neural networks. A clear example of this phenomenon is the wide accessibility of optimization software tools such as the Optimization Toolbox of MATLAB¹ and the many other commercial software packages.

An introduction to optimization techniques introduces the basic ideas and techniques of optimization. Optimization is a precise procedure using design constraints and criteria to enable the planner to find the optimal solution.

This paper mainly deals with the review on the various advanced optimization techniques. Optimization reveals significance advances in computing systems and it has become the most promising techniques for a variety of engineering applications. This paper highlights the various techniques such as evolutionary techniques, Particle Swarm Optimization (PSO) and Genetic Algorithm (GA) to enhance the search process by improving the diversity, and the convergence toward the preferred solution have been analysed. A comparative study between the single and multi-objective based Optimization techniques including GA, PSO and Hybrid are presented. This comparison will be very helpful for industries. Among all the

traditional optimization techniques applied in recent years. Optimization algorithms can lead to appropriate solution for the real time applications.

Optimization techniques are one way to obtain operation (decision making), that will, to the extent possible, approach goals that have been set in response to a given problem. As a result, solutions such as design for minimal operating cost, optimal product quality, smallest device size and the like can be realized. The development of optimization techniques began during World War II, when they were used to optimize the trajectory of missiles. Subsequently, mathematical programming has been developed to realize optimization through the application of mathematical techniques. Additionally, the optimization technique of meta-heuristic, which imitates physical phenomena and the evolution of living organisms, has been developed since in the 1970s.

For almost all the human activities there is a desire to deliver the most with the least. For example in the business point of view maximum profit is desired from least investment; maximum number of crop yield is desired with minimum investment on fertilizers; maximizing the strength, longevity, efficiency, utilization with minimum initial investment and operational cost of various household as well as industrial equipment and machineries. To set a record in a race, for example, the aim is to do the fastest (shortest time). The concept of optimization has great significance in both human affairs and the laws of nature which is the inherent characteristic to achieve the best or most favourable (minimum or maximum) from a given situation.

In addition, as the element of design is present in all fields of human activity, all aspects of optimization can be viewed and studied as design optimization without any loss of generality. This makes it clear that the study of design optimization can help not only in the human activity of creating optimum design of products, processes and systems, but also in the understanding and analysis of mathematical/physical phenomenon and in the solution of mathematical problems. The constraints are inherent part of the real world problems and they have to be

satisfied to ensure the acceptability of the solution. There are always numerous requirements and constraints imposed on the designs of components, products, processes or systems in real-life engineering practice, just as in all other fields of design activity. Therefore, creating a feasible design under all these diverse requirements/constraints is already a difficult task, and to ensure that the feasible design created is also 'the best' is even more difficult.

ADVANCED OPTIMIZATION TECHNIQUES

This is a graduate level course on optimization. The course covers mathematical programming and combinatorial optimization from the perspective of convex optimization, which is a central tool for solving large scale problems.

1. Genetic algorithm
2. Particle swarm optimisation
3. Differential evolutionary algorithm
4. Hybrid algorithm
5. Artificial immune algorithm
6. Biogeography based optimisation
7. Artificial bee colony algorithm

CHAPTER-2

COMPUTATION FOR OPTIMISATION TECHNIQUES

LITERATURE SURVEY

Genetic algorithms, computer programs that simulate natural evolution, are increasingly applied across many disciplines. Clustering, using genetic algorithms to optimize a wide range of different fit-functions. Multiple population topologies and interchange methodologies. The GA based optimization technique is suitable for solving linear and nonlinear programming optimization problem with inexact information and the field of application include operations research, industrial engineering and management science.

Kennedy and Eberhart established the first practical application of Particle Swarm Optimization in 1995. It was in the field of neural network training and was reported together with the algorithm itself. The main advantages of the PSO algorithm are summarized as simple concept, easy implementation, robustness to control parameters, and computational efficiency when compared with mathematical algorithm and other heuristic optimization techniques.

Since its inception in 1995, Differential Evolution (DE) has emerged as one of the most frequently used algorithms for solving complex optimization problems. Differential evolution (DE) is a population based evolutionary algorithm widely used for solving multidimensional global optimization problem over continuous space and has been successfully used to solve several kind of problem. Many practical problem have objective function that are non-differentiable, non-continuous, non-linear, noisy, flat, multi-dimensional or have many local minima, constraints or stochasticity such problem are difficult if not impossible to solve analytically.

Hybrid recommender systems combine two or more recommendation strategies in different ways to benefit from their complementary advantages. This systematic literature review presents the state of the art in hybrid recommender systems of the last decade.

Artificial immune system (AIS) is a metaphorical computational intelligence system developed using ideas and theories extracted from biological immune system. It is a growing area of research attempts to bridge the divide between immunology and engineering, it exploits the mechanisms of the natural immune system including functions, principles and models in order to develop problem solving techniques.

A basic overview of optimization techniques is provided. The standard form of the general non-linear, constrained optimization problem is presented, and various techniques for solving the resulting optimization problem are discussed. The techniques are classified as either local (typically gradient-based) or global (typically non-gradient based or evolutionary) algorithms. A great many optimization techniques exist and it is not possible to provide a complete review in the limited space available here.

Instead, an effort is made to concentrate on techniques that are commonly used in engineering optimization applications. The review is kept general in nature, without considering special cases like linear programming, convex problems, multi-objective optimization, multidisciplinary optimization, etc. The advantages and disadvantages of the different techniques are highlighted, and suggestions are made to aid the designer in selecting an appropriate technique for a specific problem at hand. Where possible, a short overview of a representative method is presented to aid the discussion of that particular class of algorithms.

In today's complex business world, decision making plays a vital role in the success of any business. The simplex method, an operation research technique is widely used to finding solutions in many real world problems. This paper is an attempt to get an insight about the various application of optimization techniques in business. It is a conceptual research based on various literatures available. This study is based on different cases applied on selected sectors, viz., industrial, financial, resource allocation, agriculture, marketing and personnel management area.

CHAPTER-3

3.Design and Computation for optimization Techniques

3.1 Methodology applied in algorithms

Genetic algorithm is a method for solving both constrained and unconstrained optimization problem based on a natural selection process that mimics biological evolution.

A basic variant of the PSO algorithm works by having a population (called a swarm) of candidate solutions (called particle)....the movements of the particles are guided by their own best-known position in the search-spaces well as the entire swarm's best-known position.

A basic variant of the DE algorithm works by having a population of candidate solutions (called agents). These agents are moved around in the search-space by using simple mathematical formulae to combine the positions of existing agents from the population.

Hybrid method combines the Lagrangian and Eulerian approaches. The Chimera mesh method is a hybrid method. When the boundary moves without changing its geometry, Chimera mesh might be a suitable method for large displacement cases. In this method there are two sets of meshes, Eulerian and Lagrangian.

Artificial immune system (AISs) are computational methods inspired by the biological immune system and thus classified as a nature inspired meta-heuristic

along with genetic algorithm, ant colony optimization, particle swarm optimization and others.

Biogeography based optimization (BBO) a relatively new optimization technique based on the biogeography concept, uses the idea of migration strategy of species to derive algorithm for solving optimization problems. It has been show that BBO provides performance on a par with other optimization methods.

In the ABC algorithm, the first half of the swarm consists of employed bees, and the second half constitutes the onlooker bees. The number of employed bees or the onlooker bees is equal to the number of solutions in the swarm. The ABC generates a randomly distributed initial population of SN solutions (food sources), where SN denotes the swarm size.

CHAPTER-4

4. Applications applied in techniques

4.1 Genetic algorithm applied in various field

- i. Machine learning
- ii. Data mining
- iii. Travelling salesman problem

4.1.1 GENETIC ALGORITHM APPLIED IN MACHINE LEARNING

Yann Carbone and christelle Jacob (2015) they have designed in Genetic algorithm as Machine learning for profiles recognition .Persons are often asked to provide information about themselves. These data are very heterogeneous and result in as many “profiles” as contexts. Sorting a large amount of profiles from different contexts and assigning them back to a specific individual is quite a difficult problem. Semantic processing and machine learning are key tools to achieve this goal. This paper describes a framework to address this issue by means of concepts and algorithms selected from different Artificial Intelligence fields. Indeed, a Vector Space Model is customized to first transpose semantic information into a mathematical model. Then, this model goes through a Genetic Algorithm (GA) which is used as a supervised learning algorithm for training a computer to determine how much two profiles are similar. Amongst the GAs, this study introduces a new reproduction method (Best Together), and compare it to some usual ones (Wheel, Binary Tournament).This paper also evaluates the accuracy of the GAs predictions for profiles clustering with the computation of a similarity score, as well as its ability to classify two profiles are similar or non-similar. We believe that the overall methodology can be used for any kind of sources using profiles and, more generally, for similar data recognition.

