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From the Desk of Editor – in – Chief

It is my proud privilege to present the Jan – Dec 2017, Vol. – 6, Issue – 1 of the GGGI Journal of Engineering and Technology (GGGIJET): An Annual Research Journal. This journal provides a platform to researchers of various Engineering branches, Computer applications, Applied Sciences and Fashion & Apparel design. Galaxy Global Group of Institutions, Sahabad had decided in 2012 to have their own journal to promote Research and Development activities. GGGIJET is the outcome of endless efforts of editorial team.

I consider myself fortunate to have great editorial team and advisory board for much needed guidance and help. I have set certain goals which I want to achieve during my tenure as Editor – in – chief. I intend to make GGGIJET more author friendly by facilitating online submissions of articles and fast response in keeping with the changing times. I request all the researchers to take full advantage of this platform to publish their research work. Authors are also requested to subscribe the Journal in Institution for which they are working.

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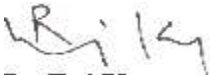

Dr. Raj Kumar
Editor – in – Chief

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GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

DESIGN OF FIR FILTERS WITH ARBITRARY AMPLITUDE AND PHASE SPECIFICATIONS USING OPTIMIZATION TECHNIQUE

***Dheeraj**
****Sourav Goyal**
*****Mukhtiar Rana**

Abstract
Digital Signal Processing is one of the most powerful technologies that are shaping science and engineering in the twenty-first century. Revolutionary changes have already been made in a broad range of fields: communications, medical imaging, radar and sonar, and high fidelity music reproduction, to name just a few. Each of these areas has developed a comprehensive DSP technology, with its own algorithms, mathematics, and specialized techniques. The digital filters are an essential part of DSP. In fact, their extraordinary performance is one of the key reasons that DSP has become so popular. The purpose of the filters is to allow some frequencies to pass unaltered, while completely blocking others. The digital filters are mainly used for two purposes: separation of signals that have been combined, and restoration of signals that have been distorted in some way.

Keyword: *FIR filter, MATLAB.*

INTRODUCTION

Digital signal processing is the mathematics, the algorithms and the techniques for analyzing and modifying a signal to optimize or improve its performance or efficiency. It is a type of signal processing performed by digital means with digital signal processor or a similar device that can execute DSP specific processing algorithms. It involves applying a number of algorithms to both analog and digital signals to generate a new signal, which has better characteristics than the original signal. Typically DSP first converts signal into a digital signal with an analog to digital convertor by sampling, quantization. However if the output required is analog then a digital to analog convertor is used.

DSP is one of the most powerful tools that will shape the science and engineering in this century as it has a major and increasing impact in many key areas of technology. Revolutionary changes have been already made in different range of fields including communications, medical imaging, radar and sonar, reproduction, oil prospecting etc.

FILTER DESIGN TECHNIQUES

DSP means digital signal processing it is an area of science and engineering that has rapidly developed over the past 30 years this rapid development is a result of advancement in computer technology and integrated circuits fabrication. Therefore, many of signal processing tasks that were performed by using analog means are realized by digital hardware.

Signal processing is a method of extracting information from the signal. Thus signal processing is concerned with representing signals in mathematical terms and extracting the information. The information contained in the signal can also be extracted either in original domain or in some other transformed domain .Signals plays a major role in our life, a signal can be a function of time, distance, position, temperature, etc., in an electrical system signals are electric current and voltage.

**M.Tech. Scholar, Dept, E.C.E, E.Max Institute. Ambala (H.R.)*
*** Asst.Prof, Dept, E.C.E, E.Max Institute. Ambala (H.R.)*
**** Lect, Ravindra Collage, Ambala (H.R.)*

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PROBLEM IDENTIFICATION

Digital filters find applications in different areas. One area is power system protection where measurement systems involve faulted signals associated with DC decaying signals, harmonic and sub-harmonic components. To eliminate these unwanted components, digital filter design based on multi-objective optimization technique to satisfy different specifications such as high speed response for a real-time application and frequency domain requirements. A digital filter based solution is proposed to remove unwanted disturbances using digital filter design techniques. The filter time response must be included the requirements. The present filtering application imposes different kind of specifications. On one hand, the time domain requirement where both a high speed and accurate system response are needed.

RESULTS

In this graph the value of t1 = 5 and the value of t2 = 7 and the central frequency = 1000 MHz We plot a graph between normalized frequency and magnitude (dB).

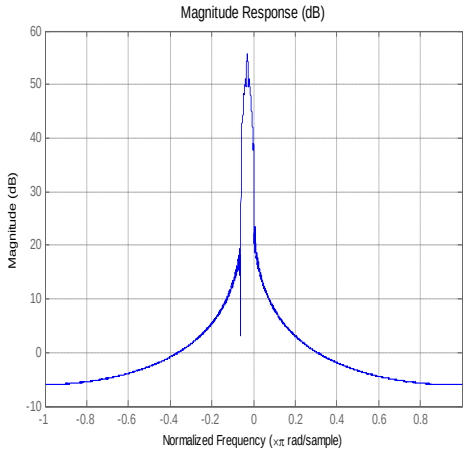

Fig 1.

In this graph the value of t1 = 10 and the value of t2 = 14 and the central frequency = 1500 MHz

CONCLUSION AND FUTURE SCOPE

Classical design methods of infinite impulse response are normally restricted to specific norms such as mini-max or least square. Additionally, the quantization effects of the coefficients are normally not possible to consider during the design process.

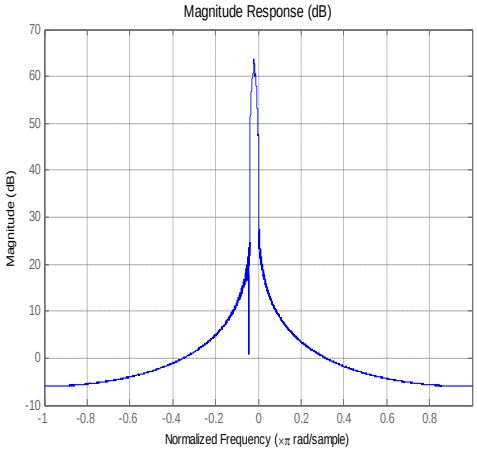

Fig 2.

In this graph the value of t1 = 15 and the value of t2 = 21 and the central frequency = 2000 MHz

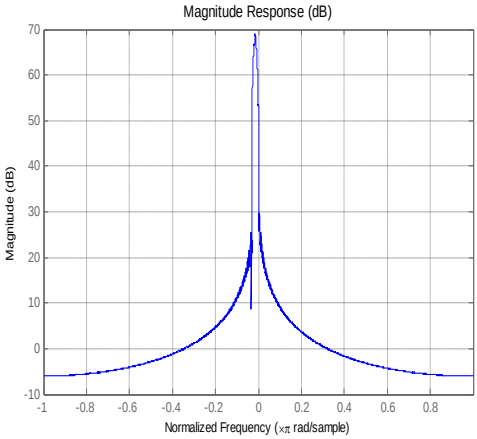

Fig 3.

To design filters with special requirements such as a trade-off in norms or concerning quantization effects there is a need of more general optimization techniques.FIR digital filters are widely used in the field of signal processing due to its distinguishing features such as: the stability, linear phase and easiness for realization. Traditionally, there exist some methods for FIR digital filters design, such as window method, frequency sampling method and best uniform approximation. Unfortunately, each of them is only suitable for a particular application.

*M.Tech. Scholar, Dept, E.C.E, E.Max Institute. Ambala (H.R.)
** Asst.Prof, Dept, E.C.E, E.Max Institute. Ambala (H.R.)
*** Lect, Ravindra Collage, Ambala (H.R.)

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*M.Tech. Scholar, Dept, E.C.E, E.Max Institute. Ambala (H.R.)
** Asst.Prof, Dept, E.C.E, E.Max Institute. Ambala (H.R.)
*** Lect, Ravindra Collage, Ambala (H.R.)

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ANALYSIS THE LEARNING APPROACH FOR 3-D SURFACE RECONSTRUCTION FROM POINT CLOUDS

***Ravinder Choudhary**
****Kaushal Kishore**
*****Mukhtiar Rana**

Abstract
Surface reconstruction is to find a surface from a given finite set of geometric sample values. In many applications, the sample values are points. Reverse engineering of geometric shapes is the process of converting a large number of measured data points into a concise and consistent computer representation. The "feature points" techniques are used to create mesh from the extraction points. The present work is to develop a system for image reconstruction from scattered cloud points.
Keyword: *surface reconstruction, feature point technique, Delaunay triangulation, Crust triangulation.*

INTRODUCTION

With the rapid development of digital technology, the demand for the original information of real-world is increasing; 3D laser scanning technology is one of the technologies which can use laser pulses to scan object's surface features and to obtain information. With the emergence of high precision 3D laser scanner, it makes for a complex composed of point cloud surfaces model more easily. In recent years, the use of 3D point cloud to express the surface of the object has become a hot topic for many scholars and developed many ways, such as the triangulation method, the level set method and the implicit function surface interpolation. Level set method was first proposed by Osher and Sethian in 1988, who applied this method to the surface reconstruction, the basic idea is to define a multi-speed function after time evolution of the zero level set close to the surface until a given point cloud model. The biggest advantage of the level set method is due to its representation is implicit, especially for complex topologies surface reconstruction, but its ability to represent the details of the limited efficiency of the algorithm is relatively low, requires a lot of computing time and enough memory space. Implicit surface interpolation function is a function of the surface equation set represents zero value measured surface, its main advantage is that only one equation to represent complex interpolated surface, but the drawback is difficult to find a suitable set of basic functions to represent implicit function.

SURFACE RECONSTRUCTION

The surfaces considered in surface reconstruction are two-manifolds that might have boundaries and are embedded in some Euclidean space Rd. In the surface reconstruction problem we are given only a finite sampling P C R^d of an unknown surface S. The task is to compute a model of S from P. This model is referred to as the reconstruction of S from P. It is generally represented as a triangulated surface that can be directly used by downstream computer programs for further processing. The reconstruction should match the original surface in terms of geometric and topological properties. In general surface reconstruction is an ill-posed problem since there are several triangulated surfaces that might fulfill these criteria. Note, that this is in contrast to the curve reconstruction problem where the optimal reconstruction is a polygon that connects the sample points in exactly the same way as they are connected along the original curve.

Applications

The surface reconstruction problem naturally arises in computer aided geometric design where it is often referred to as reverse engineering. Typically,

*M.Tech. Scholar, E.C.E. Deptt., E. Max Institute, Ambala (H.R.)
**Assistant Professor, Dept, E.C.E. Deptt., E. Max Institute, Ambala (H.R.)
***Lecturer, Ravindra Collage, Ambala (H.R.)

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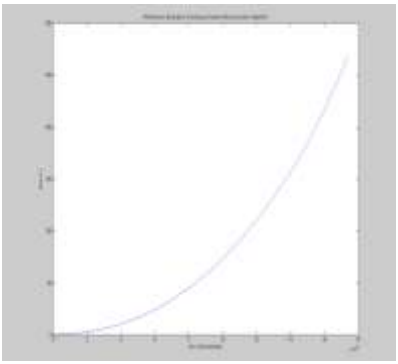
the surface of some solid, e.g., a clay mock-up of a new car, has to be turned into a computer model. This modeling stage consists of (i) acquiring data points on the surface of the solid using a scanner.
(ii) Reconstructing the surface from these points. Notice that the previous step is usually decomposed into two stages. First a piece-wise linear surface is reconstructed, and second, piecewise-smooth surface is built upon the mesh.

PROBLEM IDENTIFICATION

Various algorithms like crust algorithm and Delaunay algorithm will be implemented and compared for time taken by the algorithm for surface reconstruction. Matlab has been used for developing the simulation model. Delaunay triangulation for a set P of points in the plane is a triangulation DT(P) such that no point in P is inside the circum circle of any triangle in DT(P) will be implemented. Delaunay triangulations maximize the minimum angle of all the angles of the triangles in the triangulation; they tend to avoid skinny triangles. The circum circle of a triangle formed by three points from the original point set is empty if it does not contain vertices other than the three that define it (other points are permitted only on the very perimeter, not inside). For a set P of points in the (d-dimensional) Euclidean space, a Delaunay triangulation is a triangulation DT (P) such that no point in P is inside the circum-hyper sphere of any simplex in DT (P).

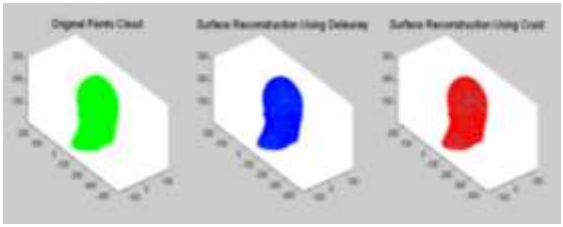
RESULTS

The results of the simulation are in the form of graphs of time taken to complete surface reconstruction v/s the number of cloud points. The graph below shows the trace for the Delaunay algorithm.



Similarly the trace below shows the time taken to complete surface reconstruction v/s the number of cloud points for the crust algorithm. Other time slices for various steps of the surface reconstruction are as shown below

Started Delaunay Algorithm
Added Shield: 0.0097 S, Triangulation Time: 3.3673 S, Connectivity Time: 1.5157 S, Circumcenters Tetraedroms Time: 0.1685 s, Intersection factor Time: 0.1191 s, Walking Time: 9.2955 s, Total Time using Delaunay: 14.5000 s.
Started Crust Algorithm
Added Shield: 0.0086 S, Triangulation Time: 3.1603 S, Connectivity Time: 0.8623 S, Circumcenters Tetraedroms Time: 0.1568 S, Walking Time: 0.7339 S, Total Time using Crust: 4.9540 s.
The original cloud point is as shown below



CONCLUSION AND FUTURE SCOPE

In this we presented several surface reconstruction methods. These methods are mainly either Delaunay-based and use a subset of a computed Delaunay complex to reconstruct the surface or represent the surface implicitly by the zero-level set of a defined function. Other techniques are learning-based or filter and do noise the input data. The area of surface reconstruction is still a field with many open problems and research directions. Recent research trends focus on reconstruction of scattered polygonal data and noisy point cloud data. Furthermore, other methods avoid surface reconstruction but visualize the surface represented by the point cloud data directly by for instance ray tracing Point Set Surfaces or using surface splitting techniques. Given a set of unorganized points that lie approximately on the boundary surface of a three-dimensional object, and without a priori information on the topology, our goal is to reconstruct the surface by building a triangular mesh using the given points as vertices.

*M.Tech. Scholar, E.C.E. Deptt., E. Max Institute, Ambala (H.R.)
**Assistant Professor, Dept, E.C.E. Deptt., E. Max Institute, Ambala (H.R.)
***Lecturer, Ravindra Collage, Ambala (H.R.)

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*M.Tech. Scholar, E.C.E. Deptt., E. Max Institute, Ambala (H.R.)
**Assistant Professor, Dept, E.C.E. Deptt., E. Max Institute, Ambala (H.R.)
***Lecturer, Ravindra Collage, Ambala (H.R.)

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LIFETIME IMPROVEMENT OF WSN: BY USING OPTIMIZATION TECHNIQUE LEACH-IQBGA

***Prince Gupta**
****Saranjeet Singh**

Abstract
Wireless sensor network (WSN) is a self-organized network made up of hundreds or thousands of sensor nodes. These sensor nodes works with some limited resources like battery power, memory, bandwidth and etc. Wireless sensor network lifetime depends upon battery power of nodes as every node operation consumed energy. These nodes cannot be replaceable and rechargeable so efficient energy consumption by the nodes is the main design issue in WSN. Although LEACH-GA is a protocol which not only provides optimal cluster head solutions but also increase the energy efficiency in WSN. But it is very complex and time consuming so here we proposed a technique called I-QBGA which is the improvement of GA (genetic algorithm) and overcomes its drawbacks, I-QBGA increased WSN lifetime and also provide more optimal solution for cluster head selection. This paper also presents the comparison of existing and proposed work.
Index Terms**:** *wireless sensor network; clustering algorithm; energy efficiency; genetic algorithm.*

1. INTRODUCTION

Wireless sensor network is self- organizing network consist of large number of sensor nodes [1]. These nodes can sense, measure and gather information from environment, process the information and send to the user. The wireless communication and information processing technology can fulfill the real time task of monitoring, sensing, collecting environmental information and processing, transmitting information to user [2] Sensor nodes are deployed in the area of interest as in ad- hoc network to monitor the event in environment and gather the data. Networking of this attenuated sensor is expected to have significant effect on efficiency of many applications (such as military applications, environment application, and health application).

