International Journal of Electrical, Electronics and Mechanical Controls
ISSN (Online) : 2319-7501
Volume 4 Issue 2 May 2015
Manuscript ID : ISSN23197501-V4I2M98-052015

REDUCTION IN MANPOWER LABOUR COST USING GENETIC ALGORITHMIC APPROACH

Sandeep Kumar
Department of Mechanical Engineering
Shree Siddhivinayak Group of Institutions
Shahpur-Bilaspur, Distt. Yamuna Nagar

Arvind Singh
Department of Mechanical Engineering
Shree Siddhivinayak Group of Institutions
Shahpur-Bilaspur, Distt. Yamuna Nagar

ABSTRACT

In social affair framework, by and large affiliation will separate work costs into direct costs and variety costs. These terms essentially prescribe if the work went to direct making of material or if the cost was by proposition related to the material's time. More important affiliations should endeavor to utilize copied suites to handle these costs as a result of the wide volume of experts. Exactly when makers set the expense of an OK they consider the cost of work. This is in light of the way that they need to charge more than that stunning's total cost of period. If enthusiasm for an unrivaled than ordinary drops or the quality customers are willing to pay for the broad falls, affiliations must change the cost of work to stay beneficial. They can lessen the measure of agents, reduce creation, oblige more raised measures of advantage, diminishing evil work expenses or reduction unmistakable considers the cost of period. This work gives a made study out of the front line in thing expense estimation covering arranged frameworks and structures ended up being as the years progressed. The general work is requested into subjective and quantitative frameworks. The subjective procedures are further subdivided into run of the mill and analogical systems, and the quantitative ones into parametric and illustrative structures. Each of the approaches may be portrayed and inspected, in explanation behind vitality, with further subdivisions. The work similarly prescribes the centrality of cost estimation in the privilege on time times of the design cycle and, in like way, rapidly discusses the present cases and future headings in the district. Examination work to be done in the field with reference to specific applications is in like way assessed. The work gives a thorough work in the field and should be profitable to experts and pros enthused about this field. The proposed algorithmic strategy is supported with the genetic estimation, a prestigious metaheuristic framework for the advancement of results.

Keywords – Manpower Optimization, Labor Cost Optimization, Genetic Algorithm

INTRODUCTION

Genetic algorithms are simple to implement, but their behavior is difficult to understand. In particular it is difficult to understand why these algorithms frequently succeed at generating solutions of high fitness when applied to practical problems. The building block hypothesis (BBH) consists of:

1. A description of a heuristic that performs adaptation by identifying and recombining "building blocks", i.e. low order, low defining-length schemata with above average fitness.
2. A hypothesis that a genetic algorithm performs adaptation by implicitly and efficiently implementing this heuristic.

Goldberg describes the heuristic as follows:

"Short, low order, and highly fit schemata are sampled, recombined [crossed over], and resampled to form strings of potentially higher fitness. In a way, by working with these particular schemata [the building blocks], we have reduced the complexity of our problem; instead of building high-performance strings by trying every conceivable combination, we construct better and better strings from the best partial solutions of past samplings.

"Because highly fit schemata of low defining length and low order play such an important role in the action of genetic algorithms, we have already given them a special name: building blocks. Just as a child creates magnificent fortresses through the arrangement of simple blocks of wood, so does a genetic algorithm seek near optimal performance through the juxtaposition of short, low-order, high-performance schemata, or building blocks."

There are limitations of the use of a genetic algorithm compared to alternative optimization algorithms:

- Repeated fitness function evaluation for complex problems is often the most prohibitive and limiting segment of artificial evolutionary algorithms. Finding the optimal solution to complex high-dimensional, multimodal problems often requires very expensive fitness function evaluations. In real world problems such as structural optimization problems, a single function evaluation may require several hours to several days of complete simulation. Typical optimization methods can not deal with such types of problem. In this case, it may be necessary to forgo an exact evaluation and use anapproximated fitness that is computationally efficient. It is apparent that amalgamation of approximate models may be one of the most promising approaches to convincingly use GA to solve complex real life problems.

- Genetic algorithms do not scale well with complexity. That is, where the number of elements which are exposed to mutation is large there is often an exponential increase in search space size. This makes it extremely difficult to use the technique on problems such as designing an engine, a house or plane. In order to make such problems tractable to evolutionary search, they must be broken down into the simplest representation possible. Hence we typically see evolutionary algorithms encoding designs for fan blades instead of engines, building shapes instead of detailed construction plans, airfoils instead of whole aircraft designs. The second problem of complexity is the issue of how to protect parts that have evolved to represent good solutions from further destructive mutation, particularly when their fitness assessment requires them to combine well with other parts.

- The "better" solution is only in comparison to other solutions. As a result, the stop criterion is not clear in every problem.