Harsh Basin and Surbhi Bhatia (may 2012) they have designed in Genetic algorithm using machine learning for chess. This genetic algorithm (GA'S) are a type of optimization algorithm which combine survival of the fittest and a simplified version of genetic process. A proposes a new technique to apply GA in using machine learning which can substitute existing methodologies. The work proposed is shown to be robust and thus making the learning a natural process rather than an algorithmic one. Inheritance, Mutation, Selection, and Cross over using this process done with this research.

Nil ton Luis Querioz Junior, Luis Gustavo Araujo Rodriguez and Anderson Faustino Da Silva (2017) they have designed in Combining machine learning with a genetic algorithm to find good compiler optimizations sequences. Artificial Intelligence is a strategy applied in several problems in computer science. One of them is to find good compilers optimizations sequences for programs. Currently, strategies such as Genetic Algorithms and Machine Learning have been used to solve it. This article propose an approach that combines both, Machine Learning and Genetic Algorithms, to solve this problem. The obtained results indicate that the proposed approach achieves performance up to 3.472% over Genetic Algorithms and 4.94% over Machine Learning.

TUO MAO, ADRIANA-SIMONA MIHAIT (March 2021) they have designed in Genetic algorithm using machine learning for Traffic control optimization. Traffic control optimization is a challenging task for various traffic canters around the world and the majority of existing approaches focus only on developing adaptive methods under normal (recurrent) traffic conditions. Optimizing the control plans when severe incidents occur still remains an open problem, especially when a high number of lanes or entire intersection are affected. Traffic control optimization at tackling this problem and presents a novel methodology for optimizing the traffic signal timings in signalized urban intersections, under non-recurrent traffic incidents. With the purpose of producing fast and reliable decisions, we combine the fast running Machine Learning (ML) algorithms and the reliable Genetic Algorithms (GA) into a single optimization framework. As a benchmark, we first start with deploying a

typical GA algorithm by considering the phase duration as the decision variable and the objective function to minimize the total travel time in the network. We fine tune the GA for crossover, mutation, fitness calculation and obtain the optimal parameters. Secondly, we train various machine learning regression models to predict the total travel time of the studied traffic network, and select the best performing regressed which we further hyper tune to find the optimal training parameters. Lastly, we propose a new algorithm BGA-ML combining the GA algorithm and the extreme-gradient decision-tree, which is the best performing regressed, together in a single optimization framework. Comparison and results show that the new BGA-ML is much faster than the original GA algorithm and can be successfully applied under non-recurrent incident conditions.

4.1.2 GENETIC ALGORITHM APPLIED IN DATA MINING

Mariya Khatoon and Abhay Agarwal (June 2021) they have designed on Data mining using Genetic algorithm. Growth in the field of data mining rapidly increasing due to its well regulated techniques and efficient algorithms. At present, Genetic algorithm is the bustling research and it allocate the drastic modification in the field of data mining in terms of better optimization of result and the performance of different ventures effectively and efficiently. Because of their accuracy and efficiency, data mining algorithms attract and motivates to researchers to show interest in their technologies and large search space. Genetic algorithm works on bio-responsive operators to evaluate the fittest function in population by the Darwinism. Data mining enumerates the enactment of genetic algorithm in frame of reference to data mining algorithms and techniques like decision tree and classification.

Mrinalini Rana and Jimmy Single (Jan 2020) they have designed on A Systematic review on Data mining rules generation optimizing via genetic algorithm. In this techno savvy eon, companies have wide range of data and without converting it into appropriate information it is of no use. KDD (Knowledge Discovery Database),

analysis process of data mining that helps the corporate to mine or extract useful information for “Decision Making process”. To mine the correct information there are plethora of techniques for mining the data or information for illustration Apriority, Pattern finding, Clustering, Classification, Prediction, Time series and so. Moreover, the emerging optimization technique is Genetic algorithm. This Data mining using genetic algorithm summarizes data mining algorithms with multiple datasets.

Behrouz Minaei and William F. Punch they have designed in Data mining optimization using Genetic algorithm in Educational Web- based system Data mining optimization an approach for classifying students in order to predict their final grade based on features extracted from logged data in an education web-based system. A combination of multiple classifiers leads to a significant improvement in classification performance. Through weighting the feature vectors using a Genetic Algorithm we can optimize the prediction accuracy and get a marked improvement over raw classification. It further shows that when the number of features is few; feature weighting is works better than just feature selection.

Osamah Ibrahim khalaf (oct 2021) have applied on Genetic algorithm in Data mining of colorectal images. There is currently no effective analytical method in colorectal image analysis, which leads to certain errors in colorectal image analysis. In order to improve the accuracy of colorectal imaging detection, this study used a genetic algorithm as the data mining algorithm and combined it with image processing technology to perform image analysis. At the same time, combined with the actual requirements of image detection, the grey theory model is used as the basic theory of image processing, and the image detection prediction model is constructed to predict the data. In addition, in order to study the effectiveness of the algorithm, the experiment is carried out to analyse the validity of the data of the study, and the predicted value is compared with the actual value. The research shows that the proposed algorithm has certain accuracy and can provide theoretical reference for subsequent related research.

Pramod Vishwakarma, Yogesh Kumar and Rajiv Kumar Nath (Dec 2012) they have designed in Data mining using Genetic algorithm The Genetic Algorithm has been used to mine the real world dataset in medical domain. The growth of information has proceeded at an explosive rate in recent years. The size of data available now is beyond the capability of our mind to analyses. Due to the size of the data, it is extremely difficult to draw meaningful conclusions about the data. To overcome the above scenario, data mining technology is introduced. In fact we are busy with data in most fields and not concerned about hidden patterns. To a certain extent, there are not enough qualified human analysts available who are expert at translating all of this data into knowledge and find the interesting patterns. Data Mining is a process that starts with data and ends with previously unknown patterns and knowledge. The Knowledge Discovery in Databases (KDD) process will be used and on the data mining stage the GA is applied. This series of activities is divided into five steps. The raw data is selected and analysed during the steps to reveal patterns and create new knowledge. The KDD will include several steps including Selection, Pre-processing, Transformation, Data Mining and Interpretation of pattern.

4.1.3 GENETIC ALGORITHM APPLIED IN TRAVELING SALESMEN PROBLEM

Saloni Gupta and Poonam Panwar (Jan 2013) they have designed in Travelling salesman problem using Genetic algorithm Optimization problem is which mainly focuses on finding feasible solution out of all possible solutions. Travelling salesman problem belongs to this one. As it is not possible to find its solution in definite polynomial time that is why it is considered as one of the NP-hard problem. Travelling salesman problem utilizes the optimization capability of genetic algorithm to find the feasible solution for TSP. The algorithm starts with the calculation of Euclidean distance between the towns to be visited by the salesman. Initial chromosome pool is generated using value encoding. Then best fit chromosomes are selected by applying roulette wheel selection which then goes through m-point crossover. Now we apply interchange mutation on the offspring

generated before. Now this whole process is repeated until the convergence of genetic algorithm.

Abid Hussain, Yousaf shad Muhammad, Nauman Sajid and Ijaz Hussain (oct 2017) they have applied on Genetic algorithm for travelling salesman problem with modified cycle crossover operator. Traveling salesman problem (TSP) is a famous NP-hard problem in the area of combinatorial optimization. It is utilized to locate the shortest possible route that visits every city precisely once and comes back to the beginning point from a given set of cities and distances. Traveling salesman problem an efficient and effective solution for solving such a problem. A modified crossover method using Minimal Weight Variable Order Selection Crossover (MWVOSX) operator, a modified mutation using local optimization and a modified selection method using KMST is proposed. MWVOSX operator chooses a particular order from multiple orders which have the minimum cost and takes the remaining from the other parent in backward and forward order. Then it creates two new offspring. Furthermore, it selects the least weight from the two offspring. The efficiency of the proposed algorithm is compared to the classical genetic algorithm. Comparisons show that the proposed algorithm provides much efficient results than the existing classical genetic algorithm.