The sensor in system is expected to work until all the energy is drained so energy is main concern in system. Wireless sensor network used energy constrain on the battery-powered devices. The sensor nodes cannot be recharged after installations. So energy is main issue of concern in WSN. The lifetime of WSN depend upon the nodes battery power as every operation of node consumed energy. Hence the nodes go out of energy.

Clustering algorithms are considering energy efficient approach for wireless sensor network. In clustering all the nodes in the network are divided in to small cluster. Every cluster has a cluster head (CH). The sensor nodes in each cluster transmit their data to their respective cluster head. Cluster head aggregate the data and then forward the data to central base station.

Communication between two nodes is main energy consuming process that depends upon the distance between two nodes. Clustering avoids this long distance communication and node has to communicate with cluster head and only cluster heads communicating with base station. The distance between the nodes to the cluster head called intra cluster communication distance and cluster head to base station is inter cluster distance. As the number of cluster head is large the intra cluster communication distance decrease and inter cluster distance increase. And if number of cluster head are less then inter cluster distance is decrease and intra cluster distance is increase [2]. The purpose of clustering is to search group of sensor node and find the cluster head as it is very important that cluster head energy is much sufficient for communication to nodes and base station. Leach protocol is also base on clustering.

2. CHARACTERISTICS OF WIRELESS SENSOR NETWORKS

**M.Tech. Scholar, ECE Department, GGGI, Saha Road, KUK, Haryana, India*
***Assistant Professor, ECE Department, GGGI, Saha Road, KUK, Haryana, India, saranjeet@galaxyglobaledu.com*

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A WSN comprises of a colossal number of minimal cost, low power, and multifunctional remote sensor nodes, with wireless communication and calculation abilities [3]. Some imperative qualities of sensor nodes clarify as beneath:

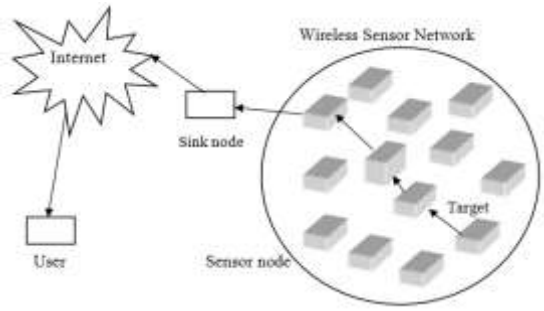

Figure 1.1: Architecture of Wireless Sensor Networks [1]

- The nodes have very limited resources such as memory, computational power, communication range and most importantly battery power.
- The nodes are not reusable and inexpensive.
- The arrangement of sensor node is absolutely distributive in nature. The node thickness is in this way changing at better places. Because of this reason one can discover thick and additionally meager locale in a similar topology.
- Sensor nodes are ready to physical damages or failures owing to its deployment in harsh or unfriendly environment.
- In most sensor network application, sensor nodes are heavily deployed in a region of interest and work together to achieve a common sensing task. Thus, the information sensed by multiple sensor nodes usually has a certain level of correlation and redundancy.
- A sensor network is usually designed and deployed for a specific application. The design requirements of a sensor network change with its application.
- The most imperative segment of the system is the sensor, required for checking physical condition for instance sound, temperature, humidity, force, vibration, weight, movement, pollutants and so forth at various areas.
- There is a Bounded Directed Stream (from /to Sink).

3. LITERATURE REVIEW

Yiming F. *et.* al. (2007) stated that Low energy adaptive clustering hierarchy (LEACH) is a fully distributed clustering algorithm. In setup phase, cluster head selection, cluster formation and TDMA scheduling to the nodes are performed. In steady phase, nodes send the Data to cluster head and cluster head aggregated the data. Aggregated data is then sends to the base station. Re-clustering is done after a regular period to rotate the role of cluster head among all the nodes that makes network load balance. LEACH does not consider the remaining energy of nodes for cluster head selection that is all nodes have equal probability of cluster head, addresses problem of fixed round time in LEACH. Increase of network lifetime by about 30% can be accomplished [4].

Tao L. *et. al.* (2010) presented a new energy-efficient LEACH-based protocol that checks the clusters residual energy and on the basis of that cluster formation was done. This scheme overcomes the drawback of unbalanced size of cluster in the network and at the same time balancing the energy load among all the nodes. The experimental results showed that the proposed algorithm efficiently utilized the energy and enhanced the network's lifetime [5].

Song X. *et. al.* (2012) described Convergence speed and scale bottlenecks of evolutionary design of circuits, explored a new evolutionary method on the basis of genetic algorithm. Several optimization methods including fitness sharing, exponential weighting, double selection population, "Queen Bee" mating, module crossover and optimal solution set were proposed to improve genetic algorithm.

The new algorithm improved fitness evaluation method and genetic strategies. The experiment showed that the new evolutionary algorithm accelerated evolution convergence greatly, improved the adaptability effectively and expands the scale of evolved circuit obviously [6].

Alahwat A. *et. al.* (2013) proposed Vice Cluster head was that alternate head that would work only when the cluster head would die. The procedure of vice habit cluster head determination on the premise of three components i.e. Least separation, most extreme remaining vitality, and least vitality.

***M.Tech. Scholar, ECE Department, GGGI, Saha Road, KUK, Haryana, India**
****Asst. Professor, ECE Department, GGGI, Saha Road, KUK, Haryana, India, saranjeet@galaxyglobaledu.com**

The proposed approach would improve the network life as never the cluster head would die. As a cluster head would die it would be replaced by its vice Cluster head. After a number of simulations, it was found that the new version of improved V-LEACH outperforms the original version of leach protocol by increasing the network life time 49.37% [7].

Garg R. *et. al.* (2014) presented that genetic algorithm was Search and optimization techniques that create answers for enhancement issues utilizing strategies inspired by normal development. Optimization was the central to any problem involving whether in engineering or economics. All evolutionary algorithms including Genetic Algorithm could find near optimal solution. A set of test functions including unimodal and multimodal benchmark functions was employed for optimization (8).

Abualigah L. M. Q. *et. al.* (2015) proposed Genetic algorithms were generally utilized as a part of information retrieval system (IRs) to upgrade the data recovery handle, and to build the proficiency of the ideal data. The change of adaptive genetic algorithm recovers the data required by the user precisely, decreases the recovered significant records and bars unessential documents. The specialist investigated the issues installed in this procedure, endeavored to find solution, for example, the method for picking mutation probability and fitness function [9].

Elhoseny M. *et.* al. (2015) Heterogeneous Wireless Sensor Network (WSN), factors such as initial energy, data processing capability, etc. greatly influence the network lifespan. Despite the success of various clustering strategies of WSN, the numerous possible sensor clusters make searching for an optimal network structure an open challenge. Here proposed a Genetic Algorithm based method that optimizes heterogeneous sensor node clustering.

Compared with five state-of-the-art methods, proposed method greatly extends the network life, and the average improvement with respect to the second best performance based on the first-node-die and the last-node-die is 33.8% and 13%, respectively. The balanced energy consumption greatly improves the network life and allows the sensor energy to deplete evenly. The computational efficiency of method is comparable to the others and the overall average time across all experiments is 0.6 seconds with a standard deviation of 0.06 [10].

4. PROPOSED WORK

A new improved algorithm "I-QBGA (Improved Queen-Bee Genetic Algorithm)" is the improved version of GA (genetic algorithm). Since in I-QBGA only one mother that is the Queen-bee is necessary and selected for the reproduction of bees and the Queen-bee reproduces many children with a number of the bee-population using the crossover operator, so the number of marriages in the Queen-bee algorithm are much less than that of the genetic algorithm which results increasing the rate of this algorithm as regards the genetic algorithm.

So I-QBGA has fast convergence than GA. And it is done to reduce the time consumption by genetic algorithm. Also the existing work is only applicable for heterogeneous nodes but proposed work is the new improved algorithm I-QBGA applicable with both homogeneous and heterogeneous nodes.

Secondly, Proposed work includes new fitness function within I-QBGA in order to reduce complexity and to give more optimal solutions than GA. New fitness function does not consider the intra cluster and inter cluster communication distance and the fitness of each chromosome is checked only on the bases of energy from all the nodes. The better energy nodes become cluster head and thus improve the lifetime of wireless sensor network.

I-QBGA Procedure

I-QBGA performs the number of iterations for the cluster head selection and provides optimal CH solution. Like GA in I-QBGA first encoding is done. The cluster head and member nodes are represented as 1s and 0s respectively Then I-QBGA starts with possible number of solutions and each solution individually called as chromosomes. These chromosomes called as initial population. The fitness of a chromosome is determined by nodes. The fitness function is given as follow:

Fitness function = Nodes remaining energy

Initial population consists of several chromosomes. After checking the fitness of all chromosomes, then

***M.Tech. Scholar, ECE Department, GGGI, Saha Road, KUK, Haryana, India*
***Asst. Professor, ECE Department, GGGI, Saha Road, KUK, Haryana, India, saranjeet@galaxyglobaledu.com*

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three I-QBGA operators (selection, crossover and mutation) are applied.

• **Selection**- Selection is the process of choosing individuals from current population for new population. The purpose of the selection process in improved Queen-bee genetic algorithm (I-QBGA) is to give more reproductive chances to those population members that are better fit. It selects one of best fitted member from all chromosomes and one select randomly. So that further swapping gives more optimal CH selection than GA. The selection procedure may be implemented in a number of ways like Roulette Wheel selection, Tournament selection, Boltzmann selection, Rank selection, Random selection, etc. Tournament selection procedure is applied to select chromosomes for generating new population.

• **Crossover**- The crossover operation takes place between two chromosomes with probability specified by crossover rate. These two chromosomes exchange portions that are separated by the crossover point. The following is an example of one point crossover.

Individual 1 1 1 1 0 **0 1 1 1 0**
Individual 2 0 1 0 1 **1 0 0 1 0**
After crossover, two offspring are created as below:
Offspring 1 1 1 1 0 **1 0 0 1 0**
Offspring 2 0 1 0 1 **0 1 1 1 0**

• **Mutation**- The mutation operator is applied to each bit of a chromosome with a probability of mutation rate. There are two types of mutation in I-QBGA, weak mutation and strong mutation. Weak mutation required when individual need to be little change, and strong mutation is applied when individual need large change.

After mutation, a bit that was 0 changes to 1 and vice versa.

Before Mutation 1 1 **1** 0 0 1 1 1 0
After Mutation 1 1 **0** 0 0 1 1 1 0

LEACH- IQBGA

Proposed clustering algorithm, LEACH-IQBGA, is a base station assisted approach. Node sends their energy and location information to the base station (BS). Base station applies proposed IQBGA for optimal selection of cluster heads. Base station sends the information message to assigns cluster head to all nodes. Also provide all the information about the clusters and TDMA scheduling for each cluster and TDMA is broadcasted to the network. Nodes wake up and send sensed data to their respective cluster head using TDMA time slots. Nodes are in sleep state otherwise. Re-clustering is done after a regular round time is over.

5. SIMULATION RESULTS AND ANALYSIS

The simulation results are shown in the Table 4.1 and table 4.2 and various comparison graphs. The comparison is made between number of nodes and number of rounds. The comparion is made between network performance in the presence of proposed algorithem with the existing scheme.

Table 4.2 shows the first node dead and half node dead comparison of Genetic Algorithm with proposed Algorithm I-QBGA. Here in GA first node is dead at 600th round where in I-QBGA first node dead achieved later at 1176th round. Similarly half nodes are dead in GA at 1106th round but in I-QBGA half nodes of the network dead at 1200th round which clearly shows that I-QBGA performed much better than GA. Thus provide more optimal cluster head solution than Genetic Algorithm improves and the lifetime of wireless sensor network.

Table 4.1 Parameters Used

S.NO.	Parameters	Value
1.	Number of Nodes(N)	50
2.	Network Area	100*100
3.	Size Of Population	10
4.	Selection Type	Tournament selection
5.	Crossover Rate	0.2
6.	Weak Mutation Rate	0.1
7.	Strong Mutation Rate	0.5
8.	Base Station Location	50,50
9.	Initial Energy	0.5J
10.	Data Packet Size	500 Bytes or 4000bits
11.	Energy of advanced nodes	Initial energy*2

Table 4.2 Number of dead nodes w.r.t rounds with heterogeneous nodes

Algorithm	FND	HND	Remaining Energy(j)	Dead nodes
LEACH-GA	600	1106	0.16	45
LEACH-I-QBGA	1176	1200	0.25	43

***M.Tech. Scholar, ECE Department, GGGI, Saha Road, KUK, Haryana, India**
****Asst. Professor, ECE Department, GGGI, Saha Road, KUK, Haryana, India, saranjeet@galaxyglobaledu.com*

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6. RESULTS WITH HETEROGENEOUS NODES

Graph No.1: Fig. 4.2 shows the first node dead comparison of GA and I-QBGA. Which shows that the I-QBGA performed much better than GA because in I-QBGA first dead is achieved later as compare to GA. In GA the fisrt node dead at 600th round Where in I-QBGA the first node dead achieved at 1176th round .

Graph No.2: fig. 4.3 shows the half node dead comparison of GA and I-QBGA. Shows that in GA around at 1106th rounds half node of the network is dead where in I-QBGA half nodes dead at 1200th round. Hence in the case of half node dead I-QBGA performed better than GA.

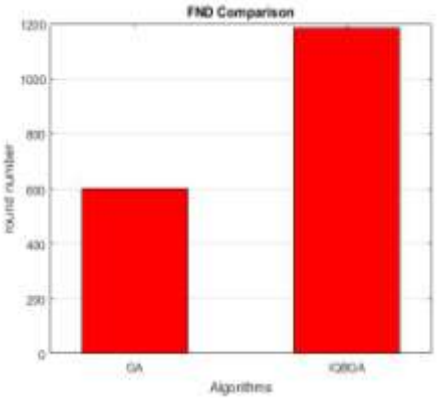

Fig. 4.2 First node dead comparison

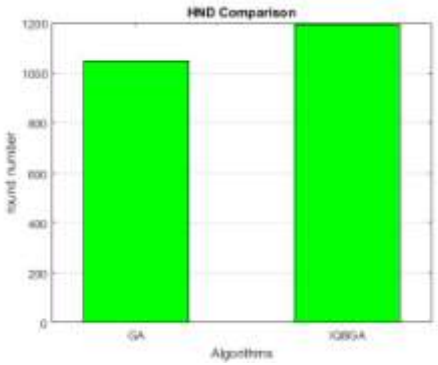

Fig. 4.3 Half node dead comparison

Graph No. 3: Fig. 4.4 shows the comparison of network remaining energy. Here it is clear that energy consumption in the network in case of I-QBGA is less as compare to GA and remaining energy is also greater than GA.

Graph No. 4: fig. 4.5 shows the total dead node comparison between existing (GA) and proposed (I-QBGA).

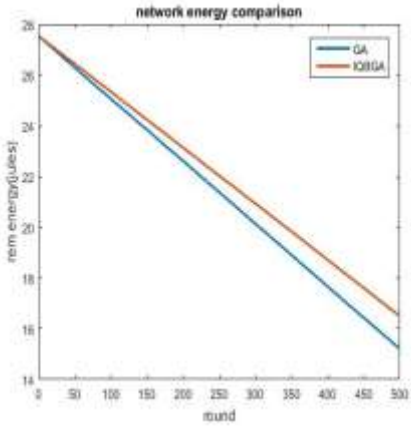

Fig. 4.4 Energy comparison of network

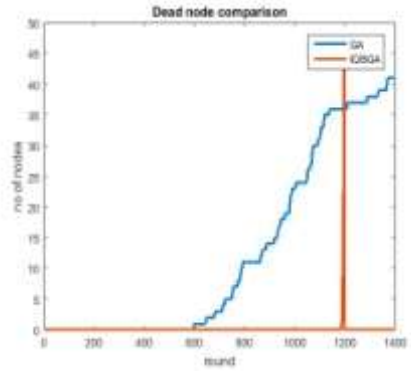

Fig. 4.5 Dead node comparison

7. RESULTS WITH HOMOGENEOUS NODES

Above results are based on heterogeneous nodes because the existing algorithm is only applicable for heterogeneous nodes but our purpose to show the proposed algorithm is applicable for both homogeneous and heterogeneous nodes. Now results comparison of GA and I-QBGA for homogeneous nodes.