- In many problems, GAs may have a tendency to converge towards local optima or even arbitrary points rather than theglobal optimum of the problem. This means that it does not "know how" to sacrifice short-term fitness to gain longer-term fitness. The likelihood of this occurring depends on the shape of the fitness landscape: certain problems may provide an easy ascent towards a global optimum, others may make it easier for the function to find the local optima. This problem may be alleviated by using a different fitness function, increasing the rate of mutation, or by using selection techniques that maintain a diverse population of solutions, although the No Free Lunch theorem proves that there is no general solution to this problem. A common technique to maintain diversity is to impose a "niche penalty", wherein, any group of individuals of sufficient similarity (niche radius) have a penalty added,

International Journal of Electrical, Electronics and Mechanical Controls
ISSN (Online) : 2319-7501
Volume 4 Issue 2 May 2015
Manuscript ID : ISSN23197501-V4I2M98-052015

which will reduce the representation of that group in subsequent generations, permitting other (less similar) individuals to be maintained in the population. This trick, however, may not be effective, depending on the landscape of the problem. Another possible technique would be to simply replace part of the population with randomly generated individuals, when most of the population is too similar to each other. Diversity is important in genetic algorithms (and genetic programming) because crossing over a homogeneous population does not yield new solutions. In evolution strategies and evolutionary programming, diversity is not essential because of a greater reliance on mutation.

- Operating on dynamic data sets is difficult, as genomes begin to converge early on towards solutions which may no longer be valid for later data. Several methods have been proposed to remedy this by increasing genetic diversity somehow and preventing early convergence, either by increasing the probability of mutation when the solution quality drops (called triggered hypermutation), or by occasionally introducing entirely new, randomly generated elements into the gene pool (called random immigrants). Again, evolution strategies and evolutionary programming can be implemented with a so-called "comma strategy" in which parents are not maintained and new parents are selected only from offspring. This can be more effective on dynamic problems.

- GAs cannot effectively solve problems in which the only fitness measure is a single right/wrong measure (like decision problems), as there is no way to converge on the solution (no hill to climb). In these cases, a random search may find a solution as quickly as a GA. However, if the situation allows the success/failure trial to be repeated giving (possibly) different results, then the ratio of successes to failures provides a suitable fitness measure.

- For specific optimization problems and problem instances, other optimization algorithms may be more efficient than genetic algorithms in terms of speed of convergence. Alternative and complementary algorithms include evolution strategies, evolutionary programming, simulated annealing, Gaussian adaptation, hill climbing, and swarm intelligence(e.g.: ant colony optimization, particle swarm optimization) and methods based on integer linear programming. The suitability of genetic algorithms is dependent on the amount of knowledge of the problem; well known problems often have better, more specialized approaches.

LITERATURE REVIEW

To propose and defend the research work, a number of research papers are analyzed. Following are the excerpts from the different research work performed by number of academicians and researchers.

Yildiz, A. R. (2013) [5] - In this research, a new optimization algorithm, called the cuckoo search algorithm (CS) algorithm, is introduced for solving manufacturing optimization problems. This research is the first application of the CS to the optimization of machining parameters in the literature. In order to demonstrate the effectiveness of the CS, a milling optimization problem was solved and the results were compared with those obtained using other well-known optimization techniques like, ant colony algorithm, immune algorithm, hybrid immune algorithm, hybrid particle swarm algorithm, genetic algorithm, feasible direction method, and handbook recommendation. The results demonstrate that the CS is a very effective and robust approach for the optimization of machining optimization problems.

Yildiz, A. R. (2013) [6] - This paper presents a novel hybrid optimization approach based on differential evolution algorithm and receptor editing property of immune system. The purpose of the present research is to develop a new optimization approach to solve optimization problems in the manufacturing industry. The proposed hybrid approach is applied to a case study for milling operations to show its effectiveness in machining operations. The results of the hybrid approach for the case study are compared with those of hybrid particle swarm algorithm, ant colony algorithm, immune algorithm, hybrid immune algorithm, genetic algorithm, feasible direction method and handbook recommendation.

Vidal, T., Crainic, T. G., Gendreau, M., Lahrichi, N., & Rei, W. (2012) [7] - We propose an algorithmic framework that successfully addresses three vehicle routing problems: the multidepot VRP, the periodic VRP, and the multidepot periodic VRP with capacitated vehicles and constrained route duration. The metaheuristic combines the exploration breadth of population-based evolutionary search, the aggressive-improvement capabilities of neighborhood-based metaheuristics, and advanced population-diversity management schemes. Extensive computational experiments show that the method performs impressively in terms of computational efficiency and solution quality, identifying either the best known solutions, including the optimal ones, or new best solutions for all currently available benchmark instances for the three problem classes. The proposed method also proves extremely competitive for the capacitated VRP.

Durgun, İ., & Yildiz, A. R. (2012) [8] - In order to meet today's vehicle design requirements and to improve the cost and fuel efficiency, there is an increasing interest to design light-weight and cost-effective vehicle components. In this research, a new optimization algorithm, called the Cuckoo Search Algorithm (CS) algorithm, is introduced for solving structural design optimization problems. This research is the first application of the CS to the shape design optimization problems in the literature. The CS algorithm is applied to the structural design optimization of a vehicle component to illustrate how the present approach can be applied for solving structural design problems. Results show the ability of the CS to find better optimal structural design.

