A Review on Analysis Search Based Software Testing using Metaheuristics Techniques

Mandeep Kumar[1*], Deepak Nandal[2]

[1]Department of Computer Science, Guru Jambheshwar University, Hissar, India
[2]Department of Computer Science, Guru Jambheshwar University, Hissar, India

*Corresponding Author: mandeepkumar.0856@gmail.com

Abstract- Search-Based Software Testing (SBST) is a form of Search-Based Software Engineering (SBSE) to optimize testing through the use of computational search. Search Based Software Testing (SBST) denotes process of meta-heuristics for optimization of task into perspective of software testing. The expenditure of meta-heuristics analysis activities are accomplished for upper numbers of inputs that essential to be verified. In this paper we explain how we created an efficient testing techniques to compare searches based Meta heuristics algorithms based on their parameter and get their performance and test them.These Algorithms are used to generate automatic test data that satisfy branch coverage, path coverage, cost and time and quality in software testing. Cost of testing behavior has primary section of the total cost of software. Finally, this paper present the result which carried out to estimate the efficiency of the proposed techniques with new fitness function compared to each other based on their parameters and analyses the performance. SBST for test Generation, efficient Meta-Heuristics search Algorithms.

Keywords: Meta heuristics Algorithms, Search Based Software Engineering, Software Quality,Path coverage, Branch coverage, Software Testing, Automated Test Case Generation.

I.   INTRODUCTION

Search-Based Software Testing (SBST) is a form of Search-Based Software Engineering (SBSE) to optimize testing through the use of computational search.SBST, the first region of software engineering where exploration based optimization methods were useful and endure that generally deliberate region.Optimization and testing in software engineering classical methods has turn into a tedious assignment now-a-days.Search based approaches have been applied to several optimization problems [6]. Search based optimization techniques with a variety of software engineering scheme through in life-cycle of software, for example project planning, cost estimation, requirement engineering [1-3],predation [4],design [5,17],testing [6-9], automated maintenance [10], quality assessment [11] and general survey of SBSE[12,13] and challenges[14]. SBSE is relevance of optimization techniques (OT) in clarifying software engineering difficulties. Optimization [25] is method of trying to discover the finest conceivable explanation among all those accessible.
The search-based algorithms occurs main step: **Search**

Initialization: The search started via at random prefer explanation from feasible candidate solutions.
Quality Assessment: Evaluating superiority of candidate solution by means of fitness function.

Modify: Modify candidate clarification by creation it slightly different.
Select: Select candidate result on the origin of fitness function in agreement with preferred algorithm.
Representation: -The problem required to be representing which can be manipulating through the search algorithm.
Fitness Function [16]: The function for guide the search. It is problem specific. It is the functions which carries vital information concerning the problem and help to make a decision between good and poor solutions.

Automated test data generation (ATDG):
SBST is recycled to make test information, arrange test circumstances, reduce experiment suit, decrease social revelation rate, confirm software representations, examination service-orientated designs, make test collections for collaboration challenging, and authenticate real-time possessions .In analysis, producing test information is very significant since the competence of challenging is extremely reliant on the information used in the stage.Maximum effort on Software Testing has disturbed the problem of generate inputs that produce examination collection that satisfy a test suitability condition. The illustration is presented in Fig.1. Frequently this difficulty of creating test efforts is called 'Automated Test Data Generation (ATDG)' although, exactly communication deprived of revelation, and individual the contribution is