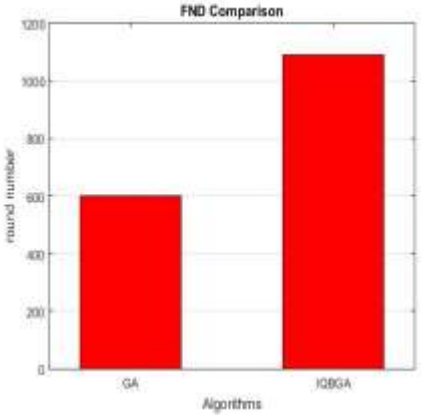

Fig. 4.6 First node dead comparison

*****M.Tech. Scholar, ECE Department, GGGI, Saha Road, KUK, Haryana, India*
***Asst. Professor, ECE Department, GGGI, Saha Road, KUK, Haryana, India, saranjeet@galaxyglobaledu.com*

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Graph No.1: Fig. 4.6 shows the first node dead comparison of GA and I-QBGA for homogeneous nodes and shows that I-QBGA performing much better than GA.

Graph No.2: Fig. 4.7 shows the half node dead comparison of GA and I-QBGA. In case of half node dead I-QBGA again proved better than GA.

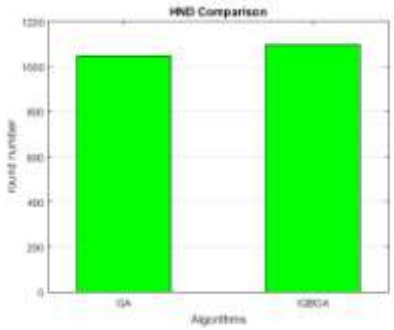

Fig. 4.7 Half node dead comparison

Graph No. 3: Fig. 4.8 shows the comparison of network remaining energy.

Graph No. 4: fig. 4.9 shows the total dead node comparison between existing (GA) and proposed (I-QBGA). Nodes start to dead at 600th round in GA where in I-QBGA node start to dead from 1000th rounds.

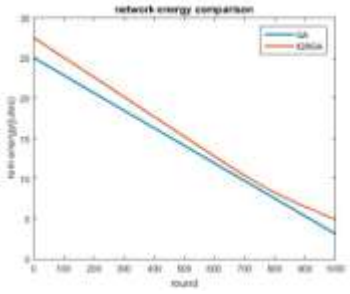

Fig. 4.8 Energy comparison of network

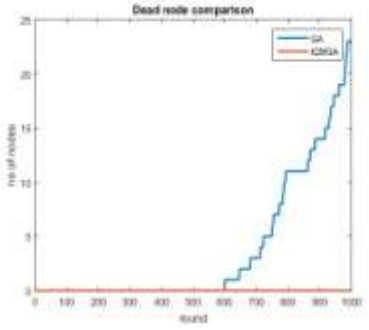

Fig. 4.9 Dead node comparison

Table 4.3 Number of dead nodes w.r.t rounds with homogeneous nodes

Algorithm	FND	HND	Remaining Energy(j)	Dead nodes
LEACH-GA	600	1030	0.14	45
LEACH-I-QBGA	1113	1176	0.19	43

8. CONCLUSION

One of the main challenges in the designing of WSNs is energy efficiency. The energy utilization of the sensors is dominated by data transmission and reception. Therefore, routing protocols proposed for WSNs should be as energy efficient as possible to prolong the lifetime of individual sensors, and hence the network lifetime. The protocols conferred have individual merits and shortcomings. Although LEACH-GA provides optimal cluster head solution for the selection of CH but there is some drawback of GA i.e it is very time consuming and complex process hence it needs to improve. Here we implemented a technique called I-QBGA (Improved Queen-Bee Genetic Algorithm) is the improvement of GA. Which not only provides more optimal cluster head selection but also reduce the complexity and time consumption by Genetic algorithm and increases the lifetime of Wireless Sensor Network. Here results are implemented on MATLAB.

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*****M.Tech. Scholar, ECE Department, GGGI, Saha Road, KUK, Haryana, India
******Asst. Professor, ECE Department, GGGI, Saha Road, KUK, Haryana, India, saranjeet@galaxyglobaledu.com

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*****M.Tech. Scholar, ECE Department, GGGI, Saha Road, KUK, Haryana, India*
***Asst. Professor, ECE Department, GGGI, Saha Road, KUK, Haryana, India, saranjeet@galaxyglobaledu.com*

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

OPTIMIZATION THE GENETIC AND DIFFERENTIAL EVOLUTION ALGORITHMS FOR DIGITAL SAW FILTER DESIGN

***Minakshi Chauhan**
****Kaushal Kishore**

Abstract
Surface Acoustic Wave filter, a semiconductor device that is used to filter out desired frequencies. Widely used in mobile phones to filter both RF and IF frequencies, a SAW filter uses the piezoelectric effect to turn the input signal into vibrations that are turned back into electrical signals in the desired frequency range. Saw filters are electromechanical devices used in wide range of radio frequency applications providing frequency control, frequency selection and signal processing capabilities their performance is based on piezoelectric characteristics of a substrate in which the electric signal is converted into mechanical one and back again to the electrical domain at the output. The frequency response characteristics of SAW filters are governed primarily by their geometrical structures, i.e., the configurations of IDTs and reflectors arranged on piezoelectric substrates. However, even if the problem, structural design of SAW filters is formulated as an optimization most design techniques have relied on local optimization methods.

Key words: - *SAW Filter, differential Evolution algorithms.*

INTRODUCTION

Surface Acoustic Wave (SAW) filter is a semiconductor device used to filter out desired frequencies, widely used in mobile phones both for RF and IF frequencies. A SAW filter uses the piezoelectric effect to turn the input signal into vibrations that are turned back into electrical signals in the desired frequency range. The SAW filters are electromechanical devices used in wide range of radio frequency applications providing frequency control, frequency selection and signal processing capabilities their performance is based on piezoelectric characteristics of a substrate in which the electric signal is converted into mechanical one and back again to the electrical domain at the output. After propagating through the piezoelectric element the output is recombined to produce a direct analogue implementation of finite impulse response filter Surface acoustic wave (SAW) filters have been widely used for many applications in recent communication systems [1, 2].

Starting from intermediate-frequency (IF) SAW filters for TVs, radiofrequency (RF) SAW filters are currently available for mobile, wireless and personal communication systems such as cellular phones and personal data assistants (PDAs). The frequency response characteristics of SAW filters are governed primarily by their geometrical structures, i.e., the configurations of IDTs and reflectors arranged on piezoelectric substrates.

EVOLUTION ALGORITHMS

It is difficult to imagine the variety of existing computational tasks and number of algorithms developed to solve them. Algorithms that either give nearly the right answer or provide a solution not for all instances of the problem are called heuristic algorithms. This group includes a plentiful spectrum of methods based on traditional techniques as well as specific ones. For the beginning we sum up the main principles of traditional search algorithms. The simplest of search algorithms is exhaustive search that tries all possible solutions from a predetermined set and subsequently picks the best one.

Local search is a version of exhaustive search that only focuses on a limited area of the search space. Local search can be organized in different ways. Popular hill-climbing techniques belong to this class. Such algorithms consistently replace the

*M.Tech. Scholar, E.C.E. Deptt., E. Max Institute, Ambala (H.R.)
**Assistant Professor, Dept, E.C.E. Deptt., E. Max Institute, Ambala (H.R.)

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

current solution with the best of its neighbors if it is better than the current. For example, heuristics for the problem of intra group replication for multimedia distribution service based on Peer-to-Peer network is based on hill-climbing strategy .Divide and conquer algorithms try to split a problem into smaller problems that are easier to solve.

Solutions of the small problems must be combinable to a solution for the original one. This technique is effective but its use is limited because there is no a great number of problems that can be easily partitioned and combined in such way. Branch-and-bound technique is a critical enumeration of the search space.

SAW FILTER

A surface acoustic wave (SAW) is a type of mechanical wave motion which travels along the surface of a solid material. The wave was discovered in 1885 by Lord Rayleigh, and is often named after him. These days, these acoustic waves are often used in electronic devices. At first sight it seems odd to use an acoustic wave for an electronic application, but acoustic waves have some particular properties that make them very attractive for specialized purposes.

And they are not unfamiliar -many wristwatches have a quartz crystal used for accurate frequency generation, and this is an acoustic resonator though it uses bulk acoustic waves rather than surface waves.Fig.2.1 shows a SAW travelling along the plane surface of a solid material. As the wave passes, each atom of the material traces out an elliptical path, repeating the path for each cycle of the wave motion.

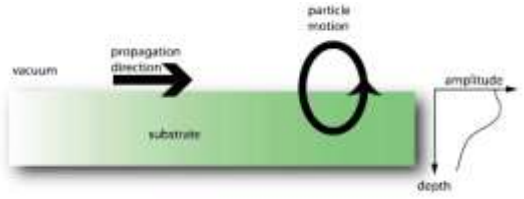

Fig 1. Basic Surface Acoustic Wave

The atoms move by smaller amounts as one looks farther into the depth, away from the surface. Thus, the wave is guided along the surface. In the simplest case (an isotropic material), the atoms move in the so-called sagittal plane, i.e. the plane which includes the surface normal and the propagation direction.

SIMULATION RESULTS

This section represents the simulation frame work for the optimization of saw filter using genetic algorithm. Simulation is carried out for certain specification such as Number of generation=10: When number of generation is 10, the BW of the passband lie between 5-6 MHz and ripples amplitude lie between -10 to -30 dB and number of ripples are less as compared to previous results obtained from previous methods.

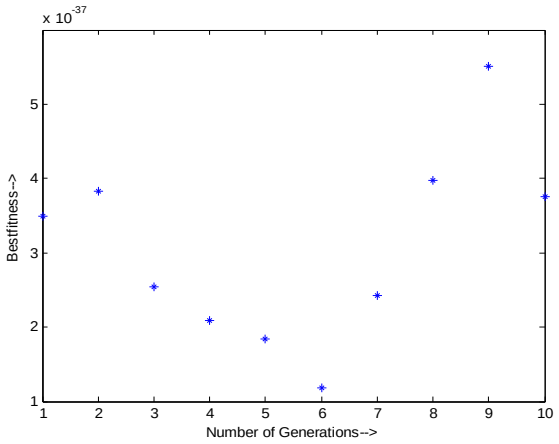

Fig 2. Bestfitness Vs Number of generation (=10)

CONCLUSION

In this the improvement version were explored for the ordering of SAW filter coefficients. Their efficiency in reducing the switching activity could be proved, since after logically synthesized, the power results of filters data path were reduced. The best reduction, as expected, occurred in switching power, since it is more susceptible to the reordering. As the reduction in the internal cell power was not too large, the total power did not get a large reduction, but these results can be interesting in critical applications.

Usually heuristic algorithms are developed to have low time complexity and applied to the complex problems.

*M.Tech. Scholar, E.C.E. Deptt., E. Max Institute, Ambala (H.R.)
**Assistant Professor, Dept, E.C.E. Deptt., E. Max Institute, Ambala (H.R.)

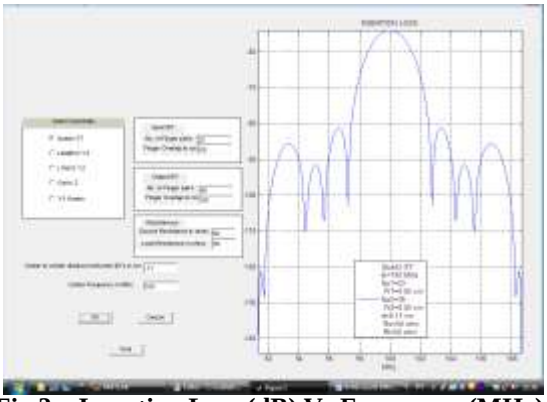

Fig 3. Insertion Loss (dB) Vs Frequency (MHz)

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*M.Tech. Scholar, E.C.E. Deptt., E. Max Institute, Ambala (H.R.)
**Assistant Professor, Dept, E.C.E. Deptt., E. Max Institute, Ambala (H.R.)

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

ANALYSIS THE OPTIMAL LINEAR PHASE FIR FILTER DESIGN USING HARMONY SEARCH ALGORITHM

***Rachna Kamboj**
****Mohinder Singh**

Abstract
In this paper we present the efficient way of designing Finite Impulse Response band pass filter using Harmony Search algorithm. In this various strategies of differential evolution have been attempted for the designing of FIR band pass filter. Impulse response coefficients of designed FIR filters have been represented as the sum or differences of powers of two individuals. The performance of filters depends upon its magnitude response and its hardware cost. Harmony Search is the heuristic approach which helps in minimizing possibly non-linear and non-differentiable functions.
Key words: *Harmony Search algorithm, FIR filters, Magnitude response.*

INTRODUCTION

A filter is a selective circuit that permits a certain band of frequency to pass while the other frequencies get attenuated. The digital filters can be implemented in hardware or through software and are capable to process both real-time and on-line signals. These days the digital filters are being used to perform many filtering tasks, which previously were performed almost exclusively by analog filters and the digital filters are replacing the traditional role of analog filters in many applications such as image processing, speech synthesis, secure communication, radar processing and biomedical etc. The design of digital infinite impulse response filter follows either transformation technique or optimization technique.

Using the transformation, Butterworth, Chebyshev and Elliptic function, have been designed. Optimization methods have been applied whereby performance for the design of digital IIR filters is measured in terms of the magnitude error, and ripple magnitudes of pass band and stop-band.

DIGITAL FILTER

A digital filter design problem determines a set of filter coefficients which meet performance specifications. These performance specifications are (a) pass band width and its corresponding gain, (b) width of the stop-band and attenuation, (c) band edge frequencies, and (d) tolerable peak ripple in the pass band and stop-band. A system may be defined as an integrated unit composed of diverse, interacting structures to perform a desired task. The task may be filtering of noise, detection of range of target in radar system. The function of system is to process a given input sequence to generate an output sequence.

SOLUTION METHODOLOGY

Various mutation variants of DE have been undertaken to design IIR digital filters. These methods perform global search and an exploratory search is proposed to perform local search so that global as well as local search is performed simultaneously. Opposition based learning is implemented to improve the chance of starting with better solution by checking the opposite solution. Differential Evolution is a population-based stochastic method.

It is applied to minimize performance index. Differential evolution uses a rather greedy and less stochastic approach to problem solving in comparison to evolutionary algorithms. DE combines simple arithmetical operators with the classical operators of the recombination, mutation, and selection to evolve from a randomly generated starting population to a final solution.

*****M.Tech. Scholar, Dept. of CE, M.V.G.I., Yamunanagar (H.R.)*
***H.O.D., Dept. of CE, M.V.G.I., Yamunanagar (H.R.)*

GGGI Journal of Engineering & Technology
ISSN 2278-1226
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PROPOSED WORK

In this digital filter design method, a comparison is established between a filter designed using Harmony Search algorithm using frequency sampling and a filter designed using the simple frequency sampling method. The FS technique has the advantages that more effective narrow band filters can be found easily, and those filters can be designed with an arbitrary response major drawback is observed where to find the values of the transition band frequency sample values that produce a filter with the maximum stop band attenuation becomes a major task. Harmony Search is an evolutionary computation technique. With very few parameters to adjust, it is extensively used in major applications. In Harmony Search, each potential solution is assigned a randomized velocity, and the potential solutions, named as particles, with an important characteristic of memory are then "flown" through the problem space. Here, we use Harmony Search to optimize the transition band frequency sample values is investigated.

RESULTS

Here we will represent the results of simple frequency and Harmony Search based frequency sampling designing method of FIR filter and their parallel comparison. All the results are created using FDA Tool in MATLAB. We take two samples in transition band and apply Harmony Search as optimization technique to optimize their values. Now we show the magnitude versus normalized frequency plot for both simple frequencies sampling designingmethod.

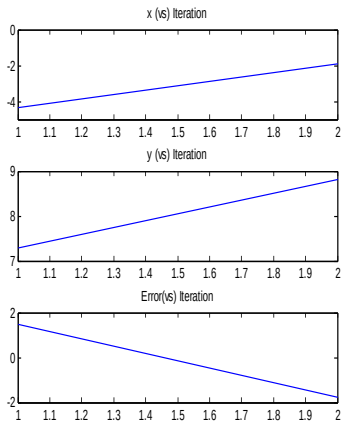

Fig.1

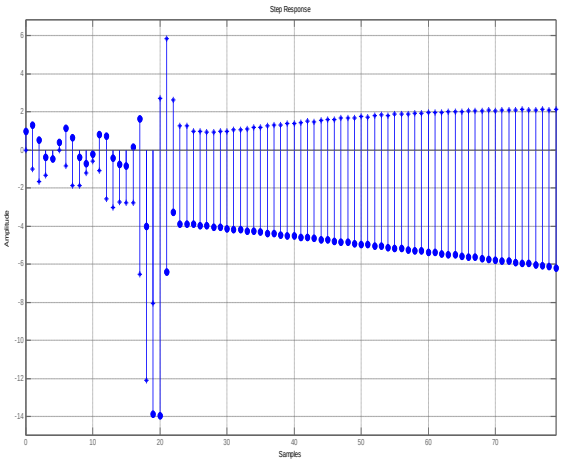

Fig 2

From the fig.1 and fig.2, it is clear that the magnitude response of Harmony Search based frequency sampling is better than simple frequency sampling method. Magnitude gain is also increase nearly about 12 db at 3012 Hz in Harmony Search based frequency sampling method.