Chiang, Y. H., Zhou, L., Li, J., Lam, P. T. I., & Wong, K. W. (2014). Achieving Sustainable Building Maintenance through Optimizing Life-Cycle Carbon, Cost, and Labor: Case in Hong Kong. Journal of Construction Engineering and Management, 140(3), 05014001 - The need to maintain an ever-increasing building stock especially in developed economies is growing. This study provides a computational framework to find the optimal solution for sustainable building maintenance. The methodology is composed of two major steps. First, the authors evaluate the life-cycle carbon emission, cost, and labor requirements of a project, which embody important environmental, economic, and social aspects of sustainable building maintenance. Second, the authors develop an optimization model to identify the optimal portfolio of materials that would minimize three sustainability objectives including carbon emission, cost, and labor deployment in their respective turns one at a time. By testing the model with seven scenarios in a case study, the authors demonstrate how this typical case project could significantly improve its sustainability objectives from environmental, economic, and social perspectives. This optimization methodology is generic. It can be readily applied to other new and nonresidential projects of varying scales and in circumstances with a different set of decision criteria. Finally, policy suggestions are proposed to promote sustainable building maintenance in Hong Kong.

Maiti, D., Dasgupta, P., & Paul, A. (2014). Productivity and Elasticity Differential between Direct and Contract Workers in Indian Manufacturing Sector. Review of Market Integration, 6(2), 236-260 - Contractual employment is an increasing phenomenon in the in-house production while informal workers are available outside at low cost. The obvious question is: are they more productive? To enquire this, the present paper examines the elasticity and productivity differential between direct and contract workers using the three-digit industrial data for major Indian states during 1998–2006. A simple theoretical exercise suggests that when direct and contract workers are employed respectively for core and peripheral activities within in-house production, the use of contract workers could rise in response to technological change even if direct workers are more productive and decline. We assume that a firm can undertake core activities by subcontracting out in place of using direct employment. Our empirical results suggest that both elasticity and productivity of contract workers have been lower than those of direct workers, even when the share of contract workers is highly explained by the capital–output ratio. We argue that the contract workers are less productive because they do not receive direct benefits from the technological upgradation in core in-house activities. While the technological upgradation can replace direct workers and subcontracting, the contract workers to be used for peripheral in-house activities can increase along with in-house production.

Kleinknecht, A., van Schaik, F. N., & Zhou, H. (2014). Is flexible labour good for innovation? Evidence from firm-level data. Cambridge Journal of Economics, 38(5), 1207-1219 - Whether the use of flexible workers is damaging to innovation or not depends on the dominant innovation regime in a sector. In sectors with a 'routinised' innovation regime, high shares of low-paid temporary workers have a negative impact on the probability that firms invest in R&D. In sectors that tend towards a 'garage business' regime, however, flexibility has no impact. The two innovation regimes differ in the nature of their knowledge base: reliance on generally available knowledge or dependence on a firm's historically accumulated knowledge base. Innovation in the latter regime benefits from longer job durations. Our results are consistent with findings in macro-level studies that coordinated market economies with rigid labour markets have higher labour productivity gains than liberalised market economies.

Anagnostopoulos, A. D., & Siebert, W. S. (2015). The impact of Greek labour market regulation on temporary employment–evidence from a survey in Thessaly, Greece. The International Journal of Human Resource Management, (ahead-of-print), 1-28 - This paper uses an original data-set for 186 workplaces in Thessaly (central Greece), to study consequences of Greece's strict employment protection law (EPL) and national minimum wage for temporary employment. We find higher temporary work contract rates among workplaces that pay low wages close to the minimum. We also find that EPL 'matters', in particular, managers who prefer temporary contracts because temporary workers are less protected definitely employ more. Our findings thus support the view that a firm's HRM decisions regarding internal versus external allocation of tasks are influenced by labour regulation.

Park, S., Kim, B. Y., Jang, W., & Nam, K. M. (2014). Imperfect information and labor market bias against small and medium-sized enterprises: a Korean case.Small Business Economics, 43(3), 725-741 – This work examine the labor market's bias against small and medium-sized enterprises focusing on the Seoul Digital Industrial Complex case. We adopt Heckman's approach to control selection bias, and use primary data from questionnaire surveys conducted at both firm and employee levels. We find that conventional firm-specific factors, such as wages, fringe benefits, and weekly work hours, primarily explain the labor market bias, but imperfect information is also positively associated with the bias. For example, a firm's inadequate ability to identify a pool of potential employee candidates or to provide them comprehensive firm- or job-specific information tends to worsen labor shortages, and an employee's ex-ante incomplete knowledge of on-the-job training or education opportunities tends to increase ex-post turnover intentions. Our results suggest that reducing the market bias requires improving imperfect information as well as conventional firm-specific conditions.