Md. Sabir Hossain, Ahsan Sadee Tanim, Sadman Sakib Choudhury and S.M.Afif Ibex Hayat (Dec 2019) they have applied on Travelling salesman problem using genetic algorithm with modified crossover operator Traveling salesman problem (TSP) is a famous NP-hard problem in the area of combinatorial optimization. It is utilized to locate the shortest possible route that visits every city precisely once and comes back to the beginning point from a given set of cities and distances. Travelling salesman problem an efficient and effective solution for solving such a problem. A modified crossover method using Minimal Weight Variable Order Selection Crossover (MWVOSX) operator, a modified mutation using local optimization and a modified selection method using KMST is proposed. MWVOSX operator chooses a particular order from multiple orders which have the minimum cost and takes the remaining from the other parent in backward and

forward order. Then it creates two new offspring. Furthermore, it selects the least weight from the two offspring. The efficiency of the proposed algorithm is compared to the classical genetic algorithm. Comparisons show that the proposed algorithm provides much efficient results than the existing classical genetic algorithm.

Abdullah Homaifar, Shanguchan Guan and Gunnar E.Liepins they have designed on Schema analysis of the travelling salesman problem using Genetic algorithm Travelling salesman problem provides a substantial proof that genetic algorithms (GAs) work for the traveling salesman problem (TSP) . The method introduced is based on an adjacency matrix representation of the TSP that allows the GA to manipulate edges while using conventional crossover. This combination, interleaved with inversion (2-opt), allows the GA to rapidly discover the best known solutions to seven of the eight TSP test problems frequently studied in the literature. (The GA solution is within 2% of the best known solution for the eighth problem.) These results are in contrast to earlier conclusions that GAs are ill-suited to solving TSP problems, and suggest that the performance of probabilistic search algorithms (such as GAs) is highly dependent on representation and the choice of neighbourhood operators.

4.2 PARTICLE SWARM OPTIMISATION APPLIED IN VARIOUS FIELD

- i. Electrical field
- ii. Agriculture
- iii. Finance
- iv. Machine learning

4.2.1 PARTICLE SWARM OPTIMISATION APPLIED IN ELECTRICAL FIELD

Sang-bing tsai (Mar 2021) have designed in particle swarm optimisation algorithm in power system network reconfiguration. With the rapid development of the social economy, the rapid development of all social circles places higher demands on the electricity industry. As a fundamental industry supporting the salvation of the national economy, society, and human life, the electricity industry will face a significant improvement and the restructuring of the network as an important part of the power system should also be optimised. -is paper first introduces the development history of swarm intelligence algorithm and related research work at home and abroad. Secondly, it puts forward the importance of particle swarm optimization algorithm for power system network reconfiguration and expounds the basic principle, essential characteristics, and basic model of the particle swarm optimization algorithm. -is paper completes the work of improving PSO through the common improved methods of PSO and the introduction of mutation operation and tent mapping. In the experimental simulation part, the improved particle swarm optimization algorithm is used to simulate the 10-machine 39-bus simulation system in IEEE, and the experimental data are compared with the chaos genetic algorithm and particle swarm optimization discrete algorithm. -rough the experimental data, we can know that the improved particle swarm optimization algorithm has the least number of actions in switching times, only 4 times, and the chaos genetic algorithm and discrete particle swarm optimization algorithm are 5 times; compared with the other two algorithms, the improved particle swarm optimization algorithm has the fastest convergence speed and the highest convergence accuracy. -e improved particle swarm optimization algorithm proposed in this paper provides an excellent solution for power system network reconfiguration and has important research significance for power system subsequent optimization and particle swarm optimization algorithm improvement.

Xiaotao tian (Nov 2021) have designed in particle swarm optimization algorithm in improved electrical control system. In today's social background where high-tech emerges endlessly, various production fields in our country have fully

entered the era of mechanical automation and electrical automation, and electrical control systems have been widely used in our country's electrical appliance manufacturing industry. This paper is based on the theoretical analysis of the particle swarm optimization algorithm. Based on this optimization algorithm, a brand-new particle swarm optimization algorithm is obtained. It is applied to the electrical control system to improve it and makes full use of the improved particle swarm optimization algorithm. The existing electrical control system is optimized. This article firstly analyses the types of common electrical control systems, puts forward some basic methods to improve the control system, and then explains the effective techniques for improvement, hoping to make reference to the improvement of electrical control systems later in this article. This article first improves the particle swarm optimization algorithm, adding the ability to adjust the control system and dynamic learning factors, focusing on strengthening the later stage of the optimization of the particle swarm algorithm and the ability to converge to improve the efficiency of the calculation. The second is to improve the traditional particle swarm optimization algorithm and update the calculation method of the formula to reduce the possibility of selecting undesirable particles and affecting the optimization results. Finally, through MATLAB and reverse simulation analysis, compared with the traditional electrical control system algorithm, the improved particle swarm optimization algorithm has a faster convergence speed and high control system efficiency. The experimental research results show that the particle swarm optimization algorithm proposed in this paper has a huge advantage compared with other algorithms, and its parameter optimization gives full play to the powerful performance of the electrical control system.

Ricardo faia, Tiago pinto, Zita vale and Manuel corchado (2019) have designed in hybrid approach based on particle swarm optimisation for electricity markets participation. In many large-scale and time-consuming problems, the application of metaheuristic becomes essential, since these methods enable achieving very close solutions to the exact one in a much shorter time. In this work, we address the problem of portfolio optimization applied to electricity markets negotiation. As in a market environment, decision-making is carried out in very short times, the application of the metaheuristic is necessary. This work proposes a

Hybrid model, combining a simplified exact resolution of the method, as a means to obtain the initial solution for a Particle Swarm Optimization (PSO) approach. Results show that the presented approach is able to obtain better results in the metaheuristic search process

Mohammad nabob alam (oct 2017) have designed in particle swarm optimisation for solving electrical engineering problems particle swarm optimization (PSO) has emerged as one of the most promising optimization techniques in solving various engineering problems. PSO is a nature-inspired swarm intelligence based metaheuristic optimization technique introduced in 1995. Subsequently, many PSO variants have been developed for solving different types of problems. Simple concepts, easy implementation and better results are the keys to applying PSO in solving various types of optimization problems. The proposed chapter discusses the concepts of PSO and its variants for solving three well known electrical engineering problems. These problems are load flow analysis, economic load dispatch, and optimum protection coordination of directional overcurrent relays. Additionally, a generalized approach to formulate an optimization problem suitable to metaheuristic is discussed. Also, strengths and weakness of PSO and its hybridization prospective with some other metaheuristic optimization techniques are discussed.

Norkharziana mohd nayan, Naziha ahmad azli, Shahrin md (sep 2013) have designed in particle swarm optimisation and its applications in power converter systems. Particle swarm optimisation (PSO) algorithm is known for its easy implementation and has been empirically shown to perform well in many optimisation problems. Thus, it is expected to mitigate the computational burden associated with the solutions of non-linear transcendental equations relevant to problems related to power converter systems. This paper starts with an overview of the general concept of PSO and its variants. It then continues with a review on the application of the PSO algorithm in power converter systems. Then, a sample application is described, focusing on the implementation of the harmonic elimination pulse width modulation (HEPWM) technique on a single-phase inverter circuit. The results of a simulation and experimental work on the inverter operation have

revealed that the PSO method employed is capable of accurately calculating the relevant switching angles and generating the gate signals for the inverter power devices and improving its overall system performance.