CONCLUSION

Compared with the other algorithms, the method is very simple, easily completed and it needs fewer parameters, which made it fully developed. In this paper, a Harmony Search algorithm is applied to the solution of the constrained, multi-modal FIR low pass filter design problem with optimal filter coefficients. Comparison of the results of GA and Harmony Search algorithm has been made. Simulation results justify that the proposed algorithm Harmony Search outperform conventional GA in the accuracy of the magnitude response of the filter as well as in the convergence speed.

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*M.Tech. Scholar, Dept, CE, M.V.G.I., Yamunanagar (H.R.)
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*M.Tech. Scholar, Dept, CE, M.V.G.I., Yamunanagar (H.R.)
**H.O.D., Dept, CE, M.V.G.I., Yamunanagar (H.R.)

GGGI Journal of Engineering & Technology
ISSN 2249-4103
An Annual Research Journal

FINITE ELEMENT ANALYSIS AND EXPERIMENTAL INVESTIGATION OF DEBONDING BEHAVIOUR OF STEEL FIBRE REINFORCED EPOXY

Sandeep Kumar
****Md. Taslim Rza**

Abstract
The mechanical advantage of using composite is high strength to weight ratios which increases their capabilities for aerospace, structural and automobile applications. The epoxy-coated reinforcement (ECR) has gained mainstream acceptance to extend the useful life of highway structures. The volume fraction of reinforcement affects the overall strength a composite and the orientation of fibers in matrix plays a significant role in determining the debonding behaviour. The present work focuses on the compressive strength and debonding behaviour of steel reinforced epoxy composite with different orientation angles of fibers. Among different orientations, fibers reinforced at 0° angles shows maximum compressive strength and least debonding than 45° and 90° angle of reinforcement.
Keywords*: FRP, Numerical analysis, Debonding behaviour, Compression test*

1. INTRODUCTION

For years, FRP (fiber reinforced plastic composites) have growing applications in different industries. Composite is a mixture of two or more constituents/materials (or phases) with different physical/chemical properties at the macroscopic or microscopic scale [ ]. In general composites have two or more constituents, fiber and matrix. Composites are classified by the geometry of the reinforcement: particulate, flake, and fibers or by the type of matrix: polymer, metal, ceramic, and carbon. The basic idea of the composite is to optimize material properties of the composite, i.e., the properties of the matrix are to be improved by incorporating the reinforcement phase. Fibers are the principal load-carrying constituents while the surrounding matrix helps to keep them in desired location and orientation and also act as a load transfer medium between them. Fiber-reinforced composites are often characterized by their high specific strength and specific modulus parameters (i.e., strength to weight ratios), and are widely used for applications in low-weight components[ ]. The composite reinforced with carbon fibers are used for making bridges and structural members [ ]. The high strength and damage resistance of the composites are very important for a number of practical applications. The aim of this paper is to study the behaviour of steel fiber reinforced epoxy composite with different angles of orientation under compressive loading. Testing of pressure loading is one of the most commonly used mechanical testing [ ]. These tests determine the influence of reinforcement on pressure strength and modulus of elasticity, but also provide the knowledge about the mechanisms of cracks which are unavoidable factor duration the testing of composite structure **[4-6].**
A dominant role in the initiation and propagation of crack when testing fibers reinforcement by composite materials has the reinforcement component, which will be confirmed experimentally and numerically in this paper.

2. TEST MATERIALS

The composite materials were fabricated by reinforcing steel fibers in epoxy resin at 10% volume fraction of reinforcement as shown in figure 2.2. The volume fraction is calculated by using equation (2.1) [ ]. The specimens were prepared with different fiber orientation angles of 0°, 45° and 90° in epoxy by hand molding process using die. The test specimens were molded into cubic pieces of dimensions 30 X 30 X 30 mm. The modulus of elasticity of matrix E_m= 20 GPa and poisson ratio ν_m= 0.4. The modulus of elasticity of steel fibers E_f = 200 GPa and poisson ratio ν_f = 0.25.

$$V_f = \frac{\pi l d^2}{4LS^2} \qquad (2.1)$$

where
l = length of fiber
L = longitudinal fiber spacing
(length of matrix)
D = diameter of fiber
S = Fiber spacing (Refer fig2.1)

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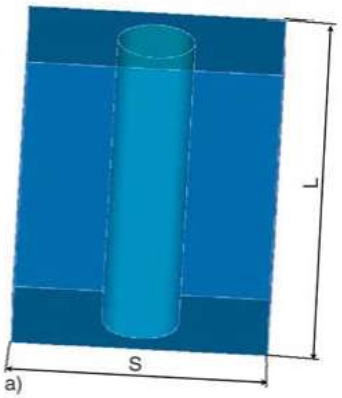

Figure 2.1: Unit cell of square array of fiber packing geometry in 3D for single fiber

Figure 2.2: Experimental test material specimen

3. EXPERIMENTAL SETUP

The compression tests were carried out on servo hydraulic testing machine (m/c name with loading capacity-------) on the test specimens of unreinforced epoxy and reinforced composite with different orientation angles of fibers (0°, 45°and 90°). The test specimen was placed between the moveable and fixed plates. The compressive load was applied and readings were obtained. The displacements corresponding to applied load were measured by displacement dial gauge and load v/s displacement graphs were plotted for each specimen.

Figure 3.1: Compression test rig

4. EXPERIMENTAL TEST RESULTS:

The force v/s displacement experimental results for unreinforced epoxy, steel reinforced (10% volume fraction) at 0°, 45° and 90° orientation angles are shown in figures 4.1- 4.4. The comparison between the breaking load and displacement is shown in figure 4.5. The comparison of breaking load for composites is shown in figure 4.6. Results shows that when epoxy is reinforced with steel fibers, the compressive load bearing capacity increases by 32% to 50% depending upon orientation angles of fibers. Debonding of fibers in matrix is also affected by the orientation angles. Breaking force is maximum for 0° angle i.e. when fibers are arranged along X-axis, then 45° and 90°. For 45 degree orientation the strength is more than 90 degree orientation due to the shielding effect [ ] which suppresses the debonding at inner edges and outer edges gets debonded as shown by numerical results.

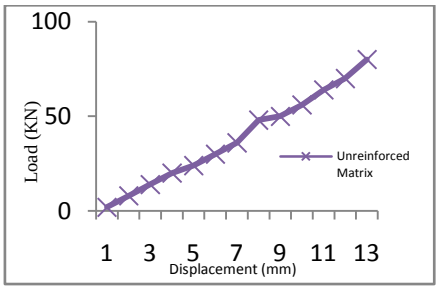

Figure 4.1: load v/s displacement plot for pure epoxy

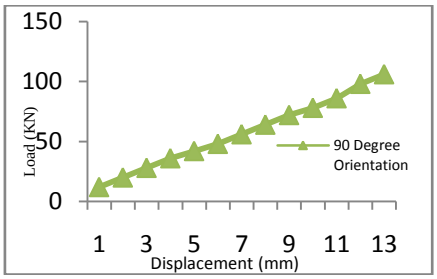

Figure 4.2: load v/s displacement plot for 90 degree fiber orientation

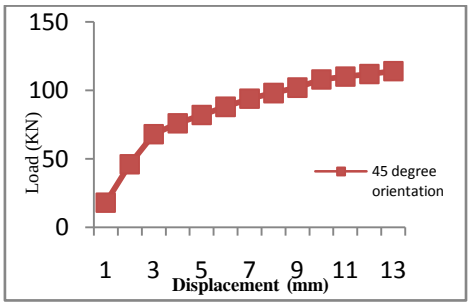

Figure 4.3: load v/s displacement plot for 45 degree fiber orientation

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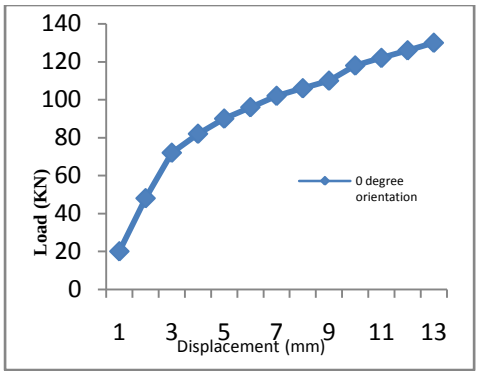

Figure 4.4: load v/s displacement plot for 0 degree fiber orientation

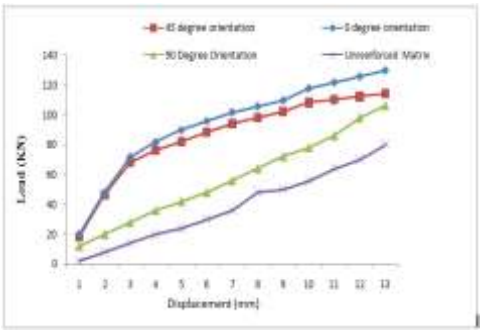

Figure 4.5: Comparison between load v/s displacement of various composites

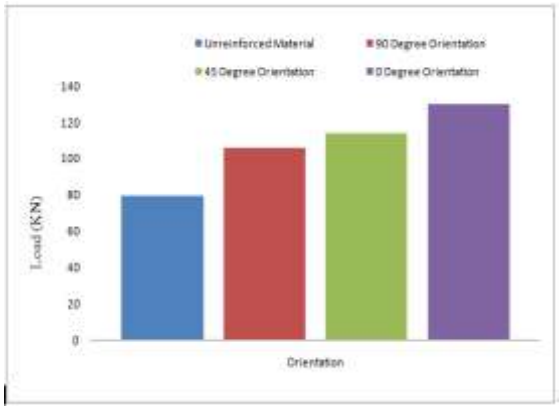

Figure 4.6: Breaking load v/s orientation plot

5. NUMERICAL RESULTS:

The composite specimens with different orientation angles were modeled using finite element analysis software ANSYS. The element type considered for the analysis was solid 8 node 45 and cohesive zone modeling approach is used which is similar to V. Kushch [ ]. The compressive displacements were given to the models to study the stresses and their location where debonding of fibers will occur. The numerical and experimental results were compared to validate the debonding behavior during compression testing.

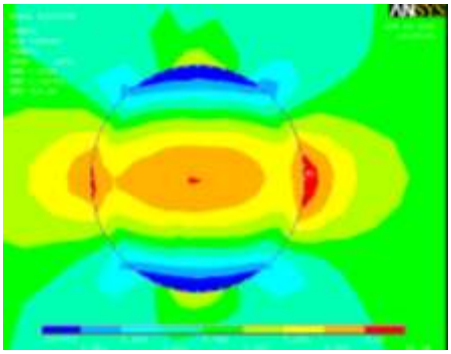

Figure 5.1: Numerical result for 0 degree orientation of fiber

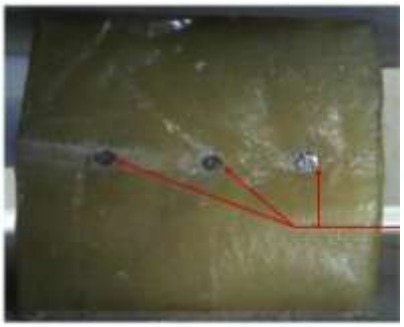

Figure 5.2: Debonding of fibers at 0 degree orientation

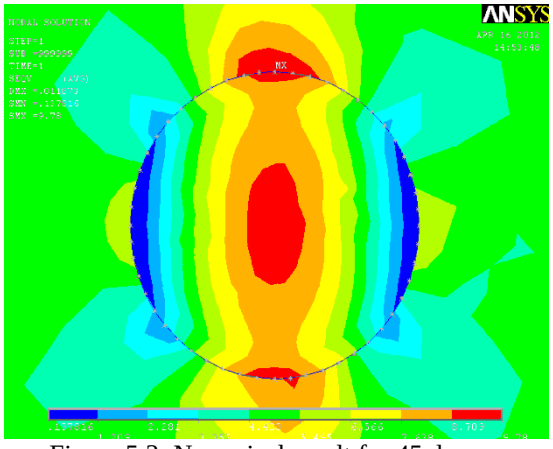

Figure 5.3: Numerical result for 45 degree orientation of fiber

6. CONCLUSIONS:

The aim of this paper was to analysis the compressive strength of steel reinforced epoxy composite at different orientation angle of fibers. F.E. Analysis of steel fiber reinforced epoxy composite has generated detailed quantitative data about the debonding behavior of composite.

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**AP, Mech.Deptt, KKCEM, Nalanada

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Compression test results shows that failure/breaking of composites will start at the fiber/matrix interface and debonding behavior depends upon the orientation of fibers.

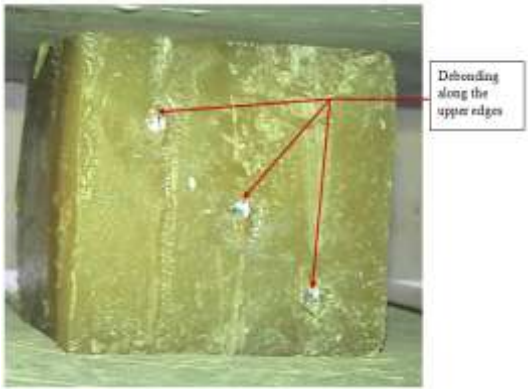

Figure 5.4: Debonding of fibers at 45 degree orientation

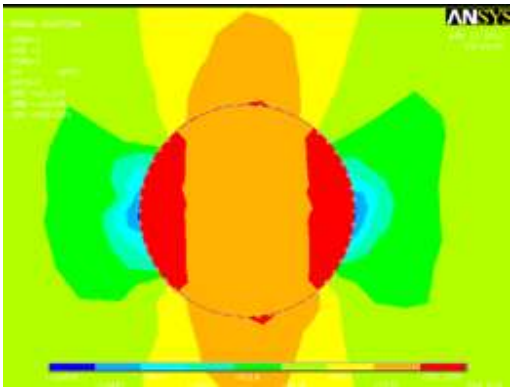

Figure 5.5 Numerical result for 90 degree orientation of fiber

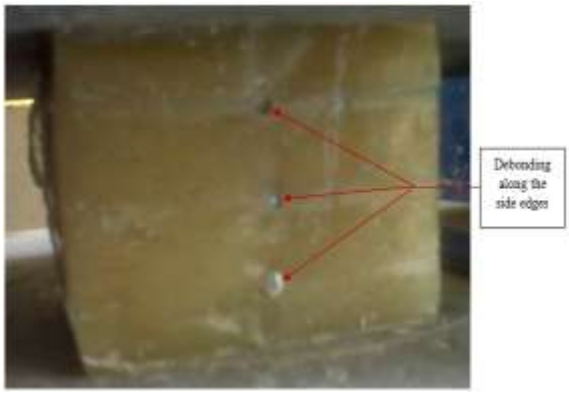

Figure 5.6: Debonding of fibers at 90 degree orientation

Breaking load for the given composite increases with increase in reinforcement in percentage because fibers are the main load carrying members. Results shows that with 10% reinforcement of steel fibers the breaking load increased by 32.5% to 50%, depending upon the orientation of fibers. Load v/s displacement graph showed that for a particular load, maximum displacement is shown by unreinforced composites, followed by 90, 45, and 0 degree. For 0 degree orientation all fibers are under uniform stress distribution but for 90 degree orientation the stress distribution is not uniform as upper fiber is stressed maximum which will cause the premature failure.

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*HOD/AP, Mech.Deptt, KKCEM, Nalanada
**AP, Mech.Deptt, KKCEM, Nalanada

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OPTIMIZATION OF RECYCLED SLAG FLUX MIXTURE RATIO AND ITS EFFECT ON WELD GEOMETRY PARAMETERS FOR SAW OF DUPLEX STEELS

***Harpreet Singh**
****Deepak Gupta**

Abstract
Submerged arc welding (SAW) process is an important component in many industrial operations. The present study deals with the application of mixture design to study the affect of different input parameters on desired response in submerged arc welding process for duplex – 304 stainless steel material The results used to optimize the parameters for the submerged arc welding process.
The purpose of present study is to optimize the best mixture ratio of slag and flux.
Key words: *ANOVA, Current, duplex-304, submerged arc welding, Travel speed, Voltage.*

INTRODUCTION

Welding is an efficient, economical method for joining of metals. The advantages of welding, as a joining process, include high joint efficiency, good set up, flexibility and low fabrication costs. Due to its good reliability, deep penetration, smooth finish and high productivity, submerged arc welding (SAW) has become a natural choice in industries for fabrication. It is widely recognized as very productive welding process from single wire approach to more productive variants as twin wire, tandem ad metal power addition. Duplex stainless steel is a high quality, high tensile, alloy steel and combines high tensile strength, shock resistance, good ductility and resistance to wear. It is most suitable for the manufacture of parts such as heavy-duty axles and shafts, gears, bolts and studs. It is capable of retaining good impact values at low temperatures. Duplex steel is a difficult-to-machine material because of its high hardness, low specific heat and tendency to get strain hardened.