made. Fig.1 shows the general method of the most familiar methodology in the mechanism, in which examination contributions are created permitting to examination capability standards [6, 19]. A test suitability standards requires the situations that requirement be occupied on the improper of some test necessities [20, 3]. The suitability assignment captures the serious information and differentiates decent clarification from humble one. Formerly, it [23, 16] has been distinct for assessment capability condition, then group of acceptable test inputs can be mechanized expending SBSE. In demand to allocate suitability to the test contributions, the ATDG classification has to type the database to be implemented for the contributions. In a survey of ATDG [18] organization then displays the implementation to evaluate capability constructed on how well the efforts meet the test capability condition. Test data group [21] in database testing is the method of classifying a usual of test information which contents assumed testing condition. Most of the remaining test information producers use representative estimate to originate test data. However, in applied sequence this technique regularly necessitates compound algebraic operations, mainly in the occurrence of arrangements. In this paper we existing other method of test data group which is created on real implementation system below test, occupation minimization methods, and decrease of charge and time. Test data are established for database expending concrete standards of contribution variables. Once the database is performed, the program implementation movement is examined. If throughout program performance an unattractive implementation flow is detected then utility minimization exploration systems are recycled to repeatedly discover the standards of input variables for particular track is negotiated. Approach of Meta-Heuristics search Techniques for the automatic generation of test data has been burgeoning interesting for many researchers in recent years
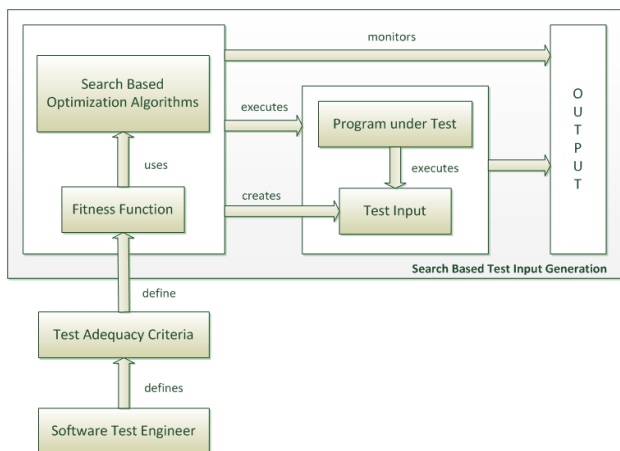

Fig.1 A basic search-based test input creation system

II.   METAHEURISTICS SEARCH ALGORITHM

The term Meta -Heuristic is collected by dual words, 'Heuristic' i.e. 'on the way to search' and attached by alternative term 'Meta' i.e. 'afar, in higher level'. Meta-heuristics can resolve composite difficulties in which finest resolution necessity originate between a huge amount of opportunities .The secure method of search based-software engineering (SBSE) techniques are presented to resolve real creation huge measure difficulties efficiently. In the field of Search Based Software Engineering, word 'search' recycled that denote the Meta heuristic search-based optimization systems that recycled. There are numerous methods which used software analysis with Metaheuristic. On the bases of survey Meta Heuristic[15,24] can estimated using techniques such as: Tabu Search, Simulated annealing,Genetic Algorithm[21], Particle Swarm Optimization[27,30], Ant Colony Optimization [26,28,31], Grey wolf optimizer Algorithm,Bee colony optimization Algorithm, Artificial bee colony Algorithm etc.From all the above techniques, Some of them formulated Local Based and Some are Global Based.There exist several search algorithms.When a particular session of difficulties is measured (e.g., software engineering), its probable that a specific exploration process executes enhanced than others on that session. On a different search problematic (e.g., software testing) is significant to associate dissimilar search algorithms [22].In this we compare 5 search based Meta heuristic techniques that are maximum recycled to attack software engineering problems [8]. They have been described to create prosperous effects in several presentations. Consequently, we emphasis examines these exploration algorithms.

Particle Swarm Optimization (PSO) for SBST: PSO have nature inspired algorithm that applies toward conception of social communication which solve computational task. Kennedy and Eberhart presented a heuristic universal optimization technique identified as PSO in year 1995 in a study paper named "Particle Swarm Optimization" [33, 34]. From that time, several alterations and enhancements are widespread. Each element retains the best place in recollection accomplished so far, called personal best (**pbest**). Correspondingly, the finest position of the group is called global best (**gbest**). Both are recycled by the element in defining its next best position in group. Its Amount of elements might be reduced to escalation the presentation [21, 30].

Ant Colony Optimization Algorithm (ACO) For SBST: Ant Colony Optimization (ACO) is instinctive algorithm emulates performance of natural ants. Ants are blind and have capable to find the better way from food foundation to their destination via chemical substance called pheromone which guides their search. A path missing ant will track this way makes on superiority of pheromone lay on earth as ants

go. Ants position pheromone on the ground whereas walking and every ant trail a direction where pheromone passion is high. While ants recognize obstruction in pathway it changes direction and tries to discover new shortest path. ACO algorithm has functioning with two ways, go with touching track of ants: onward (from starting place to goal) and rearward (from provisions to destination).

Genetic Algorithm (GA) for SBST: Genetic Algorithms (GAs) has superior for massive search places also navigate them seems for finest combination of possessions solution you might not or else discover in existence time. GA never look for superior solution it seems for first-rate and strong solution rated aligned with fitness criterion thus it avoid local optima and search for large-scale fitness unbelievable awesome and genetics algorithms are search and optimization techniques based Darwin's principle of natural selection how does it work. GAs instruct with possible clarification headed for definite problem with a straightforward chromosome-such as data structure moreover apply operator modeled later than genetic recombination also metamorphosis for these structure in a approach which are intended to protect important information. Genetic algorithms are usually worn toward resolve maximization and minimization problems which may combinatorial compound moreover who never provide themselves with ordinary algorithmic techniques.