Narayanan, S., & Lai, Y. W. (2014). Immigrant Labor and Industrial Upgrading in Malaysia. Asian and Pacific Migration Journal, 23(3), 273-297 - The New Economic Model, launched in 2010, affirmed that employing immigrant labor has delayed the upgrading of Malaysian manufacturing. We found that evidence based on the share of skilled workers, wage rate growth, capital use and productivity growth is consistent with this assertion. The way forward should embrace, among other factors, two thrusts: better regulation of foreign workers and the cost of using them in order to pressure firms to upgrade and increasing the talent pool to support the transformation. The latter thrust should include measures to raise the skills of natives, retain skilled natives, attract native talent residing abroad and enticing non-native talent to help the upgrading process.

RESULTS

Using MATLAB, the implementation of proposed algorithm designed is accomplished with the better and effective results for improvements in the assembly line stoppage.

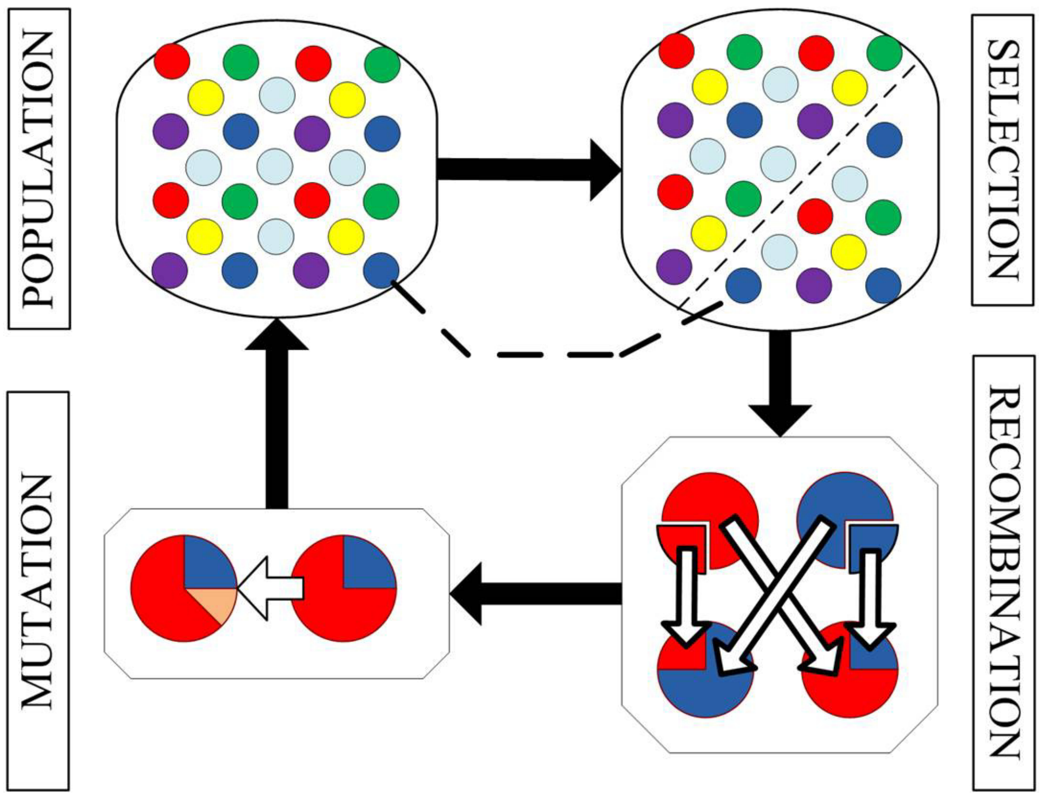

Figure 5.1 – GA Automation Process

International Journal of Electrical, Electronics and Mechanical Controls
ISSN (Online) : 2319-7501
Volume 4 Issue 2 May 2015
Manuscript ID : ISSN23197501-V4I2M98-052015