TAGUCHI METHOD

Taguchi method is a powerful tool for the design of high quality systems. It provides simple, efficient and systematic approach to optimize designs for performance, quality and cost. Optimization of process parameters is the key step in Taguchi method to achieving high quality without increasing cost. This is because optimization of process parameters can improve quality characteristics and optimal process parameters obtained from Taguchi method are insensitive to the variation of environmental conditions and other noise factors. Classical process parameters design is complex and not an easy task. To solve this task the Taguchi method uses a special design of orthogonal arrays to study the entire process parameter space with a small number of experiments only.

METHOD OF EXPERIMENT

Selection of material

Selection of material depends upon the desire weld ability qualities which must rely on basic properties of the material, such as strength, corrosion or erosion resistance, ductility, and toughness. The properties of the various metallurgical characteristics associated with the thermal cycles encountered in the welding operation must also be included in the design process.

Experimental setup*:*

The experiment was conducted at Maharishi Markandeshwar University Mullana with the following experimental set up the equipment used was submerged arc welding equipment (TORNADO M-800) having electrode Cu wire, 3.2 mm diameter. The Work Piece used EN24 ALLOY STEEL of 400*80*20 mm size. Flux used for the SAW welding EN8 with Electrode to work angle 90^0. Parameters used for the experiment were voltage, welding current and travel speed as shown in the table3.1

TABLE 3.1 Process parameters with their values at three levels.

Parameter	Level 1	Level 2	Level 3	Output parameter
Arc Voltage(volts)	30	35	40	Weld penetration shape factor
Welding Current (amp.)	300	400	500	
Travel speed(m/hr)	20	25	30	

Taguchi method was used for the experiment with design of experiment **L_9 orthogonal array.** Table 3.2 show the DOE L-9 orthogonal array.

**M.Tech Scholar, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Dinarpu,(Ambala)-133102, India.*
***Asstt. Professor, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Dinarpur(Ambala)-133102, India.*

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TABLE 3.2 Actual values of process parameters

S. No.	Design of Experiment (L_9 orthogonal array)		
	Voltage(volts)	Current (amp.)	Travel speed (m/hr.)
1	30	300	20
2	30	400	25
3	30	500	30
4	35	300	25
5	35	400	30
6	35	500	20
7	40	300	30
8	40	400	20
9	40	500	25

RESULT AND DISCUSSION

Taguchi recommends analyzing data using the S/N ratio that will offer two advantages; it provides guidance for selection the optimum level based on least variation around on the average value, which closest to target, and also it offers objective comparison of two sets of experimental data with respect to deviation of the average from the target. The experimental results are analyzed to investigate the main effects. According to Taguchi method, S/N ratio is the ratio of "Signal" representing desirable value, i.e. mean of output characteristics and the "noise" representing the undesirable value i.e., squared deviation of the output characteristics. It is denoted by η and the unit is dB.The S/N ratio is used to measure quality characteristic and it is used to measure significant welding parameters.

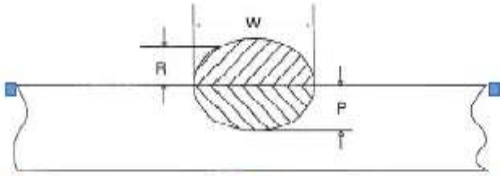


Fig. 4.1: Cross section of ideal weld bead

The above figure 4.1 is the schematic representation of the bead on plate from Submerged Arc Welding. In this figure [P] represents the PENETRATION, [R] represents the REINFORCEMENT and [W] represents the WIDTH of the bead.

TABLE 4.1 Experimental data and S/N ratio

V	I	Ts	WPSF	SNRA1	MEAN1
30	300	20	5.66667	15.0666	5.66667
30	400	25	4.37500	12.8196	4.37500
30	500	30	5.25000	14.4032	5.25000
35	300	25	4.00000	12.0412	4.00000
35	400	30	4.00000	12.0412	4.00000
35	500	20	3.83333	11.6715	3.83333
40	300	30	3.95833	11.9502	3.95833
40	400	20	3.66667	11.2854	3.66667
40	500	25	3.40909	10.6528	3.40909

TABLE 4.2 Response Table for Signal to Noise Ratio.

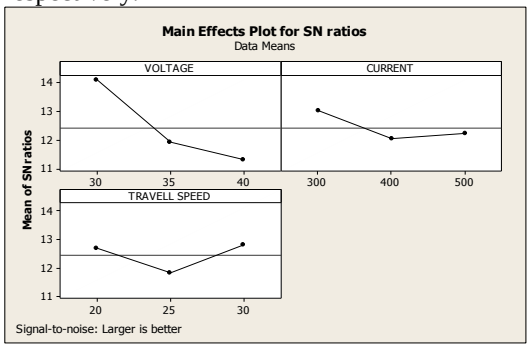
LARGER IS BETTER

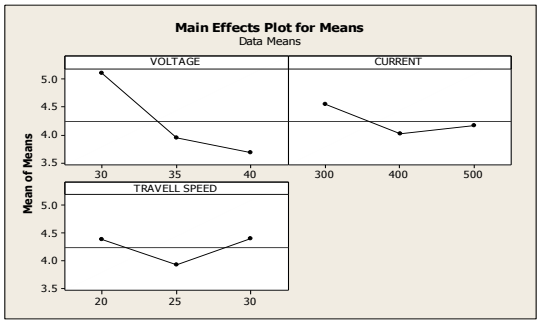
LEVEL	VOLTAGE	CURRENT	TRAVEL SPEED
1	14.10	13.02	12.67
2	11.92	12.05	11.84
3	11.30	12.24	12.80
Delta	2.80	0.97	0.96
Rank	1	2	3

TABLE 4.3 Response Table for Means.

LEVEL	VOLTAGE	CURRENT	TRAVEL SPEED
1	5.097	4.542	4.389
2	3.944	4.014	3.928
3	3.678	4.164	4.403
Delta	1.419	0.528	0.475
Rank	1	2	3

Above table's shows that the voltage is the most predominant factor having rank 1 other factors current and travel speed rank second and third respectively.





Larger is better was selected for analysis of the Taguchi's design. It was observed that the optimum condition for the weld penetration shape factor A1, B1, C3

Analysis of Variance (ANOVA)

ANOVA table for WPSF is given in table 4.4 ANOVA table indicates the significance value of various input factors. If the p value given in the first

*M.Tech Scholar, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Dinarpu,(Ambala)-133102, India.
**Asstt. Professor, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Dinarpur(Ambala)-133102, India.

column of ANOVA table is less than 0.05, this means the factor corresponding to that value of p is significant. In present study the p value for voltage is 0.028 coming lesser than 0.05. F value given in ANOVA table also indicates the significance of factors, higher the F value higher is the significance of that factor. Hence from table 4.4, voltage is the most significance factor.

TABLE 4.4 Analysis of Variance for SNRA1

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Voltage	2	12.9739	12.9739	6.4870	34.33	0.028
Current	2	1.5831	1.5831	0.7915	4.19	0.193
Travell speed	2	1.6376	1.6376	0.8188	4.33	0.188
Error	2	0.3779	0.3779	0.1890		
Total	8	16.5726				

S=0.434700 R-Sq=97.72% R-Sq=90.88%

CONCLUSION

The results shows penetration will be at maximum value when welding arc voltage and welding current are at their maximum possible value and welding speed is at its minimum value.

Arc voltage is main factor influence the Weld penetration shape factor (WPSF). It increases with arc voltage and current and decreases, with welding speed.

Optimal parameters setting for larger depth is, current = 300 amp, voltage = 30 V, Speed= 30 m/hr.

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*M.Tech Scholar, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Dinarpu,(Ambala)-133102, India.
**Asstt. Professor, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Dinarpur(Ambala)-133102, India.

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

PROCESS IMPROVEMENT THROUGH LEAN IMPLEMENTATION: A REVIEW

***Anshul Sachdeva**
****Deepak Gupta**
*****Dr. Rajkumar**

Abstract
Process in any manufacturing organization is a series of value addition steps which transforms raw material into finished product. Lean manufacturing or lean production is one of the most popular paradigms in process improvement. Lean philosophy is implemented by organizations worldwide but its implantation is snail-paced in India and needs to be augmented. Based on a systematic literature review, this paper presents a detailed analysis of lean philosophy in manufacturing and service sectors and put forward the best approaches for its implementation. We have identified various approaches for lean, but in particular, we briefly present the most effective tools and methodologies for its implementation. In this study, we aim at classifying and evaluating various tools and techniques available for lean implementation. Our work provides required preliminary information for lean implementation in an organization. In this paper, the development and need for lean production system, measure of leanness in an organization and principles of lean are also explained through review of literature. This paper presents a result oriented comparison study of most effective techniques adopted for lean implementation by manufacturing organizations.
Keywords: *Lean manufacturing, Process improvement, Leanness measures, Lean production system, Kaizan, VSM, Kanban, JIT*

INTRODUCTION

Due to intense global competition and variable customer demands, organizations need to improve their manufacturing processes and enhance product quality. Process improvement is not a fad but a necessity for the organizations. Organizations confront countless problems while manufacturing their products. Companies around the world are searching for new methodologies to improve their competitive position in the market [1, 2]. Terms like lean manufacturing, world class manufacturing, agile manufacturing, continuous flow manufacturing, and stockless manufacturing have emerged.

Lean manufacturing is defined as a production control technique for eliminating waste in the manufacturing process. It is synonymous to Toyota Production System (TPS). Lean aims at finding better, more efficient ways of accomplishing the same tasks. The motive behind lean manufacturing implementation is to identify and eliminate the non-value adding/ waste activities (m*uda*) at operational level in order to improve the quality of the final product continuously and also to improve the production process so as to make it more efficient [3]. The production processes consist of activities that do not add value to the product, consume time and resources of the organization which leads to greater lead times and increased costs. These waste activities need to be eliminated to reduce cost and time incurred for manufacturing the product. Customer wants value and will pay for the value added to the product as desired. Customer is not supposed to pay for defects or extra cost of having large inventories, i.e., customer is not going to pay for the waste activities of the manufacturing firm. Lean philosophy adopts a customer value focus and asks "What is the customer willing to pay for?" Lean manufacturing leads to continuous improvement of the production processes in an organization. It aims to deliver better quality products at lower cost to the manufacturer and consumer. The ultimate aim of

*M.Tech. Scholar, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. anshulks@ gmail.com
**Assistant Professor, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. deepak.gupta@galaxyglobaledu.com
***Professor & Director, Galaxy Global Group of Institutions, Ambala. rajkumar@galaxyglobaledu.com

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Lean Manufacturing is to speed up the process and increase productivity through proper utilization of firm's resources. Lean production is known as assembly line methodology as it was developed originally for automobile manufacturing in TPS. Lean does not have one particular definition; it is a continuously developing philosophy being applied in different situations and applications. Lean manufacturing has been deployed in various sectors; automobile sector, service sector, schools and hospitals, pharmaceuticals, electronics and electrical components manufacturing, defence sector, management, etc., and demonstrated immense benefits and improvements in radical ways. Removing all types of waste from all functions is the main purpose of the lean [4].

Forms of Waste (Muda) Targeted by Lean

In Japan, for product improvement three types of variations are studied. These include; muda, i.e., non value added waste, muri, i.e., overburdening of people or process, mura, i.e., unevenness or fluctuating production volumes over a time period. Figure 1 demonstrates the waste generated by the three variations and relation between them.

Figure 1: Types of variation

Lean manufacturing system considers the waste generated by these variations at workplace. Muda means those activities that do not add value to the product during the conversion process; it is not the useless product or scrap.

Due to immense competition in automobile industries in Japan, Toyota presented its 'seven waste' concept. Complete elimination of waste and maintaining product flow then started involvement of operations management [5]. Seven major forms [6] of non-value adding/ waste activities are identified. These forms of muda are explained in Table 1. These seven forms of waste contribute to wasted time and effort of an organization as shown in Figure 2.

Figure 2: Seven wastes

TABLE 1: Seven Forms Of Waste Activities

Form of Waste	Explanation
1. Excessive transportation	Interdepartmental movement of the product beyond requirement.
2. Waiting	The product lead time includes waiting for next operation.
3. Over-production	Producing in quantities more than required by customer is overproduction.
4. Defects	Defective products would have consumed the organization resources and are a waste.
5. Unnecessary inventory	Excessive inventory hinders the smooth flow of material, consumes large plant space and increases lead time.
6. Unnecessary motion	Any movement of worker's limbs which doesn't add value to the product during the process.
7. Inappropriate processing	Any work done on the product which is not desired by the customer.

These are the most common forms of muda. Any lean system aims for searching these waste activiites, their causes and eliminating them so that process can be improved and efficicency of the system can be enhanced. Some other forms of waste [7] are also

*M.Tech. Scholar, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. anshulks@ gmail.com
**Assistant Professor, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. deepak.gupta@galaxyglobaledu.com
***Professor & Director, Galaxy Global Group of Institutions, Ambala. rajkumar@galaxyglobaledu.com

identified recently. These forms of waste are explained in Table 2. Elimination of muda is the function of lean manufacturing. It is possible by application of tools of lean manufacturing. Some key lean tools [8] are; 5S, Kaizen, Kanban, six sigma, just in time (JIT) production system, takt time, cellular manufacturing (CM), production leveling, work standardization, total productive maintenance (TPM), value stream mapping (VSM), poka-yoke, visual control, etc.

TABLE 2: Newly identified waste activities

Form of Waste	Explanation
1. Confusion	Any missing or misinformation hinders the smooth working of an organization.
2. Under utilized employee potential	A motivated and positive workforce is the backbone of a successful organization; not utilizing employee's potential is a waste.
3. Unsafe or unergonomic layout	Plant layout which causes fatigue to the worker and compromises their health, affects their morale and thus efficiency of the system.

METHODOLOGY

A systematic literature review is presented to understand the concept, need and principles of lean manufacturing and to determine the practical application of lean implementation in organizations. Literature review is focused on development of lean philosophy, lean manufacturing principles, tools and techniques and measure of leanness. Many researchers have worked on implementing lean manufacturing in organizations using various tools and techniques. These case studies are referred to identify the most effective lean tools, benefits of their implementation. Out of the variety of approaches and methods, we only review the best one here. Information presented here is collected from journals, conference papers, books and internet sources.

Development of Lean Manufacturing Philosophy

Lean manufacturing philosophy is mentioned in a book titled 'The Machine that Changed the World' by Womack et al. (1990). The authors [4] have explained various features of lean by performing studies in automobile sector. They can be summarized as follows:

- Lean is a dynamic process of change driven by a systematic set of principles and best practices aimed at continuous improvement of process and product.
- Lean includes the total enterprise, from the shop floor workers to the executives and managers room and from the supplier to the customer.
- Lean identifies every single waste activity, i.e., non value adding activity and tries to eliminate it.
- Lean is a complex thing; an organization cannot become lean by merely adopting or doing one thing.

The concepts like Just in time (JIT), Kanban, poka-yoke and involvement of workers to sort problems were innovated due to growing level of rivalry in Japanese organizations and paucity of resources (Shingo, 1981, 1989; Monden, 1994; Ohno, 1988).

Holweg [9] has conducted research work at International Motor Vehicle Program (IMVP) in 2006 at the Massachusetts Institute of Technology (MIT) and has presented all the historical accounts and research which led to the formation of most influencing manufacturing paradigm "lean Manufacturing". In this paper, the author has presented a brief history of Toyota Production System (TPS). The study concluded that lean manufacturing concept is not a single point invention but is an outcome of dynamic learning process according to different situations. The author has talked about the transfer of knowledge and various practices like JIT from Japan to Western countries during the time of oil crisis in early 1980s.