4.2.2 PARTICLE SWARM OPTIMISATION APPLIED IN AGRICULTURAL FIELD

Qazi saiman Khalid, Shaker azim, Muhammad abas and Abdul rehman babar (Jan 2021) have designed in modified particle swarm algorithm for scheduling agricultural products. Industries tend to manufacture higher quality products with a low cost due to the competitive environmental loop and dynamic customers' demand. The integration of intelligent manufacturing planning to agricultural operations and products will permit a spike in efficiency of yield, especially in the regions of agriculturally based economies. Though, to gain a vivid exploitation, the old-fashioned agriculture products manufacturing planning and scheduling techniques needs to be revised, especially the methodology in job shop planning must be augmented with efficient operational sequential scheduling. Cellular Manufacturing Systems (CMS) inclined to possess a higher complexity than the traditional manufacturing systems. Three major problems are coping in CMS domain: cell formation, product family selection, and product scheduling. This work deals with the problem of product scheduling in the CMS environment. A mixed integer linear programming mathematical model is introduced for the conflicting performance measures i.e. minimization of work in process (WIP) and maximization of average machine cell utilization. Since the current problem is considered as NP-hard problem, so a modified particle swarm optimization (MPSO) algorithm is proposed to find the optimum scheduling under the given constraint model of conflicting objectives. In the proposed MPSO, basic PSO is integrated with NEH heuristic to achieve better optimal sequence in less computation time. The obtained results are compared with other hybrid PSO algorithms with seed solutions from Gupta and Palmer heuristics. Furthermore, results are also compared against meta-heuristics such as genetic algorithm (GA), standard PSO, and artificial bee colony (ABC) algorithm. It shows that the proposed MPSO algorithm performs better than the existing compared algorithms. A real time case scenario of agriculture-based manufacturing industry is solved to validate the proposed planning algorithm

Panpan Zhou, Hossain sadistic and Majid khayatnezhad (June 2021) have designed in application of probability decision system and particle swarm optimisation for improving soil moisture content. Drought is one of the natural disasters having the highest degrees in comparison to the other natural disasters in terms of rate, intensity, incident duration, region expansion, life losses, economic damages, and long-term effects. Hence, the prediction of drought as a meteorological phenomenon should be evaluated to determine the groundwater exploitation strategies in agriculture. The present study aims at investigating the impact of the drought duration and severity on soil moisture supplement for agricultural activities in Baghmalek plain, Khuzestan province, Iran. For this objective, a non-dimensional index of precipitation depth was defined for quantifying the drought characteristics. Furthermore, marginal distribution functions, correlation coefficients and joint functions were incorporated to a probabilistic decision-making framework to predict the variables in different return periods from 2-year to 100-year periods. Results showed that t copula was the best function for constructing the multivariate distribution in the study area based on the goodness-of-fit tests. Moreover, soil moisture content in the root zone achieved by the predetermined amounts of precipitation could be increase in the seasonal average.

4.2.3 PARTICLE SWARM OPTIMISATION APPLIED IN FINANCIAL FIELD

Armin mahmoudi, Milad jasmine and Leila Hashmi (sep 2020) have designed in a comparison on particle swarm optimisation and genetic algorithm performances in deriving the efficient frontier of stocks portfolios based on a stocks portfolios based on a mean-lower partial moment model. A portfolio optimization model on the basis of the risk measure of lower partial moment of the first order is discussed. Two meta-heuristic methods of particle swarm optimization and genetic algorithm performances are applied and compared from different aspects to derive the stocks portfolios efficient frontier. The data belongs to the monthly returns of 20 randomly selected and approved stocks in the New York Stock Exchange for the financial period of 2005–2011. The results prove that both algorithms are quite efficient in

solving the mean-lower partial moment of the first order model with the particle swarm optimization being superior.

Mohammed Siddique, Debdulal panda (oct 2019) have designed in a hybrid forecasting model for prediction of stock index of Tata motors using principal component analysis, support vector regression and particle swarm optimisation. This application presents an extremely precise prediction method which improved the decision of the investors on daily direction of the stock market. Among the studies that focus on daily stock market forecasting, the hybrid machine learning techniques are more appreciated than the conventional data mining procedures. With an intent to produce such a model with more accurate predictions, this paper analyses a series of technological indicators used in usual studies of the stock market and uses principal component analysis (PCA), along with support vector regression (SVR) and particle swarm optimization (PSO) algorithm. Feature extraction is such a procedure that can remove the unnecessary and unrelated factors, and reduce the dimension of the input variables from the original dataset. The feasibility and efficiency of the proposed PCA-SVR-PSO hybrid model was applied to forecast the daily closing prices of stock index of TATA Motors. The performance of the proposed approach is evaluated with 4304 (from 1st January 2001 to 6th April 2018) trading days historical stock price data of Tata motors collected from Bombay Stock Exchange (BSE). The total data sets were splits into two parts, 80% of the data (3444) has been used in the training phase and rest 20% of the data (860) for the testing phase. We compared our results with ANN-PSO and SVR-PSO hybrid models. The experimental results reflect that the proposed hybrid model incorporating PCA is more practicable and better performs than SVR-PSO.

Patricia jumbo Santana, Laura lanzarini and Aurelio F.Bariviera (Dec 2019) have designed in variants of particle swarm optimisation for obtaining classification rules applied to credit risk in financial institutions of Ecuador. Knowledge generated using data mining techniques is of great interest for organizations, as it facilitates tactical and strategic decision making, generating a competitive advantage. In the special case of credit granting organizations, it is important to clearly define

rejection/approval criteria. In this direction, classification rules are an appropriate tool, provided that the rule set has low cardinality and that the antecedent of the rules has few conditions. This paper analyses different solutions based on Particle Swarm Optimization (PSO) techniques, which are able to construct a set of classification rules with the aforementioned characteristics using information from the borrower and the macroeconomic environment at the time of granting the loan. In addition, to facilitate the understanding of the model, fuzzy logic is incorporated into the construction of the antecedent. To reduce the search time, the particle swarm is initialized by a competitive neural network. Different variants of PSO are applied to three databases of financial institutions in Ecuador. The first institution specializes in massive credit placement. The second institution specializes in consumer credit and business credit lines. Finally, the third institution is a savings and credit cooperative. According to our results, the incorporation of fuzzy logic generates rule sets with greater precision.

4.2.4 PARTICLE SWARM OPTIMISATION APPLIED IN MACHINE LEARNING

Dipti Kapoor sarmah (Jan 2020) have designed in a survey on the latest development of machine learning in genetic algorithm and particle swarm optimisation. Due to the industrial importance, optimisation always attracts attention of several researches from industry and academia. The complexity to solve real world problems has increased dependencies of external factors, resulting many times the classical optimisation techniques fail to solve them. At the same time, the area of optimisation is becoming richer with new concepts, ideas and algorithms due to the continuous innovations by the researchers. As there is no common method to solve a particular problem, there is always a scope of improvement towards the existing algorithms. Due to which more and more efficient optimisation algorithms are getting developed and used in various fields on regular basis, rapid development of technologies and increased computational powers of the computers are also contributing to this. The efficiency of any optimisation algorithm can be judged and observed by maintaining a good balance between two functions, exploration and exploitation, related to global search and local search, respectively. Similar to

optimisation field, a new emergent concept of machine learning such as deep learning is continuously progressing to solve such problems. It has been observed that by applying the concept of machine learning along with various optimisation algorithms, particularly along with nature inspired algorithms, the performance of the computational power is increasing while finding solution to various challenging problems.

Mosbeh R.Kalooop, Deepak Kumar, Pijush samui, Alaa R.Gabr, Jong wan hu, Xinghan in and Bishwajit Roy (Aug 2019) have designed in particle swarm optimization algorithm-extreme learning machine (PSO-ELM) model for predicting resilient modulus of stabilized aggregate bases. Stabilized base/sub base materials provide more structural support and durability to both flexible and rigid pavements than conventional base/sub base materials. For the design of stabilized base/sub base layers in flexible pavements, good performance in terms of resilient modulus (M_r) under wet-dry cycle conditions is required. This study focuses on the development of a Particle Swarm Optimization-based Extreme Learning Machine (PSO-ELM) to predict the performance of stabilized aggregate bases subjected to wet-dry cycles. Furthermore, the performance of the developed PSO-ELM model was compared with the Particle Swarm Optimization-based Artificial Neural Network (PSO-ANN) and Kernel ELM (KELM). The results showed that the PSO-ELM model significantly yielded higher prediction accuracy in terms of the Root Mean Square Error (RMSE), the Mean Absolute Error (MAE), and the coefficient of determination (r^2) compared with the other two investigated models, PSO-ANN and KELM. The PSO-ELM was unique in that the predicted M_r values generally yielded the same distribution and trend as the observed M_r data.