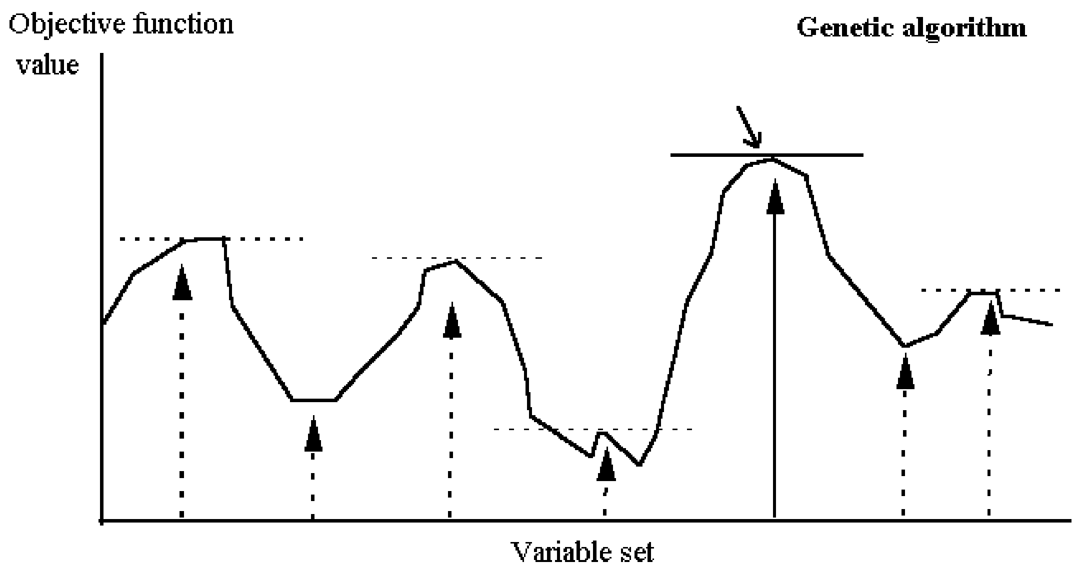

Figure 5.2 - GA Objective Function Process

Table 5.1 – Cost Factor Comparison

Cost Factor - Existing	Cost Factor - Proposed
80	66
89	77
60	40
79	59

International Journal of Electrical, Electronics and Mechanical Controls
ISSN (Online) : 2319-7501
Volume 4 Issue 2 May 2015
Manuscript ID : ISSN23197501-V4I2M98-052015