Principles of Lean Manufacturing

Dombrowski et al. [10] have talked about the importance of lean management and found that with focus on visible part on lean, i.e., waste management through tools like 5S, Quality circles, etc., improvements are seen on short term basis. For realizing gains and improvement on long term basis, proper and effective management and leadership are most necessary. With thorough literature survey, they provided five lean leadership principles which are improvement culture, self-

*M.Tech. Scholar, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. anshulks@ gmail.com
**Assistant Professor, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. deepak.gupta@galaxyglobaledu.com
***Professor & Director, Galaxy Global Group of Institutions, Ambala. rajkumar@galaxyglobaledu.com

development, qualification, gemba (shop floor management) and hoshin kanri (customer focus). Powell et al. [11] have defined a new set of lean principles for engineer-to-order (ETO) manufacturers. The aim of their study is to examine the evolution of lean principles for highly customized engineer-to-order products as customers demand for more variety products with shorter life cycles. They have given ten fundamental lean principles in context of engineer-to-order manufacturers which are; defining stakeholder value; leadership, people and learning; flexibility; modularization; continuous process flow; demand pull; stakeholder and systems integration; transparency; technology; and continuous improvement. The authors validated these set of principles through two case studies; first for ConXtech, USA, a construction company and second for Kongsberg's Maritime Subsea, Norway, which produces customized high tech products for under water navigation.

Need and Training for Lean Management and Implementation Tools

Rohac et al. [12] found that organizations must standardize their business processes, measure and analyze the performance, find out the anomalies and their root causes and finally must take steps to continuously improve the process. Value stream mapping (VSM) is used to draw the present situation of the organization and by removing the bottlenecks, hurdles and reducing the share of waste activities, future state map is drawn. By continuously improving the processes we can improve the organization performance and generate huge profits. Bhim Singh et al. [13] implemented lean to production industry. The authors highlighted the benefits from all the areas including; lead time, work in process (WIP), processing time, inventory and manpower that demonstrate the need for lean implementation in manufacturing organizations.Gadre et al (2011) [14] have tried to develop a virtual learning environment where students will be able to implement lean tools on simulated production line using latest technologies in a world of fast changing technologies. The students are required to follow a series of steps which are calculation of cycle time of a process, implementation of heijunka, implementation of SMED, calculating Kanban cards and finally calculating takt time. The study illustrates that proper learning and training of lean tools and techniques can be beneficial in successful implementation.Kreimeier et al. [15] have talked about the importance of holistic learning factories to teach and train academic students and industry participants about lean management, resource efficiency as well as management and organization improvement skills by creating a real world manufacturing environment. The main aim of learning factories is to convey the complex view of business processes and to impart methods and concepts which provide detection of improvement potential and implementation of most efficient processes.

Lean Manufacturing Tools and Techniques

Many researchers have worked to find the most effective tools for lean implementation. Sundal et al. [16] have described various methods for lean implementation within an organization. Various tools identified for lean implementation are VSM, cellular manufacturing (CM), line balancing, inventory control, pull type system, production leveling, etc., and found that most of the organizations focus on few key aspects of lean Manufacturing implementation like VSM, CM, etc. But for long term success, organizations need integration and simultaneous implementation of all the Lean elements with proper sequence. The study also included removal of the factors such as lack of planning, lack of direction, lack of sequencing for successful Lean implementation.Arungiri et al. [17] have found the high impact lean production tools in automobile industries using weighted average method for achieving optimum production by conducting survey in 91 automobile industries. Out of the thirty lean tools like Kaizen, VSM, pull type system, fishbone diagram, 5S, single minute exchange of dies (SMED), quality control, Just in Time (JIT), CM, line balancing, takt time, production leveling, poka-yoke, inventory control, work standardization and simplification, continuous flow and six sigma, they found five most effective lean tools. The most effective tools identified are; VSM, process mapping, set up time reduction,

*M.Tech. Scholar, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. anshulks@ gmail.com
**Assistant Professor, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. deepak.gupta@galaxyglobaledu.com
***Professor & Director, Galaxy Global Group of Institutions, Ambala. rajkumar@galaxyglobaledu.com

Kaizen and elimination of waste for price reduction and productivity improvement.Matt et al. [18] have discussed about the suitability of Lean implementation tools in small scale industries. They researched on the difficulties in implementation of Lean tools and finding out the critical success factors. These small and medium scale enterprises are of great economic importance, so the finding were used in productivity improvement by these industries. The methods for successful lean implementation as identified by them are 5S, FIFO, Kaizen, Kanban, JIT, VSM, zero defect, CM, automation, benchmarking and standardization.

Measure of Leanness in Organizations

Wahab et al. [19] have given a conceptual model of lean manufacturing dimensions. With thorough literature survey, they found that companies adopt certain set of tools and techniques to implement lean manufacturing in their production system which vary from company to company which results in varying leanness measures in order to measure lean practices. They identified seven most common dimensions used to measure leanness in an organization which are; manufacturing process and equipment; manufacturing planning and scheduling; visual information system; product development and technology; workforce management; supplier relationship; and customer relationship. They also described relation between these dimensions and the eight types of waste.Ali et al. [20] have done dynamic lean assessment for takt time implementation. They have presented a dynamic model to measure the degree of leanness in a manufacturing company by considering two scenarios in the industry; first considering the original cycle time as planned by production planner and another by considering the takt time and compared the leanness score for the two situations and presented the comparison in graphical manner. Leanness score consists of three things; overall equipment efficiency (OEE), overall service level and overall work in process efficiency.

Lean Implementation in Organizations

Case studies of lean implementation performed by researchers using various tools and methodologies have been referred for the review and the understanding of benefits of lean production system (LPS). The best of these studies are briefly presented here:Rahman et al. [21] have found that Kanban system is one of the manufacturing strategies besides other techniques like 5S, quality circles, continuous improvement, etc., for implementing lean production with minimum inventory and reduced cost. In this study, authors have performed a case study by implementing Kanban system which led to many benefits like minimized operational costs, wastes, scraps and losses; and controlled over production stocks with flexible work stations. The study also identified the factors that hinder Malaysian small and medium enterprises for implementing lean manufacturing through Kanban. The factors identified are; ineffective inventory management, lack of supplier participation, lack of quality improvement and quality control, lack of employee participation and top management commitment.

Anil S. Badiger et al. [22] performed a case study to determine the areas of improvement in equipment by implementing Kaizen and poka-yoke. The study intends for improving overall performance to enhance the productivity. Why-why method of root cause analysis is used to identify the causes. The OEE is increased from 49.9% to 74.68%. The improved OEE resulted in better utilization of resources, increase in availability, high quality products and also raised employee morale and confidence.

Intra et al. [23] have done thorough literature review and found that basic knowledge about lean production system (LPS) is given but particular methodology for its implementation on daily basis is not given in most of the cases. In this study, authors have talked about the transformation waves for powerful and holistic continuous improvement process (CIP) of a LPS in a case study done at MAN Truck & Bus AG. Transformation waves are employed for continuous improvement on the shop floor on daily basis.

Kumar et al. [24] have done a case study in an automobile company with aim to reduce cycle time of a truck body assembly by application of lean principles. Study was mainly focused on assembly line. Cycle time reduction was done in two stages; first by line balancing and then by applying lean

*M.Tech. Scholar, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. anshulks@ gmail.com
**Assistant Professor, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. deepak.gupta@galaxyglobaledu.com
***Professor & Director, Galaxy Global Group of Institutions, Ambala. rajkumar@galaxyglobaledu.com

principles like 5S, VSM, etc. This study helps to identify the waste activities and eliminate it step by step, thereby reducing the cycle time by proper line balancing. In their work, they have increased line efficiency from 17.5% to 30.09%.

Haefner et al. [25] have presented a combined model of classical value stream mapping and quality management to address the issue of quality improvement with cost and lead time reduction in an automotive industry to remain competitive in the market. In quality value stream mapping, in addition of chasing the product, quality defects, quality inspection and quality control loops are also considered. Basically quality is improved simultaneously with waste reduction.

Gracanih et al. [26] have pointed out that only lead time reduction is not sufficient but cost reduction is also imperative for an organization to excel. They have combined VSM which is most efficient tool for identifying non-value adding activities and eliminating them with value stream costing and cost time profile. Value stream costing tries to eliminate the unnecessary cost associated with the processes mapped during value stream mapping.

EVALUATION AND ANALYSIS

A comparison of presented case studies of lean implementation performed in manufacturing organizations in terms of methodology/ tool adopted for lean implementation and its consequences is provided in Table 3.

TABLE 3: Comparison of presented techniques for Lean implementation

Literature Reference	Methodology/Tool	Improvements/ Benefits
Rahman et al.	Kanban,Just-in-time (JIT)	Reduced operational costs, wastes, scraps and losses; controlled over production stocks with flexible work stations; factors that hinder lean implementation through Kanban system identified
Anil S. Badiger et al.	Kaizen, poka-yoke, why-why analysis	Increased overall equipment efficiency (OEE); better resource utilization; increased availability, improved quality; raised employee morale and confidence
Intra et al.	Transformation waves	Powerful and holistic continuous improvement process (CIP)
Kumar et al.	Line balancing, 5S, VSM	Reduced cycle time; workstations synchronization; increased line efficiency
Haefner et al.	VSM, quality management	Waste reduction, improved quality; cost and lead time reduction
Gracanih et al.	VSM, value stream costing, cost time profile	Lead time reduction; cost reduction

CONCLUSION

Throughout this paper, the authors have systematically studied the lean manufacturing system and tried to present an overview of the best methods out for lean implementation that have been deployed worldwide by organizations. Lean implementation intends for improvement of manufacturing processes that leads to overall production system development of a manufacturing organization. To contribute some effort to improve the manufacturing processes, authors have presented the study performed by the researchers over the years and summarized the most efficient lean elements adopted and targets achieved by their implementation. The study also presents a review on development and need of lean implementation along with the principles of lean manufacturing and measure of leanness in an organization. We believe this review will help in shaping the future research directions in the area of lean production system. This review will provide the required preliminary information to understand lean philosophy for its implementation to the industrial professionals. Further study is in progress to determine more methods of identifying waste activities/ muda, to eliminate them and to develop a powerful continuous improvement process.

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*M.Tech. Scholar, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. anshulks@ gmail.com
**Assistant Professor, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. deepak.gupta@galaxyglobaledu.com
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*M.Tech. Scholar, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. anshulks@ gmail.com
**Assistant Professor, Department of Mechanical Engineering, Galaxy Global Group of Institutions, Ambala. deepak.gupta@galaxyglobaledu.com
***Professor & Director, Galaxy Global Group of Institutions, Ambala. rajkumar@galaxyglobaledu.com

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

METHODS OF QUALITY CONTROL FOR PRODUCT RELIABILITY, MAINTAINABILITY AND SAFETY

***Parveen Kumar**

Abstract
This chapter reviews the present status and new trends in quality control for product reliability, maintainability and safety. In this competitive time we require advanced technology products in a range of conditions which may lead to their unintended performance in practical situations in the market. If we are achieving reliability, maintainability and safety then we consider different sources of incertitude and variations in design, manufacturing and operation of products. Moreover, in this paper concepts of quality function deployment, approach are study for quality control of products against to unsettled are proposed which helps to increase product reliability, maintainability and safety operations.
Keywords: Reliability, Failure mode and effect analysis, Fault tree analysis

I. INTRODUCTION

1.1 Reliability:- This is a measure of the capability of a machine to operate without breakdown under a specified environment.

According to NASA (National Aeronautics and space administration), reliability is defined to be the probability of a device performing a required function adequately for a period of time while working under a specified working condition.

Reliable means problem free and closely related to the unsettled factors. There are few factors which are listed below to determine the reliability factor

- Probability
- Adequate performance
- Specific duration
- Operating environment and condition

1.2 Maintainability:- This is defined as probability of a failed and breakdown equipment and a machine can be reinstate to a working condition when maintenance is taken into consideration and essential repair, maintenance work is carried out as per the procedure and schedule.

1.3 Safety:- Safety is referred to the relative protection from exposure to hazards. Safety can also refer to the control of acknowledge jeopardize in order to achieve an acceptable level of risk.

Customer gratification influence the success of a new product and only products at high value meet inevitably of clients who expect them to perform correctly in their whole life cycle. In order to execute such requirements the minimum of mutant of parameters should be assured within the manufacturing processes and the product itself. From primary part to combine parts, they must be designed and manufactured on high quality level and be reliable and safe in use. In the literature the notions: quality, reliability, maintainability and safety are often used interchangeable. Moreover, it is a fundamental property for safe operations as common methods are used for their analysis and it happens that they require input from each other [2]. In reliability analysis the subject matter is the incertitude in the failure occurrences, noises and disturbances during product operation, whereas the objective of safety is to protect the product against the incertitude of its accidental scenarios [1]. Both reliability and safety engineering aim at study, characterization, measurement, analysis of failure, its repair and consequences to be able to improve operational system use. They result from product complexity, development of technology, customer requirements, public awareness, market competition, safety and liability legal requirements, former system failures and their consequences [3]. So, the quality of the finished product depends on the quality of its component. This access is still undertaken in practice in spite of the fact that it is based on the consideration of huge calamity. It may lead to unnecessary; sometimes even excessive regulatory barriers, in the design and operation of the product [1]. Thus, in the last two decades of the previous century more and more aid has been paid to approaches which swear on statistical judgment of probability of manufacturing faulty product [4,5]. The effectiveness of these methods depends on the number and representativeness of data used for statistical analysis. Moreover, these approaches are not always able to detect all defective items, thus in order to overcome these problems it is advisable to apply control methods in which the manufactured attribute is compared with nominal product. These methods are originally based on expensive hardware redundancy but currently instead of the nominal product an analytical model is used and it reflects the behavior of the product

*Assistant Professor, Department of Mechanical Engineering, GGGI, Dinarpur, Ambala, Haryana , parveen.kumar716@gmail.com

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

[6]. In the paper some considerations of quality, reliability, maintainability and safety are shared as a number of problems must be faced in manufacturing and operation of products.

II. DESIGN FOR RELIABILITY

The objective is to design a given product which meets the target failure rate under the specified conditions. The following general Principals of design for reliability should be observed:

a) Element selection
b) De-rating
c) Redundancy
d) Environmental conditions
e) Diversity
f) Minimum complexity
g) Calculation of system reliability

2.1 Design Process

The realization of works is a complex process. To reduce the complexity, the project manager decomposes the job into two phases. A phase is a bundle of tasks that can be controlled in complexity, time, and costs.

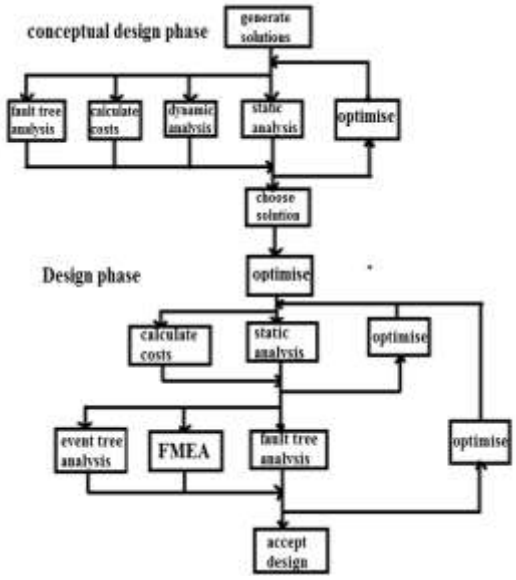

Fig. 2.1 Ideal Conceptual design and design process

The reliability analysis takes place at the end of the design process. The role of the analysis is to verify if the reliability of the equipment satisfies the demanded reliability. Therefore, the results of the analysis have little influence on the design. The reliability analysis would have a major influence on the design, if it were to be applied during the conceptual design. This would result in more reliable and less expensive manner. It is known that about eighty percent of the costs of a design are determined in the first twenty percent of the time. This means that eighty percent of the costs are determined in the conceptual design phase. Therefore, the price of a concept is a major issue in pre-design. However, the most affordable design usually is not the safest solution. Therefore, a designer should not make his decisions based on costs alone. Not only should a designer produce a cost-effective design, he should also make a reliable design. Reliability analysis gives a designer the possibility to make decisions based on more aspects than costs only, since it gives him the opportunity to optimize the reliability and cost. In conceptual design, the role of reliability analysis is to optimize the costs and the reliability. In Figure 2.1, the optimization is placed in the main iteration loop of the conceptual design process.

III. RELIABILITY ANALYSIS TECHNIQUE

3.1 Failure mode and effect analysis

A FMEA is often the first step of a system reliability study. It involves reviewing as many components, assemblies, and subsystems as possible to identify failure modes, and their causes and effects. For each component, the failure modes and their resulting effects on the rest of the system are recorded in a specific FMEA worksheet. There are numerous variations of such worksheets. A FMEA can be a qualitative analysis,[10] but may be put on a quantitative basis when mathematical failure rate models[11] are combined with a statistical failure mode ratio database.