4.3 DIFFERENTIAL EVOLUTIONARY ALGORITHM APPLIED IN VARIOUS FIELD

- I. Electrical field
- II. Agriculture
- III. Machine learning

4.3.1 DIFFERENTIAL EVOLUTIONARY ALGORITHM APPLIED IN ELECTRICAL FIELD

Rui chi, Xuexin chi, Zheng li and zhijian qu (Feb 2021) have designed in Reactive power optimization of power system based on improved differential evolution algorithm. This application presents a novel differential evolution (DE) algorithm, with its improved version (IDE) for the benchmark functions and the optimal reactive power dispatch (ORPD) problem. Minimization of the total active power loss is usually considered as the objective function of the ORPD problem. (constraints involved are generators, transformers tapings, shunt reactors, and other reactive power sources. (aim of this study is to discover the best vector of control variables to minimize power loss, under the premise of considering the constraints system. In the proposed IDE, a new initialization strategy is developed to construct the initial population for guaranteeing its quality and simultaneously maintaining its diversity. In addition, to enhance the convergence characteristic of the original DE, two kinds of self-adaptive adjustment strategies are employed to update the scaling factor and the crossover factor, respectively, in which the detailed information about the two factors can be exchanged for each generation dynamically. Numerical applications of different cases are carried out on several benchmark functions and two standard IEEE systems, i.e., 14-bus and 30-bus test systems. (e results achieved by using the proposed IDE, compared with other optimization algorithms, are discussed and analysed in detail. (e obtained results demonstrated that the proposed IDE can successfully be used to deal with the ORPD problem.

Rick hao tan and Carlos rossa (Oct 2020) have designed in Electrical impedance tomography using differential evolution integrated with a modified newton raphson algorithm Electrical impedance tomography (EIT) is a non-invasive medical imaging procedure. Image reconstruction in EIT is difficult because it involves solving a non-linear and ill-posed mathematical problem. One of the most commonly implemented inverse approaches is usually a variation of the Newton Raphson algorithm. However, this approach is not guaranteed to reach a global optimum or a local optimum and as such, it requires an accurate initial estimation of the resistance distribution, which is not always available in practice. In this paper, a

new method is proposed to solve for the inverse problem in EIT while avoiding dependencies on the initial estimation of the resistance distribution. The proposed approach uses a differential evolution (DE) optimizer integrated with the Newton Raphson algorithm. The stochastic nature of DE allows the problem to be solved without having an accurate initial estimation and allows for solutions that will not be trapped in local minimal values. Simulation results indicate that the proposed approach outperforms the traditional differential evolution algorithm, and performs similarly to the traditional Modified Newton Raphson algorithm with accurate initial estimation. The proposed method does, however, have an advantage over the Modified Newton Raphson algorithm as it does not require an estimate of the initial resistance distribution

Ouafa herbadji, Linda slimming and Trek bouktir (DEC 2016) have designed in A differential evolution algorithm for the solution of optimal power flow with consideration of FACTS devices “UPFC” This method present the solution of optimal power flow problems using a Differential Evolution algorithm (DE) with consideration of unified power flow controller (UPFC). Differential Evolution method is one of the best evolutionary algorithms for global optimization, it using three basic operations, namely: mutation, crossover, and selection operators. The objective of this method is to minimize the total fuel cost of generation, total real power loss and also maintain an acceptable system performance in terms of limits on generator real power, bus voltages. In this work, the proposed method (DE) has been applied to solve the optimal power flow problems with and without installation of UPFC device on the standard IEEE 30-bus system.

Julio C.Rosas-Caro, Pedro M.Garcia-Vite, Alma rodriguez, Abraham Mendoza, Avelina Alejo-Reyes, Erik curves and Francisco Beltran-Carbajal (Oct 2021) have designed in Differential evolution based algorithm for optimal current ripple cancelation in an unequal interleaved power converter. This application proposes an optimal methodology based on the Differential Evolution algorithm for obtaining the set of duty cycles of a recently proposed power electronics converter with input current ripple cancelation capability. The converter understudy was recently introduced to the state-of-the-art as the interleaved connection of two

unequal converters to achieve low input current ripple. A latter contribution proposed a so-called proportional strategy. The strategy can be described as the equations to relate the duty cycles of the unequal power stages. This article proposes a third switching strategy that provides a lower input current ripple than the proportional strategy. This is made by considering duty cycles independently of each other instead of proportionally. The proposed method uses the Differential Evolution algorithm to determine the optimal switching pattern that allows high quality at the input current side, given the reactive components, the switching frequency, and power levels. The mathematical model of the converter is analysed, and thus, the decision variables and the optimization problem are well set. The proposed methodology is validated through numerical experimentation, which shows that the proposed method achieves lower input current ripples than the proportional strategy.

4.3.2 DIFFERENTIAL EVOLUTIONARY ALGORITHM APPLIED IN AGRICULTURAL FIELD

Antonio Martinez-Ruiz, Agustin Ruiz Garcia, Jorge victor prado henandez and Irineo L.L.Lopez-cruz (FEB 2021) have designed in Global sensitivity analysis and calibration by differential evolution algorithm of HORTSYST crop model for fertigation management. Sensitivity analysis is the first step in elucidating how the uncertainties in model parameters affect the uncertainty in model outputs. Calibration of dynamic models is another issue of considerable interest, which is usually carried out by optimizing an objective function. The first aim of this research was to perform a global sensitivity analysis (GSA) with Sobol's method for the 16 parameters of the new HORTSYST nonlinear model that simulates photo-thermal time (*PTI*), daily dry matter production (*DMP*), nitrogen uptake (*Nup*), leaf area index (*LAI*), and crop transpiration (*ET_c*). The second objective was to carry out the calibration of the HORTSYST model by applying a differential evolution (DE) algorithm as the global optimization method. Two tomato (*Solanum lycopersicum* L.) crops were established during the autumn-winter and spring-summer seasons under greenhouse and soilless culture conditions. Plants were distributed with a density of 3.5 plants m⁻². Air temperature and relative humidity were measured with

an S-THB-M008 model sensor. Global solar radiation was measured with an S-LIB-M003 sensor connected to a U-30-NRC data logger. In the sensitivity analysis run in the two growth stages, it was observed that a greater number of parameters were more important at the beginning of fructification than at the end of crop growth for 10% and 20% of the variation of the parameters. The sensitivity analysis came up with nine parameters as the most important of the HORTSYST model, which were included in the calibration process with the DE algorithm. The best fit, according to *RMSE*, was for *LAI*, followed by *Nup*, *DMP*, and *ET_c* for both crop seasons; the *RMSE* was close to zero, indicating a good prediction of the model's performance.

Thoranin sujjaviriyasup (SEP 2020) have designed in A hybridization of feed forward neural network and differential evolution to forecast fertilizer consumption emphasizing on selecting optimal architecture. A fertilizer marketing or producing sector has played an important role in agricultural productivity and also food security around the world for many years. However, the demand of fertilizer consumption is uncertain and difficult to be forecasted by using simple approaches. Therefore, an accuracy of future demand concerning fertilizer is very interesting task to support decision making. In this research, a hybrid model of feed forward neural networks and differential evolution emphasizing on architectural evolution is developed to forecast ten datasets of fertilizer consumption and is compared with conventional models based on five accuracy measures. The empirical results indicated that the developed model can provide more accuracy than conventional models at 0.05 significance levels. Furthermore, the capability of the developed model can also provide the highest precision compared with both ARIMA and SVR models. Consequently, the developed model can be a promising tool to predict future demands of fertilizer consumption.

