

4.1 Pseudo Code for Memetic Algorithm:

Encode solution space

- 1) Encode solution space
- 2) Set pop_size, chrom_size, max_gen, Gen=0
- 3) Initialize population P randomly
- 4) For each individual $i \in P$: calculate fitness (i);
- 5) While(Gen<Gensize)
 - Apply generic GA *selection * cross-over *mutation
 - ** For each individual $i \in P$: do local_search(i);
 - *replacement
- 6) Test: Test whether the termination condition is Satisfied. If so, stop. If not, return the best solution in current population and go to Step 5

Hill climbing is applied in replacement for hybridization. A chromosome is chosen randomly and its random gene value is replaced by a random value. If the newly generated chromosome have better fitness than it replace the old chromosome else check the loop condition. To analyse the optimization ability of the algorithm on different De jong's functions, work is applied on it. Algorithms that are not able to discover good directions underperform in some problems.

4.2 Pseudo Code for Memetic Local Search:

1. Loop: if $i < no_of_run$
2. Select random chromosome
3. Select random gene position and Replaces its value by a randomly generated valid value
4. Calculate the fitness of new chromosome
5. If (fitness_new < fitness_old) Replace the old chromosome if better

The simplest test function is De Jong's F1. It is continuous, convex and unimodal. The performance on Sphere is a measure of the general efficiency of the algorithm. Generalized Rastrigin Function is a typical example of non-linear multimodal function. This function is a fairly difficult problem due to its large search space and its large number of local minima. The Ackley Problem is a minimization problem. Originally this problem was defined for two dimensions, but the problem has been generalized to N dimensions. Number of local minima: several local minima. The global minimum: $x^* = (0, \dots, 0)$, $f(x^*) = 0$. Schwefel's function is deceptive in that the global minimum is geometrically distant, over the parameter space, from the next best local minima. Therefore, the search algorithms are potentially prone to convergence in the wrong direction. The schwefel's function is symmetric, separable and multimodal (left). Rotating this function creates a non-separable surface with similar features [13].

5. Experimental Results

Using the method described in the previous section we tried to determine the effect on the performance of GA. Using low probability for mutation removes an additional variable of consideration. The general parameters used for all experiments, unless otherwise stated were:

- Random initialization
- Permutation encoding
- PMX crossover

- Inversion mutation
- 0.8 crossover probability
- Breeding pool at 100% of population size
- mutation probability .01
- For 500 Generations.
- Population size of 50 and 100.

Next section of this chapter includes graph of proposed hybrid and simple genetic algorithm applied on chosen TSP instances as well as result table. Graphs are plotted for minimum tour cost found in every generation. Implemented code is attached here with this report in the appendix.

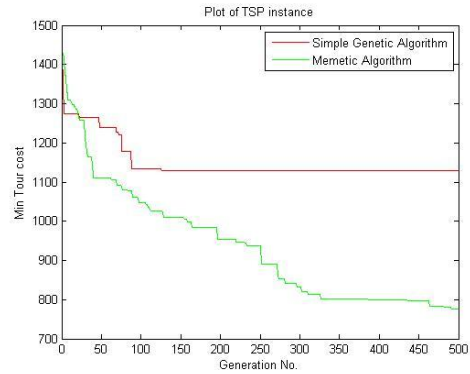


Figure 1: EIL51 Results with population size 50

Figure 1 shows the performance of Genetic algorithm and Memetic algorithms on eil51 with 50 population size and 500 generations and shows more closeness to optimum with memetic algorithm in comparison to simple genetic algorithm.

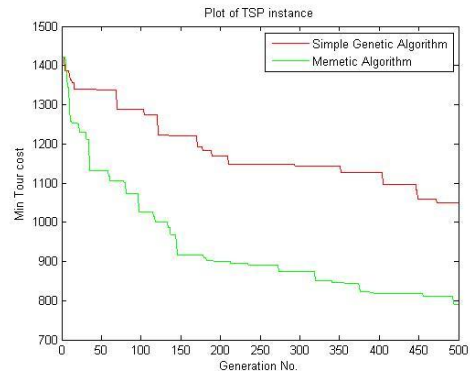


Figure 2: Eil51 Results with population size 100

Figure 2 shows the performance of Genetic algorithm and Memetic algorithms on eil51 with 100 population size and 500 generations and shows more closeness to optimum with memetic algorithm in comparison to simple genetic algorithm.

Table 1: Results for Eil51 with 51 cities and 426 Known optimum

Sr. No.	Best tour cost with Simple GA	Best tour cost with Memetic Algorithm
1	1153	746
2	1034	712
3	1035	635

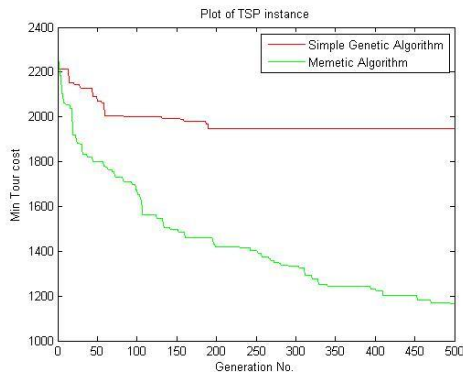


Figure 3: Experiment Results with population size 50

Figure 3 shows the performance of Genetic algorithm and Memetic algorithms on eil76 with 50 population size and 500 generations and shows more closeness to optimum with memetic algorithm in comparison to simple genetic algorithm.