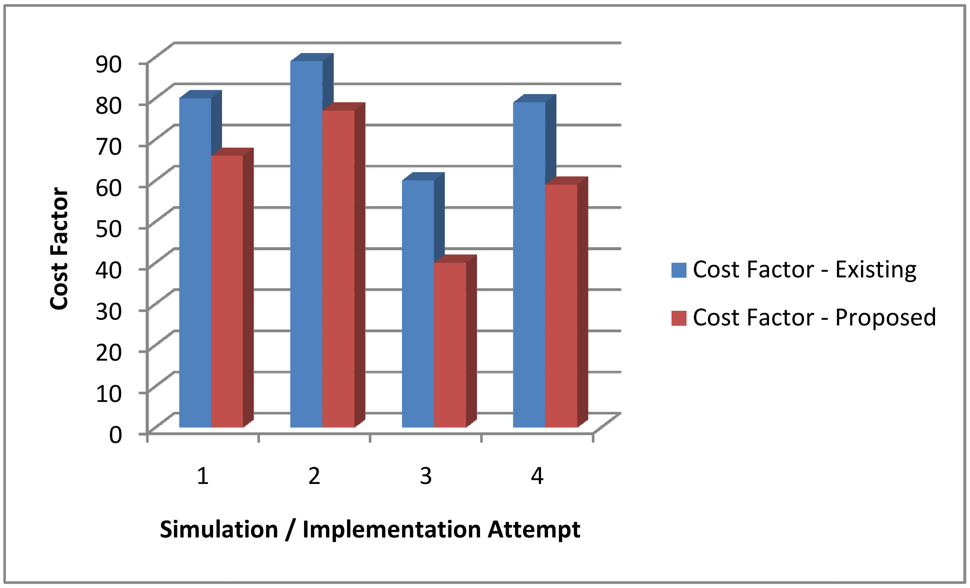

Figure 5.3 – Cost Factor Comparison - 1

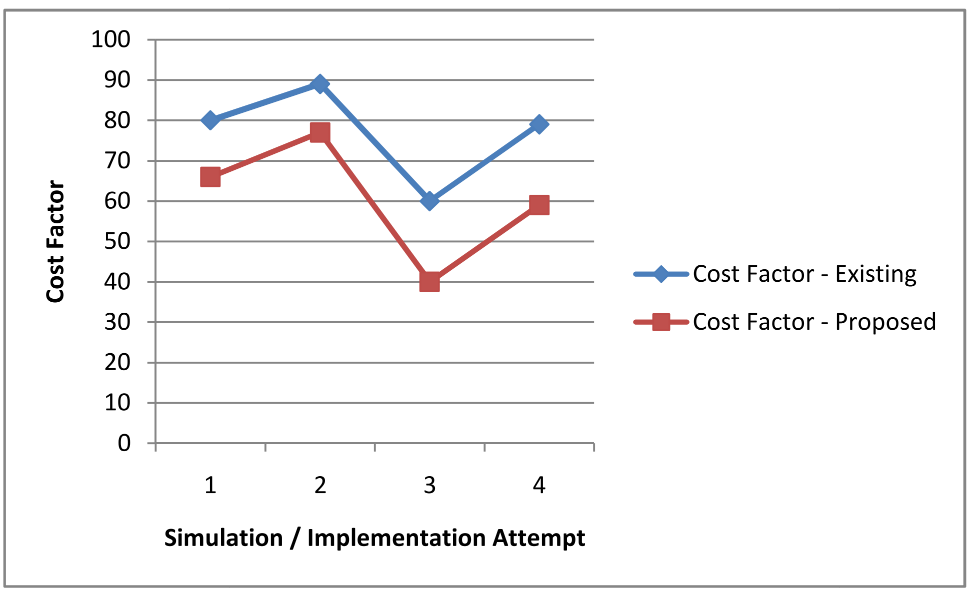

Figure 5.2 – Cost Factor Comparison - 2

Table 5.2 - Cost Factor Comparison

Cost Factor - Without GA	Cost Factor - With GA
49	20
79	58
48	30
67	20

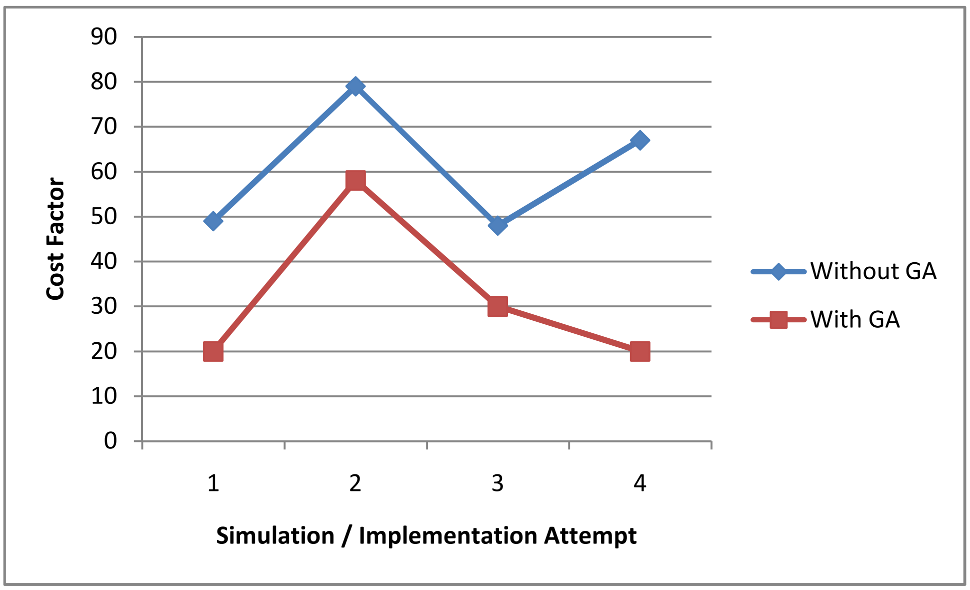

Figure 5.4 – Difference between Classical and Proposed Work

International Journal of Electrical, Electronics and Mechanical Controls
ISSN (Online) : 2319-7501
Volume 4 Issue 2 May 2015
Manuscript ID : ISSN23197501-V4I2M98-052015