Bee Colony Optimization (BCO) For SBST: Bees Algorithm has nature inspired-based search algorithm which was found in 2005[5] It mimic food foraging activities like honey bee colonies. Their essential versions of an algorithm perform a variety of local investigate collective through large-scale search, moreover may use on behalf of equally combinatorial optimization and permanent optimization. Single situation on behalf of function of the Bees Algorithm are to facilitate some evaluate of topological expanse among

the solution is definite. Efficiency as well as explicit ability of Bees Algorithm has been verified during various study.

Grey wolf Optimizer (GWO) algorithm for SBST:
This work proposes new Meta heuristics called Grey Wolf Optimizer inspired by grey wolves .The GWO algorithm mimics the leadership hierarchy and hunting mechanism of grey wolf in nature. Four type of grey wolf such as alpha, beta, delta and omega are employed for simulating the leadership hierarchy. It belongs to candidate family. Grey wolf mostly prefer to live in a pack. The leaders are male and female called alphas. The alpha is responsible for making decision about hunting, sleeping place, time to wake and so on. The alpha wolves are only allowed to mate the pack. The beta is subordinate wolves that help the alpha in decision making or other pack activities. The omega plays to role of scapegoat. Omega wolves always have to submit to all the other dominant wolves. They are last wolves that are allowed to eat.

Harmony Search (SH) for SBST: Harmony search is a population based mate heuristics algorithm that are inspired from musical process searching for a perfect state of harmony .This Algorithms is proposed by Geem et. al. in 2001.The pitch of each musical instrument determine the aesthetic quality just as fitness function value determine the quality of decision variable. In the musician improvisation process all players' sound pitches within possible range together to make one harmony. If all pitches makes a good harmony, each players store in his memory that experience and possibility of making good harmony is increased next time. That same thing in optimization, initial solution is generated randomly from decision variable within possible range. The initial population HM Consists of HMS vectors is generated randomly.

III. LITRATURE REVIEW

Table 1: Comparison Table of Literature Review:

Sr. No.	Title	Meta Heuristics Algorithms Used	Testing Techniques Used	Tools	Parameter Used	Research Perspectives
1	Approach for software test case selection using hybrid PSO [21]	ACO – PSO	Test Case Selection and Prioritization, Regression Testing	Mat lab	Cost, Time, path, probability	1.It proves its power and effectiveness towards Solving complex testing problem. 2. Some other techniques for test case prioritization can be modify to achieve better result.
2	Evaluation of Swarm Optimization	ABC-PSO-ACO	CBSE reusability	Mat lab	No. of Iteration, Simulation time	1 .Compute the best cost value within time

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	Techniques using CBSE Reusability Metrics [22]		Metrics to save time and memory space		,Fitness Function, Best Cost Value.	and save memory space. 2. It may not solve complex problem of component integrity.
3	A new automatic test data generation algorithm based on PSO-ACO [23]	PSO-ACO	Test data generation for Coverage and accuracy	Not defined	Population Size ,No. of iteration , efficiency, diversity, learning factor of PSO	1. New algorithm can avoid a premature and local extreme problems 2 It work only dynamically adjusts search capabilities not work for statics search.
4	Comparative Study of Meta-heuristics Optimization Algorithm using Benchmark Function [24]	7 Meta heuristic algorithms namely: GA ,DE,SA,FFA, CS,TPO	11 Test benchmark Function	Not Defined	Iteration, population, Mutation, crossover, Diff. Weight, fireflies, Gen., leaves, initial Temp. ,Final ,Nests ,pa rate ,α,β,θ	1. It explain wide range of nonlinear optimization Problems optimally and also differentiate between convergence and computation time. 2. Discontinuous function, F9 has numerous plateaus which provide outcome in poor convergence.
5	Comparison of Search based Techniques for Automated Test Data Generation [25]	GA,ABC,ACO	Automatics Test data generation to optimize test suits	C++	Path coverage, No. of iteration, No. of test cases , number of programs, Time	1. Performance of ABC can be improved by distributed and parallel processing approach. 2. It solved 9 C++ programs for ATDG.
6	A Comparative Analysis of Ant Colony Optimization forits Applications into Software Testing [26]	ACO	Apply various software testing techniques	Not mention	Distance, time, path	1.We may reducing the time of global or local search through the connected graphs 2. It afford optimized solutions to Explain a little composite computational problem.
7	A Comparative Evaluation of "m-ACO" Technique for Test Suite Prioritization [27]	m-ACO ,GA ,BCO,ACO	Test Suit Prioritization ,Regression Testing ,Fault Coverage	Automated tool	PTR, APFD	1. It decreases testing efforts via sinking the portion of test set. 2. It belong less visited module became weaker in later iterations.
8	Comparing Algorithms for Search-Based Test Data Generation ofMat lab Simulink Models [28]	SA ,GA	Test Data Generation for Simulink Models	Mat lab	Coverage, MSR ,Means of fitness Evaluations ,No of path/branch, ,no of blocks	1. This is first approach for code based systems using Simulink modules that gives better performance.