4.3.3 DIFFERENTIAL EVOLUTIONARY ALGORITHM APPLIED IN MACHINE LEARNING

Mustafa shuaeib sabri (OCT 2015) have designed in The study of evolutionary computation and machine learning techniques. This method discussed

the study of evolutionary computation and machine learning techniques. The standards of common determination and evolution have been embraced to acknowledge optimization algorithms, and the number of research regions and true applications to which they have been effectively connected is vast for sure. In the field of electromagnetism, specific consideration has been committed to Genetic Algorithms (GAs) and Differential Evolution (DE) Plans, albeit intriguing outcomes have additionally been acquired by utilizing Micro genetic Algorithms (MGAs), Mimetic Algorithms (MAs), Invasive Weed Optimization (IWO) and the Covariance Matrix Adaptation Evolutionary Strategy. The essential highlights of the previously mentioned optimization strategies will be talked about in the accompanying. The initial step performed in a GA algorithm is the encoding of every single parameter into a quality.

Yi-Chuan Chiu, Hsin-Hung lin and Yung-Tsan jou (JUNE 2019) have designed in Differential evolution based model selection approach for machine learning. As the application of big data becomes more and more popular, machine learning algorithms are changing with each passing day, and the models produced by machine learning are increasingly diversified. The focus of big data applications has gradually shifted to the prediction and inference of models. How to choose the most suitable model for enterprise application scenarios among many machine learning models has become a topic of research that has attracted much attention. Ensemble methods have been proposed to discover best model by multiple training phase. Studies of finding best combination within multiple modes are still few. Configuring different machine learning models with appropriate parameters and looking for parameters is an NP-hard problem, which requires an optimization algorithm. This study proposes to apply differential evolution algorithm to integrate multiple trained machine learning models into an appropriate model. In this paper, the regression model is taken as an example and the differential evolution algorithm is compared with the particles swarm optimization algorithm. The results show that the differential evolution algorithm has better performance.

4.4 HYBRID ALGORITHM APPLIED IN VARIOUS FIELD

- i. Electrical
- ii. Agriculture
- iii. Finance

4.4.1 HYBRID ALGORITHM APPLIED IN ELECTRICAL FIELD

Raj Kumar kaushik, Om Prakash mahela, pramod kumar bhatt and Baseem khan (Dec 2020) have designed A hybrid algorithm for recognition of power quality disturbances. An algorithm making use of hybrid features of Hilbert transform (HT) and Stockwell transform (ST) to identify the single-stage and multiple (multi-stage) power quality disturbances (PQDs) is introduced in this manuscript. A power quality index (PI) and time location index (TLI), based on the features computed from the voltage signal by the use of HT and ST are proposed for recognition of the PQDs. Four features extracted from the PI and TLI are considered for classification of the PQDs achieved using decision tree driven by rules. The algorithm is tested on the PQDs generated with the help of mathematical models (in conformity with standard IEEE-1159). Performance is evaluated on 100 data set of every disturbance computed by varying various parameters, and efficiency is found to be greater than 99%. It is established that an algorithm is effective for recognition of PQ events with an efficiency greater than 98% even in the presence of high-level noise. Algorithm is faster compared to many reported techniques and scalable for application to voltages of all range. Results are validated through comparison with the results of the algorithms reported in the literature. Performance of the algorithm is effectively validated on the practical utility network. This algorithm can be effectively implemented for designing the power quality (PQ) monitoring devices for the utility grids.

S.Chakroune, Zorig assam and A.Benoudjit (Aug 2015) have designed in Hybrid method using genetic algorithm for induction motor design problem. This paper describes the use of a new approach optimization procedure to determine the design of three phase electrical motors. The novelty lies in combining a motor design

program and employing a Hybrid Genetic Algorithm (HAGs) technique to obtain the maximum of objective function such as the motor efficiency. A method for evaluating the efficiency of induction motor is tested and applied on 2.2 kW experimental machines; the aforementioned is called equivalent circuit method (EC-M) and based on the analysis of the influence losses. As the equations which calculate the iron losses make call to magnetic induction. From this point, the paper proposes to evaluate the B(H) characteristic by estimating the circuit's flux and the counting of excitation. Next, the optimal designs are analysed by finite element method (F.E.M) and compared with results of another method which is genetics algorithms (GAs) optimisation technique, was done to demonstrate the validity of the proposed method. They reveal that the efficiency can be noticeably improved (+1.3%) by optimizing the machine parameters using (HGAs) techniques as well as by an appropriate parameters choice

Ping jiang, Xuejiao ma and Feng liu (oct 2015) have designed in A new hybrid model based on data pre-processing and an intelligent optimization algorithm for electrical power system forecasting. The establishment of electrical power system cannot only benefit the reasonable distribution and management in energy resources, but also satisfy the increasing demand for electricity. The electrical power system construction is often a pivotal part in the national and regional economic development plan. This paper constructs a hybrid model, known as the E-MFA-BP model, that can forecast indices in the electrical power system, including wind speed, electrical load, and electricity price. Firstly, the ensemble empirical mode decomposition can be applied to eliminate the noise of original time series data. After data pre-processing, the back propagation neural network model is applied to carry out the forecasting. Owing to the instability of its structure, the modified firefly algorithm is employed to optimize the weight and threshold values of back propagation to obtain a hybrid model with higher forecasting quality. Three experiments are carried out to verify the effectiveness of the model. Through comparison with other traditional well-known forecasting models, and models optimized by other optimization algorithms, the experimental results demonstrate that the hybrid model has the best forecasting performance.

4.4.2 HYBRID ALGORITHM APPLIED IN AGRICULTURAL FIELD

Sonal Agarwal and Sandhya tarar (Jan 2021) have designed in A hybrid approach for crop yield prediction using machine learning and deep learning algorithms. Agriculture is defined as the science and art of cultivating the flora and fauna. Farming in India is ranked as second around the globe and occupies 60.45% of Indian land. The Indian economy, dominatingly, depends upon farming along with agro-industry things. The soil ingredients (like Nitrogen, Phosphorous, Potassium), crop rotation, soil clamminess, atmospheric and surface temperature, precipitation, etc, play an efficient role in cultivation. The present evidence related to this field includes a model which is incorporated with ML algorithms (Random Forest, Decision Tree, Artificial Neural Network) to determine best crop. In this paper, the proposed model is enhanced by applying deep learning techniques and along with the prediction of crop, a clear information is achieved regarding the amounts of soil ingredients needed with their expenses separately. It provides a better accuracy than the existing model. It analyzes the given data and help the farmers in predicting a crop which in return help in gaining profits. The climatic and soil conditions of land are taken into consideration to predict a proper yield. The objective is to present a python based system that uses strategies smartly to anticipate the most productive reap in given conditions with less expenses. In this paper, SVM is executed as Machine Learning algorithm while LSTM and RNN are used as Deep Learning algorithms.

Potnuru sai nishant, Pinapa sai venkat and Bollu Lakshmi avinash (june 2020) have designed in Crop yield prediction based on indian agriculture using machine learning. Crop yield prediction based on indian agriculture using machine learning uses climatic factors like rainfall, sunlight and agricultural factors like soil type, nutrients possessed by the soil (Nitrogen, Potassium, etc.) but the problem is we need to gather the data and then a third party does this prediction and then it is explained to the farmer and this takes a lot of effort for the farmer and he doesn't understand the science behind these factors. To make it simple and which can be directly used by the farmer this uses simple factors like which state and district is

the farmer from, which crop and in what season (as in Kharif, Rabi, etc.). In India, there are more than a hundred crops planted around the whole country. These crops are categorized for better understanding and visualization. The data for this research has been acquired from the Indian Government Repository. The data consists of attributes – State, District, Crop, Season, Year, Area and Production with around 2.5 Lakh observations. The depicts the states and territories of India which visualize that which category of crops are famous in which season. We used advanced regression techniques – Lasso, Enter and Kernel Ridge and further we used stacking of these models to minimize the error and to obtain better predictions.

Yuvaraja teekaraman and Hariprasath manoharan (feb 2021) have designed in Implementation of cognitive radio model for agricultural applications using hybrid algorithms. In recent days there the farmers who are having enormous expanses of land are facing heavy loss due to sudden changes like monsoon and presence of high amount of CO₂. Therefore, this article presents a Cognitive Radio (CR) model for implementing in agricultural field to predict the parameters like CO₂ effect and strength of received signal. In order to monitor these parameters a new fanged technique with low cost implementation is necessary. Therefore, a low cost Effective CR Agricultural model has been incorporated by integrating the algorithms in two folds. The proposed method has the advantage that the strength of received signal will be higher even if the distance is too long. In addition the effect of CO₂ will also be reduced. The projected technique is compared with other existing techniques where, the implementation cost is much lesser and also the CR model proves to be a precise technique for agricultural application.