A few different types of FMEA analyses exist, such as:

- Functional
- Design
- Process

Sometimes FMEA is extended to (failure mode, effects, and criticality analysis) to indicate that criticality analysis is performed too.

FMEA is an inductive reasoning single point of failure analysis and is a core task in reliability engineering, safety engineering and quality engineering. A successful FMEA activity helps identify potential failure modes based on experience with similar products and processes—or based on common physics of failure logic. It is widely used in development and manufacturing industries in various phases of the product life cycle. Effects analysis refers to studying the consequences of those failures on different system levels.

Functional analyses are needed as an input to determine correct failure modes, at all system levels, both for functional FMEA or Piece-Part FMEA. An FMEA is used to structure Mitigation

*Assistant Professor, Department of Mechanical Engineering, GGGI, Dinarpur, Ambala, Haryana , parveen.kumar716@gmail.com

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

for Risk reduction based on either failure effect severity reduction or based on lowering the probability of failure or both. The FMEA is in principle a full inductive analysis; however the failure probability can only be estimated or reduced by understanding the failure mechanism. Hence, FMEA may include information on causes of failure to reduce the possibility of occurrence by eliminating identified.

3.2 Fault Tree Analysis

Fault tree analysis (FTA) is a top-down, deductive failure analysis in which an undesired state of a system is analyzed using Boolean logic to combine a series of lower-level events. This analysis method is mainly used in the fields of safety engineering and reliability engineering to understand how systems can fail, to identify the best ways to reduce risk or to determine (or get a feeling for) event rates of a safety accident or a particular system level (functional) failure.

- Fault tree analysis can be used to:
- Understand the logic leading to the top event / undesired state.
- Show compliance with the (input) system safety / reliability requirements.
- prioritize the contributors leading to the top event- creating the critical equipment/parts/events lists for different importance measures
- Monitor and control the safety performance of the complex system.
- Minimize and optimize resources.
- Assist in designing a system. The FTA can be used as a design tool that helps to create requirements.
- Function as a diagnostic tool to identify and correct causes of the top event. It can help with the creation of diagnostic manuals / processes.

IV. QUALITY FUNCTION DEPLOYMENT

Quality function deployment (QFD) is a method developed in Japan beginning in 1966 to help transform the voice of the customer into engineering characteristics for a product. Yoji Akao, the original developer, described QFD as a "method to transform qualitative user demands into quantitative parameters, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts, and ultimately to specific elements of the manufacturing process."[8] . The house of quality, a part of QFD, identifies and classifies customer desires, identifies the importance of those desires, identifies engineering characteristics which may be relevant to those desires, correlates the two, allows for verification of those correlations, and then assigns objectives and priorities for the system requirements. This process can be applied at any system composition level (e.g. system, subsystem, or component) in the design of a product.

V. CONCLUSION

In engineering approach to new product design, manufacturing and operation it must be ensured that all mutation and incertitude affecting its performance are considered as far as practicably possible. In order to achieve it, it is advisable to apply reliability analysis techniques. These techniques allow for further evolution of quality control of products in the manufacturing and operation phase. Quality control techniques based on the parameters estimation can be applied for those products in which the one-dimensional relation between parameters and outputs can be found. In the case of more complex products the above approach cannot be applied and the application of output technique presented in the paper seems to be a promising solution.

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*Assistant Professor, Department of Mechanical Engineering, GGGI, Dinarpur, Ambala, Haryana , parveen.kumar716@gmail.com

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

EXPERIMENTAL INVESTIGATION AND OPTIMIZATION OF BURR HEIGHT AND MATERIAL REMOVAL RATE IN DRILLING OF CARBON STEEL USING GREY RELATIONAL ANALYSIS

***Er. Ravinder Kumar**

Abstract

The Research presented here the multi objective optimization of drilling parameters based on the Grey based Taguchi method for minimizing the burr height and Maximizing the material removal rate in drilling Carbon steel AISI 1060. A plan of experiments, based on L9 Taguchi design method, was performed drilling with cutting parameters in Carbon steel. The parameters namely cutting speed, feed rate and Drill diameter are varied at three levels to study their effect on Burr height and Material removal rate. Drill diameter was found to be the most significant factor affecting the Burr height and Material removal rate.

INTRODUCTION

A burr is a raised edge or small piece of material remaining attached to a work-piece after a machining process. It is usually an unwanted piece of material and is removed with a de burring tool in a process called 'de burring'. Burrs are most commonly created by machining operations, such as grinding, drilling, milling, engraving or turning. It may be present in the form of a fine wire on the edge of a freshly sharpened tool or as a raised portion of a surface; this type of burr is commonly formed when a hammer strikes a surface. De burring accounts for a significant portion of manufacturing costs.

The material removal rate(MRR) in drilling is the volume of material removed by the drill per unit time. For a drill with a diameter D, the cross-sectional area of the drilled hole is $\pi D^2/4$. The velocity of the drill perpendicular to the work-piece is the product of the feed F_r and the rotational speed N, where $N= V/ \pi D$. Thus,

$$MRR = (\pi D^2/4)* F_r$$

Carbon Steels containing carbon as the main alloying elements. They contain up to 0.4 % silicon and 1.2 % manganeses. Residual elements such as copper, molybdenum, aluminium, chromium and nickel may also be present in theses steels. In this study the work-piece material was AISI 1060 carbon steel.

Table1.1 Chemical composition of AISI 1060

Material	Fe%	C%	Mn%	P%	S%
AISI 1060	98.6	0.65	0.675	0.035	0.040

OBJECTIVES OF RESEARCH

- The aim is to identify the significant process parameters & optimizes the machining conditions in the presence of selected parameters to get minimum burr height and maximum material removal rate for AISI 1060.
- To develop a general regression equation for the Burr height and material removal rate.
- The optimal conditions of the Drilling parameters for multi-response characteristics like Burr height and Material removal rate using GRA.

EXPERIMENTAL WORK

Experiments were conducted on CNC Milling machine made by Maximart taiwan. A rectangular block of AISI 1060 carbon steel of dimensions 120*80*12 mm was used as work-piece.

Figure 1.1 CNC Milling Machine

The experiments were conducted as per L9 design matrix. Burr height was measured by using

* Assistant Professor, Department of Mechanical Engineering, GGGI, Dinarpur, Ambala, Haryana.er.ravinder.ambala@gmail.com

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

CMM(Co-ordinate measuring machine).

Table 1.2 Drilling Parameters and their levels

Sr. No.	Parameter	Unit	Levels 1	Levels 2	Levels 3
1.	Cutting Speed	rpm	650	850	1150
2.	Feed	mm/min.	0.013	0.015	0.017
3.	Drill Diameter	mm	8	10	12

Table 1.3 Experimental observations

Run	C.S(r.p.m.)	Feed rate mm/min.	Drill dia.(mm)	Burr height(mm)	(MRR) mm^3/min.
1	650	0.013	8	0.461	424.528
2	650	0.015	10	0.142	765.375
3	650	0.017	12	0.11	1249.092
4	850	0.013	10	0.557	867.425
5	850	0.015	12	0.219	1441.26
6	850	0.017	8	0.691	725.968
7	1150	0.013	12	0.262	1689.948
8	1150	0.015	8	0.883	866.64
9	1150	0.017	10	0.426	1534.675

GREY RELATIONAL ANALYSIS(GRA)

The GRA procedure is used to combine all the considered performance characteristics into a single value that can then be used as the single characteristic in optimization problems. The procedure of the grey-based Taguchi method is shown in Figure 1.2

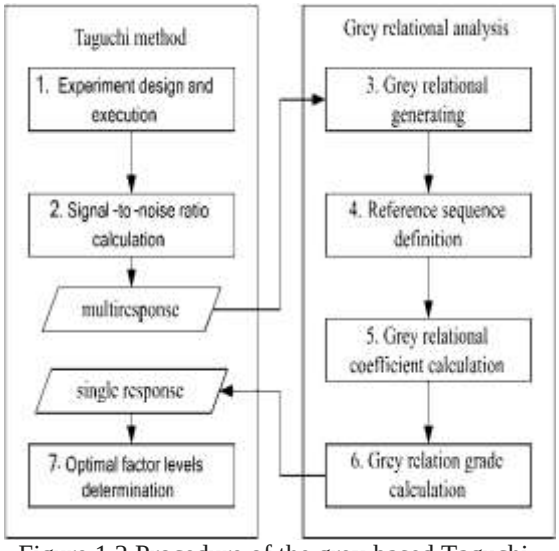

Figure 1.2 Procedure of the grey-based Taguchi method

GREY RELATIONAL GENERATING

There are three types of data normalization according to the requirement of lower the better(LB), higher the better and nominal the better. The desired quality characteristics for Burr height is LB and for MRR is HB, therefore the normalization for this responses was done by using the following equations, For larger is better

$$\frac{\text{Yij} - \min(Yij, i=1,2,3,\ldots,n)}{\max(Yij, i=1,2,3,\ldots,n) - \min(Yij, i=1,2,3,\ldots,n)} \quad \text{-------(i)}$$

And for lower is better criterion can be expressed as

$$\frac{\max(Yij, i=1,2,3,\ldots,n) - \text{Yij}}{\max(Yij, i=1,2,3,\ldots,n) - \min(Yij, i=1,2,3,\ldots,n)} \quad \text{----- (ii)}$$

Grey relational coefficient calculation

The grey relational coefficient is used to determine how close *xij* is to *x*0*j* . The larger the grey relational coefficient, the closer *xij* and *x*0*j* are. The grey relational coefficient can be calculated by

$$\square\ \square\ \square\ \text{k)}\ \frac{\Delta \min + \zeta \Delta max}{\Delta o + \zeta \Delta max}$$

ζ is the distinguishing coefficient, ζ=[0, 1]

Grey relation grade calculation

After calculating the entire grey relational coefficient *γ (x*0*j, xij)*, the grey relational grade can be calculated using

$$\Upsilon_i = \frac{1}{n}\sum_{k=1}^{n} \xi i(k)$$

Where Υ_i is grey relation grade for j^{th} experiment.

RESULTS & DISCUSSIONS

The normalized S/N ratio for Burr height and MRR in table 1.4 is calculated with the help of equations (i) and (ii) .

After calculating the S/N ratio the next step is to calculate the Deviation sequence. The deviation sequence is calculated by subtracting each value from 1 and is given in table 1.4.

After calculating the deviation sequence ,next step is to calculate the Grey relational coefficient by using the relation and is given in table 1.5.

$$\square\ \square\ \square\ \square\ \text{k)}\ \frac{\Delta \min + \zeta \Delta max}{\Delta o + \zeta \Delta max}$$

ζ is the distinguishing coefficient and its value is 0.5

Table 1.4 Normalized S/N ratio

Run	Cutting speed (r.p.m.)	Feed Rate (mm/min.)	Drill Dia. (mm)	Burr Height (mm)	M.R.R (mm^3/min.)
1	650	0.013	8	0.545	0
2	650	0.015	10	0.958	0.269
3	650	0.017	12	1	0.651
4	850	0.013	10	0.421	0.35
5	850	0.015	12	0.858	0.803
6	850	0.017	8	0.248	0.238
7	1150	0.013	12	0.803	1
8	1150	0.015	8	0	0.349
9	1150	0.017	10	0.591	0.877

* Assistant Professor, Department of Mechanical Engineering, GGGI, Dinarpur, Ambala, Haryana.er.ravinder.ambala@gmail.com

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

Table 1.4 Deviation sequence

Run	C.S.	Feed rate	Drill Dia.	Burr height	MRR
1	650	0.013	8	0.45407	1
2	650	0.015	10	0.041397	0.73064
3	650	0.017	12	0	0.34838
4	850	0.013	10	0.57826	0.65
5	850	0.015	12	0.14100	0.19652
6	850	0.017	8	0.75161	0.76178
7	1150	0.013	12	0.19663	0
8	1150	0.015	8	1	0.65062
9	1150	0.017	10	0.40879	0.12270

Table 1.5 Grey relational coefficient

Run	C.S	F.R.	Drill Dia.	Burr height	M.R.R.
1	650	0.013	8	0.524068	0.333333
2	650	0.015	10	0.923537	0.406291
3	650	0.017	12	1	0.589354
4	850	0.013	10	0.463707	0.434783
5	850	0.015	12	0.78002	0.717848
6	850	0.017	8	0.399483	0.396263
7	1150	0.013	12	0.717735	1
8	1150	0.015	8	0.333333	0.434548
9	1150	0.017	10	0.550178	0.802948

The last step is to calculate Grey relational grade, It is calculated by averaging the Grey relational coefficient corresponding to each performance characteristics, it is shown in table 1.6.

Table 1.6 Grey relational grade

Run	C.S	F.R	Drill dia.	Grey relational Grade	Rank
1	650	0.013	8	0.428701	7
2	650	0.015	10	0.664914	5
3	650	0.017	12	0.794677	2
4	850	0.013	10	0.449245	6
5	850	0.015	12	0.748934	3
6	850	0.017	8	0.397873	8
7	1150	0.013	12	0.858867	1
8	1150	0.015	8	0.383941	9
9	1150	0.017	10	0.676563	4

Table 1.6 shows the experimental results for Grey relational grade. The higher value of grey relational grade means that the corresponding parameter is closer to the optimal. From the table 1.6 it is clear that experimental run no. 7 is at 1st rank, means parametres at this levels will be closer to optimal.

Table 1.7: Response Table for Means of GRG(larger is better)

Level	Cutting speed	Feed rate	Drill Dia.
1	0.6294	0.5789	0.4035
2	0.5320	0.5993	0.5969
3	0.6398	0.6230	0.8008
Delta	0.1078	0.0441	0.3973
Rank	2	3	1

Table 1.7 shows that Drill diameter has highest delta and rank values, which indicates that Drill diameter has the highest effect on Burr height and material removal rate and is followed by Cutting speed and feed rate. So Drill diameter was found to be the most significant factor affecting the output responses. From Table 1.6 it is clear that Experiment run No. 7 has the optimal set of parameters for best multi response characteristics such as Burr height and material removal rate, hence cutting speed at level 3(1150 r.p.m.), feed rate at level 1(0.013mm/rev.) and drill diameter at level 3(12mm) will be the optimum parameter combination for minimum burr height and maximum MRR and the optimum values are as Burr height 0.262 mm and MRR 1689.948mm^3/min.

REGRESSION EQUATIONS FOR BURR HEIGHT AND MRR

The general regression equations for Burr height and MRR has been formed with the help of Minitab 17 software and are given below:

Burr height = 1.213 + 0.000536 Cutting speed - 4.4 feed - 0.1203 Drill dia.

MRR = -2544 + 1.107 Cutting speed + 43986 feed + 196.9 Drill dia.

CONCLUSIONS

The following important conclusions drawn from the present study are summarized below:

- .Drill diameter was found to be the most significant factor affecting the Burr height and Material removal rate
- General regression equations for Burr height and Material removal rate is developed.
- With Grey relational analyis ,optimal drilling parameters for minimum Burr height and Maximum Material removal rate are as follows:

* Assistant Professor, Department of Mechanical Engineering, GGGI, Dinarpur, Ambala, Haryana.er.ravinder.ambala@gmail.com

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

- Cutting speed-1150 r.p.m.
- Feed rate-0.013mm/min.
- Drill diameter-12mm

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* Assistant Professor, Department of Mechanical Engineering, GGGI, Dinarpur, Ambala, Haryana.er.ravinder.ambala@gmail.com

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

TEXTILE ECO LABELLING: AN ASSURANCE OF ENVIRONMENT FRIENDLY TEXTILE

[*]**Deepti Pargai**
[**]**MamtaGodara**
[***]**Anshul Sharma**

Abstract
The market of eco-friendly textile products has been increasing since last few decades as a result of various environment issues like global warming, climate change etc. The interest of global consumers towards the environment friendly products has also been increased. As an outcome of all these issues the concept of eco labelling emerged to differentiate the co-friendly products from other non-eco-friendly products in the market. These eco-labels not only provide the several benefits to manufactures by adding value to the products but also helps consumer to identify authentic eco-friendly product. This article gives the insight about the brief history, objectives, benefits and types of eco-labels. Procedure for the developments of eco-labels has also been discussed in brief. This would not only be beneficial from consumer's points of view, but also gives an insight to the researchers and manufacturers of textiles to apply this particular knowledge in respective fields, that can directly or indirectly leads to environmental sustainability.
Keywords: Ecolabelling, eco-friendly, environmental sustainability, textiles

1. Introduction

With the advent of industrialisation the production process of different types of products becomes easier and faster but it adversely affects the environment. Textile industry is a one of the major polluter. Various kind of environmental pollutions are being caused by this industry, specially the water pollution. In this era of global warming and climate change the concern towards the environment is on its peak, various regulations are being implemented on different countriesby the various environment protection authorities of the world. Consumers are also becoming increasingly concerned with the adverse impacts of industrial pollution on the environment and their health, resulting mounting pressure on textile, fashion industry to adopt more eco-friendly, chemicals and manufacturing processes [1]. Hence in order to combat these problems many eco-friendly techniques havenot only been adopted manufacturer and researcher. The labelling of these eco-friendly products is also required from consumer point of view;hence the eco

labelling concept has been emerged. Ecolabelling referred to as a consumer information tool as it gives an idea to the consumer about the environmental friendliness of products. According to International Organization for Standardization (ISO), the overall goal of these labels and declarations is communication of verifiable and accurate information, that is not misleading, on environmental aspects of products and services, to encourage the demand for and supply of those products and services that cause less stress on the environment, thereby stimulating the potential for market-driven continuous environmental improvement. Generally, these labels are voluntary in nature and the objectivity of the ecolabelling scheme is usually guaranteed by a large participation of stakeholders in the definition of the environmental criteria. The stakeholders such as representatives of industry, government, retailers, consumer and environmental associations are usually involved[2].