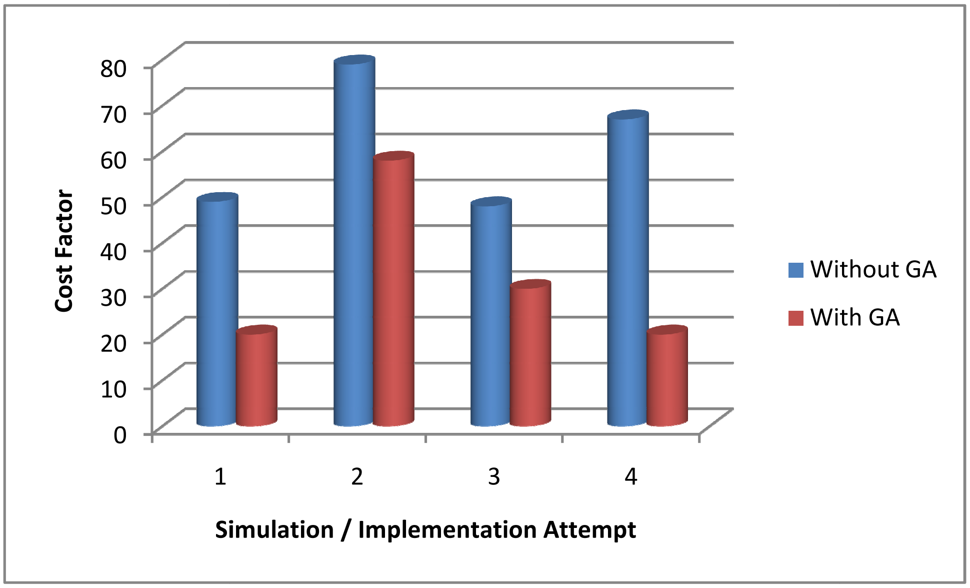

Figure 5.4 – Difference between Classical and Proposed Work

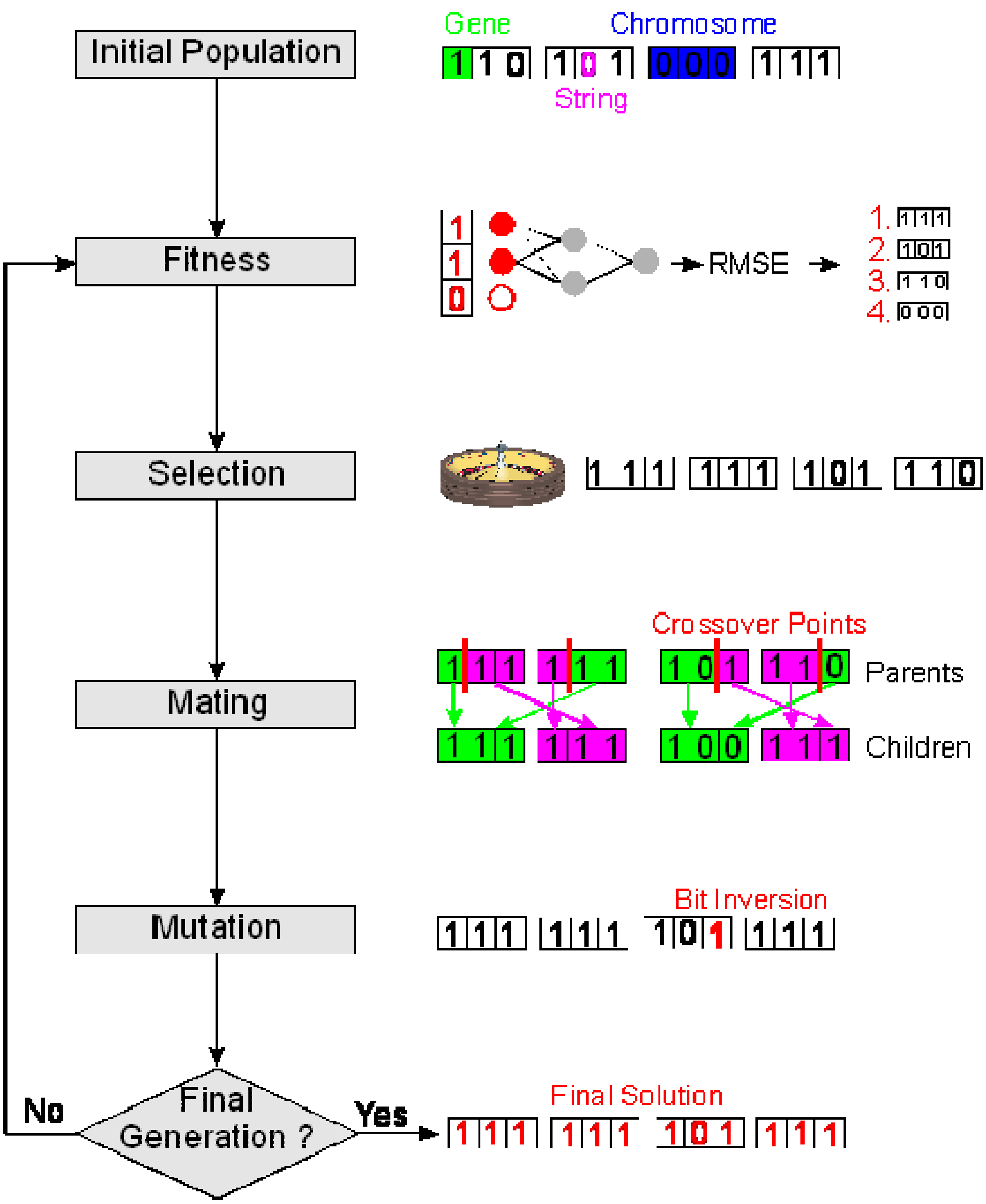

Figure 5.6 – GA Flowchart

CONCLUSION AND FUTURE SCOPE

Although low-cost labor can be obtained by employing unskilled labor, another way to decrease labor costs is to improve the efficiency of experienced labor. Study all production practices to eliminate wasted steps in the process. Reduce the time required to produce an average unit by providing specialized training that allows employees to work at a faster pace. Offer incentives to employees who can introduce labor-saving techniques into your production facility.

The base work can be improved on the multiple parameters using following techniques and the global optimal results can be obtained

- Ant Colony Optimization
- Simulated Annealing
- Honeybee Algorithm
- Swarm Intelligence

REFERENCES

[1] Lu, H. C., & Huang, Y. H. (2015). An efficient genetic algorithm with a corner space algorithm for a cutting stock problem in the TFT-LCD industry. *European Journal of Operational Research*.

[2] Jun, S., & Park, J. (2015). A hybrid genetic algorithm for the hybrid flow shop scheduling problem with nighttime work and simultaneous work constraints: A case study from the transformer industry. *Expert Systems with Applications*, *42*(15), 6196-6204.

[3] Bhunia, A., Biswas, A., & Sen, N. (2014). An application of extended elitist non-dominated sorting Genetic Algorithm in multi-objective linear programming

problem of tea industry with interval objectives. *Uncertain Supply Chain Management*, *2*(4), 245-256.

[4] Razavi, H., Ramezanifar, E., & Bagherzadeh, J. (2014). An economic policy for noise control in industry using genetic algorithm. *Safety Science*, *65*, 79-85.