4.4.3 HYBRID ALGORITHM APPLIED IN FINANCIAL FIELD

Mengxing huang, Qili boa, Yu zhang and Wenlong Feng (march 2019) have designed in A hybrid algorithm for forecasting financial time series data based on DBSCAN SVR. Financial prediction is an important research field in financial data time series mining. There has always been a problem of clustering massive financial

time series data. Conventional clustering algorithms are not practical for time series data because they are essentially designed for static data. This impracticality results in poor clustering accuracy in several financial forecasting models. In this paper, a new hybrid algorithm is proposed based on Optimization of Initial Points and Variable-Parameter Density-Based Spatial Clustering of Applications with Noise (OVDBCSAN) and support vector regression (SVR). At the initial point of optimization, and MinPts, which are global parameters in DBSCAN, mainly deal with datasets of different densities. According to different densities, appropriate parameters are selected for clustering through optimization. This algorithm can find a large number of similar classes and then establish regression prediction models. It was tested extensively using real-world time series datasets from Ping An Bank, the Shanghai Stock Exchange, and the Shenzhen Stock Exchange to evaluate accuracy. The evaluation showed that our approach has major potential in clustering massive financial time series data, therefore improving the accuracy of the prediction of stock prices and financial indexes.

Rahim ghasemiyeh, Reza moghdani and Shib sankar sana (march 2017) have designed in A hybrid artificial neural network with metaheuristic algorithm for predicting stock price. Most investors change stock prices in long-term businesses because of global turbulence in the markets. Consequently, prediction of stock price is a difficult task because of unknown effective factors in this area although previous researches have shown that neural networks are more effective and accurate in many areas than traditional statistical models. The proposed study aims to predict prices on stock exchange via the hybrid artificial neural network models and metaheuristic algorithms which consist of cuckoo search, improved cuckoo search, improved cuckoo search genetic algorithm, genetic algorithm, and particle swarm optimization. The important 28 variables of value-added knowledge related to stock indices are identified as input parameters in this network, and then real values are obtained (<http://www.tsetmc.com>). The results of the proposed model suggest that particle swarm optimization is a dominant metaheuristic approach to predict stock price according to statistical performances of the above approaches.

4.5 ARTIFICIAL IMMUNE ALGORITHM APPLIED IN VARIOUS FIELD

- i. Agricultural field
- ii. Machine learning

4.5.1 ARTIFICIAL IMMUNE ALGORITHM APPLIED IN AGRICULTURAL FIELD

Oladayo tosin akinwande and Muhammad Bashir Abdullah (April 2019) have designed in Artificial immune system (AIS) algorithms for crops classification using principal components analysis. There have been tremendous increase in crop production data which can be used to characterize and predict models in data mining for agriculture. Recently, researchers have shown a lot of interest in applying biologically inspired systems for solving classification and recognition problems. Several solutions have been proposed using Artificial Immune System (AIS), Ant Colony Optimization and so forth in classification problems as another machine learning technique. The field of agriculture is not left behind in the use of machine learning technique for crop and soil classification but few research has been carried out in using AIS as a machine learning technique for crop edibility and disease classification. In this paper, we propose an Artificial Immune System (AIS) solution using AIRS, Clonal and Immunes algorithms with PCA for crop edibility and crop disease classification. The proposed solution is tested on two crop dataset (Mushroom and Soybeans dataset). The results show significant improvement of the proposed solution over other techniques in most of the cases. Accuracy, true positives and false positives were used as performance measures. The proposed model can be used to enhance crop productivity.

A.B.M.Khidzir, M.A.Malek, Amelia ritahani Ismail, Liew juneng and Ting sie chun (Feb 2015) have designed in Utilization of artificial immune system in prediction of paddy production. This paper proposed an Artificial Immune System

(AIS) approach using the Clonal Selection Based Algorithms (CSA) to analyses the pattern recognition capability of the paddy trend, and to predict the paddy production based on climate change effects. Climate factors and paddy production are used as input parameters. High percentage of accuracy ranges from 90%-92% is obtained throughout the training, validation and testing steps of the model. The results of the study were tested using the Root Mean Square Error (RMSE), Mean Average Percentage Error (MAPE) and coefficient of determination (R^2). Based on the results of this study, it can be concluded that the CSA is a reliable tool to be used as pattern recognition and prediction of paddy production.

4.5.2 ARTIFICIAL IMMUNE ALGORITHM APPLIED IN MACHINE LEARNING

Ishaan gupta, Ruchir shangle, Vishwas latiyan and Umang soni (Aug 2021) have designed in Cardiovascular disease detection using artificial immune system and other machine learning model. Researchers and medical institutions face problems in detecting and diagnosing cardiovascular diseases in the early stages. Therefore, having a tool for detecting cardiovascular diseases in early stages will be helpful for the medical institutions to combat the disease. In this paper, we have presented a solution for detection of cardiovascular diseases by using clonal selection algorithm. Clonal selection is an Artificial Immune system (AIS) based algorithm which is often used for pattern recognition problems. Here, we propose modified clonal selection algorithm (CLONALG) which effectively detects cardiovascular diseases. With the proposed algorithm, we have achieved an average accuracy of 78%. Further, we compared the accuracy of CLONALG algorithm with different models of Machine Learning, viz. Random Forest Classifier (RFC), Decision Tree Classifier (DTR), Support Vector Machines (SVM), Logistic Regression (LR) and Artificial Neural Networks (MLP-ANN) for cardiovascular disease detection

M.Revathi and K.Arthi (July 2014) have designed in Application of artificial immune system algorithm in dataset classification. In recent years there is a huge

increase in emphasis of interest in studying biologically inspired systems. Artificial immune systems (AIS) are a class of computationally intelligent systems inspired by the principles and processes of the vertebrate immune system. Computer engineers, mathematicians, philosophers and other researchers are particularly interested in the capabilities of this system, whose complexity is comparable to that of the human brain. AIS algorithms are machine-learning algorithms that typically exploit the immune system's characteristics of learning and memory to solve complex problem. It attempts to take advantages and benefits of natural immune systems for use in tackling complex problem domains. It is a class of adaptive or learning computer algorithm inspired by function of the biological immune system, designed for and applied to difficult problems such as intrusion detection, data clustering, and classification and search problems. In this paper, a study of artificial immune systems algorithms like Artificial Immune system Recognition system algorithm (AIRS) , parallel AIRS and clon ALG are presented with the possible number of applications in various domain.

4.6 BIOGEOGRAPHY BASED OPTIMISATION APPLIED IN VARIOUS FIELD

- i. Electric
- ii. Agriculture

4.6.1 BIOGEOGRAPHY BASED OPTIMISATION APPLIED IN ELECTRICAL FIELD

Salam waley shneen (sep 2018) have designed Biogeography based optimisation tuned fuzzy logic controller to adjust speed of electric vehicle. There are many power electronic converters and motor drives connected together to form the electrical system of an Electric Vehicle. we have presented a modelling tool that has the advantages of utilizing capabilities of the PMSM software in detailed simulations of converters, motor drives, and electric machines. In addition, equivalent electrical models of Electric Vehicle drive system. This also gives a brief

idea of PMSM validity as an Electric Vehicle simulation tool. PMSM drive system is described and analysed due to its importance in many applications especially in Electric Vehicle applications. Applications due to their high efficiency, low inertia and high torque to volume ratio. we embody the simulation of Fuzzy Logic Controller. The controller govern the speed control of Electrical Vehicle EV using permanent magnet synchronous motor PMSM. This work characterizes to obtain the optimal parameters of FLC. Biogeography Based Optimization (BBO) is a new intelligent technique for optimization; it can be used to tune the parameters in different fields. The main contribution of this work efforts the ability of BBO to design the parameters of FLC by determining the shapes of triangle memberships of the inputs and output. The results of optimal controller (BBO-FLC) compared with the other controllers designed by Genetic Algorithm GA which it is a powerful method has been found to solve the optimization problem. The implementation of BBO algorithm has been done by M-file/Mat lab, this program linked with SIMULINK to calculate the fitnesses function which has the complete mathematical system model has implemented using. The results show the excellent performance of BBO-FLC compared with GA-FLC and PI controller, also the proposed method was very fast and need a few number of iterations. These results also confirmed that the transient torque and current never exceed the maximum permissible value.