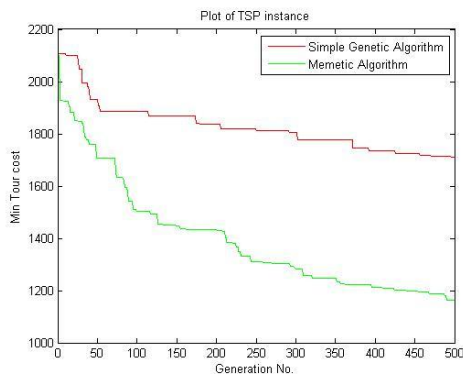


Figure 4: Experiment Results with population size 100

Figure 4 shows the performance of Genetic algorithm and Memetic algorithms on eil76 with 100 population size and 500 generations and shows more closeness to optimum with memetic algorithm in comparison to simple genetic algorithm.

Table 2: Results for Eil76 with 76 cities and 538 known optimum

Sr. No.	Best tour cost with Simple GA	Best tour cost with Memetic Algorithm
1	1884	1118
2	1787	1101
3	1765	1076

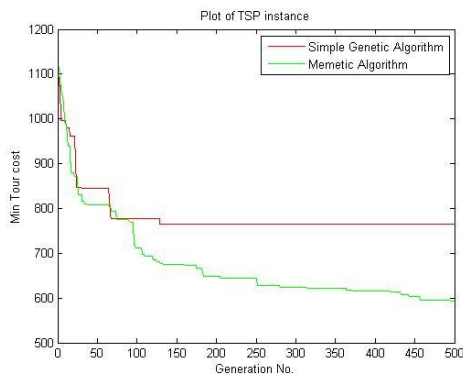


Figure 5: Experiment Results with population size 50

Figure 5 shows the performance of Genetic algorithm and Memetic algorithms on oliva30 with 50 population size and

500 generations and shows more closeness to optimum with memetic algorithm in comparison to simple genetic algorithm.

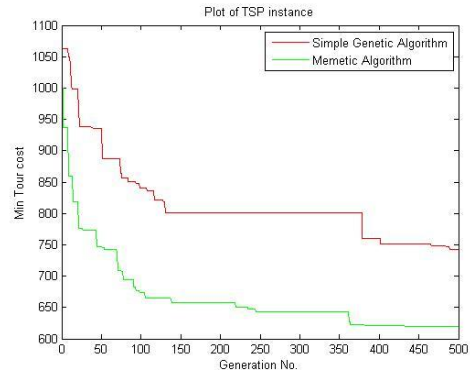


Figure 6: Experiment Results with population size 100

Figure 6 shows the performance of Genetic algorithm and Memetic algorithms on oliva30 with 100 population size and 500 generations and shows more closeness to optimum with memetic algorithm in comparison to simple genetic algorithm.

Table 3: Results for Oliva30 with 30 cities and 426 known optimum

Sr. No.	Best tour cost with Simple GA	Best tour cost with Memetic Algorithm
1	758	565
2	725	578
3	712	501

6. Conclusion

This paper proposes a hybrid genetic algorithm and analyze the optimization ability of Hill climbing in replacement (by implementing the proposed algorithm in matlab). The memetic algorithm ability depends on the way of utilizing the information from both the searching mechanism i.e. genetic algorithm and local search. The optimization of different tsp instances is implemented to evaluate the general computational behavior of Genetic and memetic algorithm. At the initial stage, the genetic algorithm is implemented as the basic architecture on this algorithm. Further, the analysis is performed on the different replacement operators.

References

- [1] Holland J., 1975, "Adaptation in Natural and artificial Systems", the university of Michigan.
- [2] JG Digalakis, KG Margaritis, 2002 "An experimental study of benchmarking functions for genetic algorithms", International Journal of Computer Mathematics 79 (4), 403-416.
- [3] Jean-Michel Renders and Hugues Bersini, "Hybridizing genetic algorithms with hill-climbing methods for global optimization: two possible ways", 1994 IEEE.
- [4] T. Elmihoub, A. A. Hopgood, L. Nolle and A. Battersby, "Performance of Hybrid Genetic Algorithms Incorporating Local Search", 2004.
- [5] Natalio Krasnogor and Jim Smith, 2005 "A Tutorial for Competent Memetic Algorithms: "Model, Taxonomy and Design Issues", ISSN : 1089-778X .IEEE
- [6] J. Digalakis and K. Margaritis, 2004, "Performance

- Comparison of Memetic Algorithms” Appl. Math. Comput 158.
- [7] Milenic Mitchell, John H. Holland, 1994, “When will a genetic algorithm outperform Hill climbing”.
- [8] Stephen M. Goldfeld, Richard E. Quandt and Hale F. Trotte, “Maximization by Quadratic Hill-Climbing”
- [9] Kurt A. Hacker, John Eddy and Kemper E. Lewis, 2002, “Efficient Global optimization using Hybrid Genetic Algorithms”, American Institute of Aeronautics and Astronautics, Inc.
- [10] Nicholas J. Radcliffe and Patrick D. Surry, “Formal Memetic Algorithms”, in "Evolutionary Computing: AISB Workshop", Ed: T.C. Fogarty, Springer-Verlag LNCS 865, pp1-16, 1994.
- [11] Tarek A. El-Mihoub, Adrian A. Hopgood, Lars Nolle, Alan Battersby, “Hybrid Genetic Algorithms: A Review”, Engineering Letters, 13, ISSN: 1816-093X, 2006.
- [12] Aaquil Bunglowala, Dr. B. M. Singhi, 2008, “A Solution to combinatorial Optimization Problem using Memetic Algorithms”, International Journal Of Computer Science and Applications Vol. 1, No. 3, ISSN 0974-1003.
- [13] H.G. Beyer, H.P. Schwefel, Evolution strategies, 2002, “A comprehensive introduction, Natural Computing”

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