[5] Yildiz, A. R. (2013). Cuckoo search algorithm for the selection of optimal machining parameters in milling operations. *The International Journal of Advanced Manufacturing Technology*, *64*(1-4), 55-61.

[6] Yildiz, A. R. (2013). A new hybrid differential evolution algorithm for the selection of optimal machining parameters in milling operations. *Applied Soft Computing*, *13*(3), 1561-1566.

[7] Vidal, T., Crainic, T. G., Gendreau, M., Lahrichi, N., & Rei, W. (2012). A hybrid genetic algorithm for multidepot and periodic vehicle routing problems. *Operations Research*, *60*(3), 611-624.

[8] Durgun, İ., & Yildiz, A. R. (2012). Structural design optimization of vehicle components using cuckoo search algorithm. *Materials Testing*, *54*(3), 185-188.

[9] Vernon, R. (1966). International investment and international trade in the product cycle. The quarterly journal of economics, 190-207.

[10] Niazi, A., Dai, J. S., Balabani, S., & Seneviratne, L. (2006). Product cost estimation: Technique classification and methodology review. Journal of manufacturing science and engineering, 128(2), 563-575.

[11] Berman, E., Bound, J., & Griliches, Z. (1994). Changes in the demand for skilled labor within US manufacturing: evidence from the annual survey of manufacturers. The Quarterly Journal of Economics, 367-397.

[12] Humphrey, D. B., & Moroney, J. R. (1975). Substitution among capital, labor, and natural resource products in American manufacturing. The Journal of Political Economy, 57-82.

[13] Del Moral, Pierre (1996). "Non Linear Filtering: Interacting Particle Solution." (PDF). *Markov Processes and Related Fields* **2** (4): 555–580.

[14] Del Moral, Pierre (1998). "Measure Valued Processes and Interacting Particle Systems. Application to Non Linear Filtering Problems". *Annals of Applied Probability*(Publications du Laboratoire de Statistique et Probabilités, 96-15 (1996) ed.) **8** (2): 438–495.doi:10.1214/aoap/1028903535.

[15] Del Moral, Pierre; Miclo, Laurent (2000).*Branching and Interacting Particle Systems Approximations of Feynman-Kac Formulae with Applications to Non-Linear Filtering*. (PDF). *Lecture Notes in Mathematics* **1729**. pp. 1–145. doi:10.1007/bfb0103798.

[16] Del Moral, Pierre (2004). *Feynman-Kac formulae. Genealogical and interacting particle approximations*.http://www.springer.com/gp/book/9780387202686: Springer. Series: Probability and Applications. p. 556.ISBN 978-0-387-20268-6.

[17] Whitley 1994, p. 66.

[18] Eiben, A. E. et al (1994). "Genetic algorithms with multi-parent recombination". PPSN III: Proceedings of the International Conference on Evolutionary Computation. The Third Conference on Parallel Problem Solving from Nature: 78–87. ISBN 3-540-58484-6.

[19] Ting, Chuan-Kang (2005). "On the Mean Convergence Time of Multi-parent Genetic Algorithms Without Selection". Advances in Artificial Life: 403–412. ISBN 978-3-540-28848-0.

[20] Akbari, Ziarati (2010). "A multilevel evolutionary algorithm for optimizing numerical functions" IJIEC 2 (2011): 419–430[1]

[21] Bäck, Thomas (1996). *Evolutionary Algorithms in Theory and Practice*. Oxford Univ. Press.

[22] Lipowski, Adam; Lipowska, Dorota (2012). "Roulette-wheel selection via stochastic acceptance". *Physica A: Statistical Mechanics and its*

Applications **391** (6): 2193–2196.doi:10.1016/j.physa.2011.12.004. ISSN 0378-4371.

[23] Del Moral, Pierre (2013). *Mean field simulation for Monte Carlo integration*. Chapman & Hall/CRC Press. p. 626. Monographs on Statistics & Applied Probability

[24] "Sequential Monte Carlo samplers - P. Del Moral - A. Doucet - A. Jasra - 2006 - Journal of the Royal Statistical Society: Series B (Statistical Methodology) - Wiley Online Library". *onlinelibrary.wiley.com*. Retrieved 2015-06-08.

[25] Del Moral, Pierre; Hu, Peng; Wu, Liming (2012). *On the Concentration Properties of Interacting Particle Processes*. Hanover, MA, USA: Now Publishers Inc. ISBN 1601985126.

[26] Goldberg 1989, p. 41.

[27] Taherdangkoo, Mohammad; Paziresh, Mahsa; Yazdi, Mehran; Bagheri, Mohammad Hadi (19 November 2012). "An efficient algorithm for function optimization: modified stem cells algorithm". *Central European Journal of Engineering* **3**(1): 36–50. doi:10.2478/s13531-012-0047-8.

[28] Wolpert, D.H., Macready, W.G., 1995. No Free Lunch Theorems for Optimisation. Santa Fe Institute, SFI-TR-05-010, Santa Fe.