					2. It does not consider state-based testing.
9	An Analysis ofForaging and EcholocationBehavior of Swarm Intelligence Algorithms in Optimization: ACO, BCO and BA [29].	ACO, BCO,BA	Varies Application area covered by Swarm intelligence	Not defined	Inspiration Agent ,Communication ,Efficiency ,Selection of Path ,Computational Time ,	1. It consider difficulty-solving activities of party of moderately effortless Agent. 2. The Major argument in parameter organize, optimality of the settlement, high execution Time.
10	A Comprehensive Review of Swarm Optimization Algorithms [30] .	DE ,PSO,GWO	Taking no. of benchmark function get the performance of algorithms	Mat lab	No. of iteration , No .of function , Mean error, SD ,Time	1. Time consuming is a major issue with this approach . 2. Meta heuristic methods and benchmark functions measure Performance.
11	Performance Evaluation of GSA and PSO based Algorithms for Automated Test Data Generation for Software [31]	PSO ,GSO	Automated test data generation ,Symbolic testing	GATBX	Iteration ,Population ,Fitness function ,test coverage ,Percentage coverage	1.For large domain sometimes it fails to generate the test cases.. 2. It shows that Local PSO is performing better than Global PSO for test case generation
12	Nature-inspired approaches in software faults identification and debugging [32].	ACO ,AIS	Test data generation, Mutation Testing, Unit Testing, Evolutionary Testing	Not defined	Reliability, Dependability	1.If we have large data set for testing that get more time for software faults identification and Debugging. 2. The software Reliability and dependability able to recover through optimized software testing.
13	Comparison among five evolutionary-based optimization algorithms [33].	GA, memetic Algorithm ,PSO ,ACO ,SFL	Test for Discrete and continuous Benchmark function for all evolutionary algorithms	Virtual Basic	Time, Speed ,Cost ,Success rate	1.No other optimization algorithms applicable for continuous function and discrete function 2. Using Evolutionary Algorithms we can optimize the problem within time.
14	The Survey on Artificial Life Techniques for Generating the Test Cases for Combinatorial Testing [34]	GA,ACO,PSO	Complexity of Test case generation using combinatorial testing	Not defined	Cost	1These search techniques can't be improvement their relationship and not used in wide range of area. 2. UsingCombinatorial

						testing small number of test cases is more effective at an overall lower cost.
15	Grey Wolf Optimizer [35]	GWO , PSO ,DE ,GSA , EP ,ES	Benchmark function for each algorithms	Mat lab	Average, Standard ,Angling , searching for prey ,encircling prey ,attacking prey	1. It may not perform on binary values and multi-objective function. 2. A substantial improvement of NDBP compared to current approaches solving real problems.

IV. CONCLUSION & FUTURE SCOPE

This paper presents a review of the Different-Different search based Meta heuristics algorithms, for Test Data generation to reduced Time and Cost estimation and path coverage, branch coverage. From the review, it may be concluded that using Testing techniques that has compared Meta heuristics algorithm and get better results than other techniques. By using these approaches, the quality of software can also be increased and Cost; Time also reduced.A better accuracy can be achieved, If we further hybridize the techniques for Code Coverage, loop coverage.

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Authors Profile

Mandeep kumar pursed Bachelor of Technology from Maharshi Dayanand University ,Rohtak, India in 2015. He is currently pursuing Master of Technology from guru Jambheshwer Univercity Hisar (HR),India.His main research work focuses on Software Engineering ,Meta heuristics Algorithms.

Mr.Deepak Nandal (Co-Author) pursed Bachelor of Tehnology from Maharshi Dayanand Rohtak,India and Master of Technology from Maharshi Dayanand Rohtak, India.He is currently pursuing Ph.D. and currently working as Assistant Professor in Department of Computer Science and Engineering,in Guru Jambheshwer University Hisar,India.He has published 14 research papers in reputed international journals and it's also available online. His main research work focuses on Computer network,Software Engineering, and Networking. He has 7 years of teaching experience and 5 years of Research Experience.