India is not only one of the largest textile producing countries in the world. The textiles and clothing sector is the second largest provider of employment after agriculture in India. However, the prevailing standards of production in the domestic textiles and clothing industry to some extent are inherently unsustainable in comparison to other competing sectors within the country[3]. The each stage of textiles production is associated with a negative environmental impact, because of the use of many

*Assistant Professor, Galaxy Global Group of Institution, Ambala, pargai.deepti16@gmail.com
**Research Scholar, Punjab Agricultural University, Ludhiana
***Assistant Professor, Galaxy Global Group of Institution, Ambala

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

litres of water, chemicals, energy and generation of wastes at each stage. The major part of textile industry in India is decentralised which result in geographical dispersal of pollution and in difficulties in monitoring and standardization. There is definitely a need for a holistic, cradle-to-grave, life-cycle approach that enables adoption of sustainable methods of production and processes. In India eco-labelling has been existing since 25 years but still both the producers and the consumers are neither aware about its existence nor willing to go for this label. Hence there is need to create awareness towards the environmental sustainability and eco-labelling that could drive the market demand and hence the manufacturer will have to shift towards the environmental friendly processes in manufacturing of textiles goods, which further leads to the environmental sustainability. This article gives an insight towards the aims, benefits, types and the developmental procedure of the eco-labels

2. Brief History of Eco-Labels

The concept of Eco labelling is not very new. With the growth of industrialisation the need for environmental conservation was increasing in nineties, with this need the manufacture of different products inclined towards the eco-friendly production. But the differentiation of these eco-friendly products from the other products was also necessary hence theconcept of ecolabelling also arose. Both in Europe and North America environmental concerns arose in the 1970's and 1980's to a prominence in public discourse never before known. "Green consumerism" was born. Claims such as "eco-friendly," "environmentally safe," "recyclable," "biodegradable," "ozone friendly," "safe in a landfill," had bombarded consumers (West). Differentiating fact from fiction and meaningful from irrelevant became difficult and so the idea of third party certification via eco-labels was born [4].

There is variation in history and evolution of eco-labels and certification. In some sectors like in textiles and apparel, personal health and safety have been the primary forces behind certification efforts whereas other sectors like forestry prioritized broader environmental or social considerations. Sectors also vary based on the maturity of the leading systems used to certify products, the relative roles of different sponsoring organizations, the level of consumer awareness, global application, and a variety of other factors. The push for environmental safety in textile production was rooted primarily in Europe, and began roughly in 1992 when the European Economic Council adopted Council Regulation No. 880/92 establishing a Community Eco-Label award scheme. Textiles were one of the first product groups for which Eco-Label criteria were established. Criteria were mainly targeted at concerns regarding environmental pollution and human health and safety. The criteria established therefore related to toxicological and environmental considerations in the production of textiles, covering such products as textile clothing and accessories, home textiles, yarns, fibres, and fabrics. This and subsequent ecolabelling schemes for textiles required multiple production standards for maximum allowable heavy metal residues in dyes used in eco-textiles, as well as use of other inputs including pesticides, allergens, and biologically active compounds. The movement for improved working conditions and wages in textile and apparel production became strongest in the 1990s. Majority of new organizations formed to address labour conditions in textile factories were formed in the mid-1990s [5].

India is also not new to the ecolabelling topic as in 1991, its own ecolabelling scheme called "Ecomark", for easy identification of environment friendly products was launched.This scheme covers a broader range of environmental friendly products. In 1996 under the ecomark scheme, the ecomark criterion for textiles was also amended that targets specifically the textile industry[6].

3. Objectives of Eco Labelling

i. Protecting the environment
ii. Encouraging environmentally sound innovation and leadership
iii. Building consumer awareness of environmental issues [7].

Eco-labelling can accomplish several goals which not only cover the environment but the consumer and manufacturer also.

1. Improving sales or image of a labelled product

*Assistant Professor, Galaxy Global Group of Institution, Ambala, pargai.deepti16@gmail.com
**Research Scholar, Punjab Agricultural University, Ludhiana
***Assistant Professor, Galaxy Global Group of Institution, Ambala

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

2. Stimulating consumer awareness about environmental impact of products
3. Directing manufactures for the environmental impact of their products; and Ultimately improving the quality of the environment and encouraging the sustainable management of resource

The overall goal of eco-labelling is to encourage the demand for and supply of those products and services that cause less stress on the environment, thereby stimulating the potential for market-driven continuous environmental improvement[8].

4. Benefits of Eco Labelling

Eco-labelling has a number of major benefits:

i. Informing consumer choice

Eco-labelling is an effective way of informing customers about the environmental impacts of selected products, and the choices they can make. It empowers people to discriminate between products that are harmful to the environment and those more compatible with environmental objectives. An eco-label makes the customer more aware of the benefits of certain products, for example, recycled paper or toxic-free cleaning agents. It also promotes energy efficiency, waste minimization and product stewardship.

ii. Promoting economic efficiency

Eco-labelling is generally cheaper than regulatory controls. By empowering customers and manufacturers to make environmentally supportive decisions, the need for regulation is kept to a minimum. This is beneficial to both government and industry.

iii. Stimulating market development

When customers choose eco-labelled products, they have a direct impact on supply and demand in the marketplace. This is a signal which guides the market towards greater environmental awareness.

iv. Encouraging continuous improvement

A dynamic market for eco-labelled products encourages a corporate commitment to continuous environmental improvement. Customers can expect to see the environmental impacts of products decline over time.

v. Promoting certification

An environmental certification program is a seal of approval which shows that a product meets a certain eco-label standard. It provides customers with visible evidence of the product's desirability from an environmental perspective. Certification therefore has an educational role for customers, and promotes competition among manufacturers. Since certified products have a prominent logo to help inform customer choices, the product stands out more readily on store shelves. Coveting the logo may induce manufacturers to re-engineer products so that they are less harmful to the environment.

vi. Assisting in monitoring

Another benefit of an official eco-labelling program is that environmental claims can be more easily monitored. Competitors and customers are in a better position to judge the validity of a claim, and will have an incentive to do so should a claim appear dubious[9].

5. Types of Eco labels

There are different approaches to categories the eco labels [10]. These approaches are following –

According to the International Organization for Standardization (ISO)

- ISO has published following standards under environmental labels and declarations
- ISO 14020: 1998 –This standard comprises the general principles
- ISO 14021:1999 –This standard of ISO includes the self-declared Environmental Claims which is known as Type II Environmental labelling.
- ISO 14024: 1999 - This standard of ISO includes Type I Environmental Labelling which describes the principles and procedures for environmental labelling.
- ISO/TR 14025:2000 –This is known as Type III Environmental declarations.

Type 1 Eco-labels (ISO 14024: 1999)

This first type of ecolabelling includes a voluntary, multiple-criteria based. Under this a third party other than the manufacturer who have rights toawards a license to the manufacturer for using of environmental labels on products. This indicates overall environmental preferability of a product within a particular product category based on life cycle considerations

Type 2 Eco-labels (ISO 14021:1999)

These types of eco-labels are informative in nature and generally based on the self declarationby the manufacturers their self.

Type-3 Eco-labels (ISO 14025: 1999)

*Assistant Professor, Galaxy Global Group of Institution, Ambala, pargai.deepti16@gmail.com
**Research Scholar, Punjab Agricultural University, Ludhiana
***Assistant Professor, Galaxy Global Group of Institution, Ambala

GGGI Journal of Engineering & Technology
ISSN 2278-1226
An Annual Research Journal

This type ecolabels comes under a voluntary programs that provide quantified environmental data of a product, under pre-set categories of parameters set by a qualified third party and based on life cycle assessment, and verified by that or another qualified third party(ISO, 2012).

I. According to overall or specific production process of a product.

There are essentially two types of eco-labels.

1. Life cycle / cradle to grave approach: Thefirst focuses on the overall environmental impact of a product, often employing a life cycle or"cradle to grave" type analysis (LCA). This roughly corresponds to a Type I label as defined by ISO 14024. LCA should play an important role in address ecological impacts with respect to extraction of resources, manufacturing, distribution, use,recovery, and disposal.
2. Single issue approach:The second type of eco-label is a single-issue label granted by a third party certificationagency that refers to a specific environmental or sometimes ethical characteristic of a product,e.g., certified organic cotton, dolphin safe tuna fishing, or sustainable forestry(Nimon and Beghin, 1999).

II. Other types of eco-labelling are:

Industry labelling

This type of labelling is specific to anindustry for example forest exploitation, agriculture,textiles.

Corporate labelling

Corporate labelling is used by organisations manufacturing or selling products. However, it must be remembered that the meeting of some specific environmental requirements by the organisation may not be related to its product's compliance with other environmental criteria

Package labelling

This type of labelling gives about the eco-friendly nature of packaging material instead of the material inside [**11].**

6. Process of Eco-Labels Development

Examination of the various schemes reveals that a similar procedure is used for the development of the different eco-labels. The transparency and consultation processes follow the same general pattern with certain variations. Eco-labelling programmes all have mechanisms for transparency, ranging from publication of information to active dissemination to interested parties, to simply establishing inquiry points; and they have similar consultation processes. Once product groups have been selected by the decision-making body, representatives of various interest groups generally participate in the expert group responsible for the development of the eco-label criteria. The draft criteria are then available for public review before the final criteria are adopted by the decision-making body. Lack of consideration given to comments provided on the draft criteria has been a source of criticism. Furthermore, decision-making on the final eco-label criteria is generally not open to outside participation. While no examples of overt discrimination have been found in the course of this study, for practical reasons, access to information and participation in criteria development will be more difficult for foreign producers without a domestic presence. The need for an international notification system centralising information on all eco-labelling programmes has been suggested, by those running eco-labelling programmes, as a way to minimise these problems [12].

7. Global scenario for Ecolabelling

The importance of Eco labelling is being realised all over world. At least, 15 countries including India have launched the eco labelling schemes that are either sponsored by the governments or by the voluntary organisations that receive technical and financial support from their government. Government sponsored schemes are Blue Angel of Germany, Eco Mark of Japan, Environmental Choice of Canada, White Swan of Nordic Countries, Eco-Mark of India, Green Label of Singapore. While private labelling schemes areeco-tex, Oeko-Tex (textiles and clothing) of Germany, Green Seal of United States, Bra Miljval of Sweden, Britta Steilmann Collection of Germany etc.**[13]**. A survey of the textile and apparel labels presented on Ecolabelling.org show that most of the certifications presented are not textile-specific, only 16 of the 38. Textiles are often grouped under broad-ranging ecolabels, which cover products as varied as building supplies, agricultural goods, and all consumer goods. Environmental issues addressed across this category include organic production, energy usage, pollution, and biodiversity conservation. Social issues addressed

*Assistant Professor, Galaxy Global Group of Institution, Ambala, pargai.deepti16@gmail.com
**Research Scholar, Punjab Agricultural University, Ludhiana
***Assistant Professor, Galaxy Global Group of Institution, Ambala

GGGI Journal of Engineering & Technology
ISSN 2278-1226
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across this category include labor practices, worker health and safety, consumer health and safety, economic development and animal treatment [14]. Some most popular eco-labels attached to textile and clothing products are fairtrade, rugmark/goodweave, Global Organic Textiles Standards (GOTS), care and siegel, fair trade organisation mark, EFTA, clean clothes campaign, fair wear foundation [15].

8. **Indian scenarion for ecolabeling**

Eco Mark (India)

Eco-Mark is an eco-labelling scheme which was constituted by the Government of India in 1991 for easy identification of environment-friendly products.The Eco-Mark logo is that of an earthen pot as indicated in the Figure 1 [**16].**

Figure1: Eco-Mark Scheme of India Logo

The specific objectives of the scheme are as follow:

1. To provide an incentive for manufacturers and importers to reduce adverse environmental impact of products.
2. To reward genuine initiatives by companies to reduce adverse environmental impact of their products.
3. To assist consumers to become environmentally responsible in their daily lives by providing information to take account of environmental factors in their purchase decisions.
4. To encourage citizens to purchase products which have less harmful environmental impacts
5. Ultimately to improve the quality of the environment and to encourage the sustainable management of resources [17].

Eco-mark Criteria for Textiles

Eco Mark Criteria for Textiles-1996 (Under Eco Mark Scheme-1991)

This scheme has mentioned that all the textile products manufactured shall meet relevant standards of Bureau of Indian Standards. The product manufacturer must produce the consent clearance as per the provisions of Water (Prevention and Control of Pollution) Act 1974 and Air (Prevention and Control of Pollution) Act 1981, Water (Prevention and Control of Pollution) Cess Act, 1977 respectively, along with the authorisation, if required under Environment (Protection) Act, 1986 and the rules made there under to BIS while applying for Ecomark. Besides this there is also provision to produce documentary evidence by the manufacturers on compliance of the provisions related to noise level and occupational health under the provisions of Factories Act, 1948 and Rules made there under. The product packaging may display in brief the criteria based on which the product has been labelled environment friendly. The material used for product packaging shall be reusable or made from recyclable or biodegradable materials. Fatty alcohol based non-ionics as emulsifier should be sued wherever required. Poly halogenated based phenolic fire retardants shall not be used.

Specific requirement for different fabric have been categorised into 3 groups the first category includes the cotton, wool, man-made fibre & blends, second category includes jute and jute productsand the third category includes the silk and silk products. There are several parameters for each category like Free & ReleasableFormaldehyde, Extractable artificialsweat/salvia Heavy MetalsMercury, chromium, lead, PCP etc. The maximum limits for these parameters are given in mg/kg (ppm). The maximum limit is given for baby clothing, close to skin clothing and for the outer clothing in case of into cotton, wool, silk and man-made fibre & blends. While for the jute and jute products the maximum limit has beencategorised intoHome Textiles & Clothing as well as for Hessians & Sackings.

CONCLUSION

Eco labelling along with other forms of environmental labelling, standards, reporting, declaration and other forms of green or ethical claims allow selecting products and services according to specific environmental and social criteria. They often refer to as consumer information tools. Hence the proper use of these eco labels is important for the sustainable

*Assistant Professor, Galaxy Global Group of Institution, Ambala, pargai.deepti16@gmail.com
**Research Scholar, Punjab Agricultural University, Ludhiana
***Assistant Professor, Galaxy Global Group of Institution, Ambala

environment by creating awareness among consumers.

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*Assistant Professor, Galaxy Global Group of Institution, Ambala, pargai.deepti16@gmail.com
**Research Scholar, Punjab Agricultural University, Ludhiana
***Assistant Professor, Galaxy Global Group of Institution, Ambala

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Affiliation: … .. …
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… ...... … … … … … … ....

Author-II

Name: … ...... … … Designation:... … … … … … … … …
Mobile Number (s):... … … … … … … … … … … … … … … … E-mail Address(s): … … … … … … … … … … … … … … … … … … …
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Mailing Address: …
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Author-III

Name: … ...... … … Designation:... … … … … … … … …
Mobile Number (s):... … … … … … … … … … … … … … … … E-mail Address(s): … … … … … … … … … … … … … … … … … … …
Affiliation: … .. …
Mailing Address: …
… ...... … … … … … … ....

Signature of the Corresponding Authors(s)

Author I	Author II	Author III
… … … … … … … … … … … … …	… … … … … … … … … … … … …	… … … … … … … … … … … … …

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