Purushottam narayanrao padghan and Abhijit Mukherjee (Jan 2014) have designed Biogeography based algorithm for high voltage electrode surface optimisation of a single phase GIS bus terminal. A new method applying the biogeography-based optimization (BBO) technique is presented for the optimization of high voltage electrode surfaces. The aim is to obtain the optimization of the electrode shape in order to achieve a uniform field distribution along the surface of the electrode and maintain maximum field stress at minimum value. The principle of the developed optimization technique is described with an axis-symmetric single-phase GIS bus terminal electrode considered as a quarter-ellipse. In this scheme different aspects of the optimization technique are compared by means of semi-infinite line charges and ring charges to compute the electric field with the charge simulation method (CSM). The new Biogeography Based optimized approach helps in achieving a uniform field distribution with a minimum electric stress on the

electrode surface and a minimum deviation angle for the otherwise normal stress vector, holding the assignment factor within the assigned range. The deviation angle is the more sensitive indicator of the simulation accuracy. The assignment factor has an impact on simulation accuracy. The combined BBO/CSM algorithm is capable of finding a better-quality solution, better accuracy, better convergence characteristics and computational efficiency.

Purushottam narayanrao padghan and Abhijit Mukherjee (Dec 2013) have designed Effective field optimisation of high voltage electrode surface by biogeography based algorithm. In high voltage engineering, optimization of electric field distribution is directly related with the design of high voltage electrode surface. Various field optimization techniques are in use and this presents a new method based on the biogeographically isolated habitats for the optimization of high voltage electrode surface. This new method is known as Biogeography Based Optimization (BBO) and is used to obtain the shape of electrode in such a way that it can produce a nearly uniform field distribution along the surface of the electrode. The developed optimization technique is demonstrated with an axisymmetric single phase high voltage electrode. To compute the electric field, Charge Simulation Method (CSM) is used. For better simulation accuracy the sensitive indicators like deviation angle and assignment factor are kept well within the assigned values. These factors affect the simulation accuracy to a greater extent as compare to the statistical data. The new BBO technique helps to keep the maximum stress at a minimum possible value along the high voltage electrode surface.

4.6.2 BIOGEOGRAPHY BASED OPTIMISATION APPLIED IN AGRICULTURAL FIELD

A.Negrin, D.Roose, E.L.Chagoyen, G..Lombaert (mar 8) have designed Biogeography based optimisation of RC structure including static soil structure interaction. A method to minimize the cost of the structural design of reinforced concrete structures using Biogeography-Based Optimization, an evolutionary algorithm, is presented. SAP2000 is used as computational engine, taking into

account modelling aspects such as static soil-structure interaction (SSSI). The optimization problem is formulated to properly reflect an actual design problem, limiting e.g. the size of reinforcement bars to commercially available sections. Strategies to reduce the computational cost of the optimization procedure are proposed and an extensive parameter tuning was performed. The resulting tuned optimization algorithm allows to reduce the direct cost of the construction of a particular structure project with 21% compared to a design based on traditional criteria. We also evaluate the effect on the cost of the superstructure when SSSI is taken into account.

4.7 ARTIFICIAL BEE COLONY ALGORITHM APPLIED IN VARIOUS FIELD

- i. Electric
- ii. Agriculture

4.7.1 ARTIFICIAL BEE COLONY ALGORITHM APPLIED IN ELECTRICAL FIELD

Kassim ai-anbarn and Husham moaied nalet (apr 2017) have designed Application of artificial bee colony algorithm in power flow studies. Artificial bee colony (ABC) algorithm is one of the important artificial techniques in solving general-purpose optimization problems. This presents the application of ABC in computing the power flow solution of an electric power system. The objective function to be minimized is the active and reactive power mismatch at each bus. The proposed algorithm has been applied on typical power systems. The results obtained are compared with those obtained by the conventional method. The results obtained reveal that the ABC algorithm is very effective for solving the power flow problem in the maximum load ability region.]

Kalim ullah, Quanyuan jiang, Guangchao geng, Sahar rahim and Rehan ali khan (Jan 2022) have designed Optimal power sharing in micro grids using the

artificial bee colony algorithm. : In smart grids, a hybrid renewable energy system that combines multiple renewable energy sources (RESs) with storage and backup systems can provide the most cost-effective and stable energy supply. However, one of the most pressing issues addressed by recent research is how best to design the components of hybrid renewable energy systems to meet all load requirements at the lowest possible cost and with the best level of reliability. Due to the difficulty of optimizing hybrid renewable energy systems, it is critical to find an efficient optimization method that provides a reliable solution. Therefore, in this study, power transmission between micro grids is optimized to minimize the cost for the overall system and for each micro grid. For this purpose, artificial bee colony (ABC) is used as an optimization algorithm that aims to minimize the cost and power transmission from outside the micro grid. The ABC algorithm outperforms other population-based algorithms, with the added advantage of requiring fewer control parameters. The ABC algorithm also features good resilience, fast convergence, and great versatility. In this study, several experiments were conducted to show the productivity of the proposed ABC-based approach. The simulation results show that the proposed method is an effective optimization approach because it can achieve the global optimum in a very simple and computationally efficient way

4.7.2 ARTIFICIAL BEE COLONY ALGORITHM APPLIED IN AGRICULTURAL FIELD

P.Surya, I.Laurence aroquiaraj (Aug 2019) have designed Crop prediction analysis in north western zone of tamilnadu using artificial bee colony with weighted based fuzzy clustering. Agriculture is most important part for living people. Crop prediction analysis is more useful analysis to choose the particular crop for cultivation in particular season. A hybridization technique that is Artificial Bee Colony with weighted based Fuzzy Clustering algorithm was proposed to predict a district which produces a most high yield in the north western zone of Tamilnadu in that particular district. North western zone of Tamilnadu consist four districts such as Dharmapuri, Krishnagiri, Namakkal and Salem. In this research work the proposed algorithm shows that the district in the north western zone of Tamilnadu which yields

high production of particular crop for that particular season. In north western zone of Tamilnadu, Crop prediction analysis consider as high yield area, moderate yield area and low yield area as district wise. The Experimental result shows that hybridized artificial bee colony with weighted based fuzzy clustering algorithm yields better performance than other clustering algorithm like k-means and kmedoids with high accuracy.

Mehrdad bijandi, Bashman farhadi, Mohammad karimi and Wim van der knaap (oct 2020) have designed Agricultural land partitioning model based on irrigation efficiency using a multi objective artificial bee colony algorithm. In the process of agricultural land consolidation, the land parcels are optimally redesigned and rearranged in such a way that the dimensions of the resulting parcels are proportional to agricultural criteria such as irrigation discharge, soil texture, and cropping pattern. Besides these criteria, spatial factors like slope, road accessibility, volume of earthwork, and geometrical factors such as size and shape of parcels are also included in the design process of agricultural land partitioning. In this study, a land partitioning model was proposed using a multi-objective artificial bee colony algorithm (MOABC-LP) taking into consideration the mentioned factors. Initially, a feasible dimension range of parcels in a block was calculated based on irrigation efficiency. Two partitioning layouts were defined according to the topography and geometry of blocks. The proposed method was applied to a real study area and the results suggest that the land partitioning plan obtained by the MOABC-LP model, in comparison with a designer's plan, not only makes the shape and size of parcels more compatible with the topographical and agricultural conditions of each block, but also reduces their cut-and-fill ratio.

CHAPTER-5

5. SUMMAARY

5.1 Conclusion

This paper divulge an overview of advanced optimization techniques typically applied in various field like machine learning, electrical, agricultural and finance. An analysis is made for various optimisation techniques such as Genetic algorithm, PSO, DEA, AIA, BBO, and ABC algorithm to update applied in various field. There are many algorithm techniques that have shown to be successful for different applications. We have provided a review of an algorithm framework reported in the literature. This comparison will be very helpful for improve to determine the optimal solution and improve the process.

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