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Optimization of Surface Roughness of EN24T Steel Using Genetic Algorithm in Turning Operation

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***Abstract*—Surface Roughness is the key response character in the quality of a machining process. It is the deviation of the real surface from the ideal form. Turning is the operation selected for the experiment. The objective of the experimentation work is to optimize the Surface Roughness using Genetic Algorithm and analyze the percentage of variation of the experimental result from the theoretical value. Java is the language used to write the program. EN24T is the material and Carbide Insert is the tool selected for the experiment. After the validation process it is observed that Genetic Algorithm can be used with 17.10 percentage of error for the turning of any of the material.**

Keywords - EN24T, Surface Roughness, Genetic Algorithm, Percentage of error,Carbide insert

I. INTRODUCTION

In the present scenario subtractive production process plays key role in the manufacturing process. The main consideration is customer satisfaction. Customer satisfaction mainly concerned with the performance of the product and quality. All the industries have the same goal, to improve the quality of the product. While considering the machining process it deals with both surface roughness and material removal rate. Surface roughness plays an important role in the quality and material removal rate deals with the productivity. Many subtractive production processes are there, turning, milling, boring, etc. Here it aims to optimize the surface roughness in turning operation of EN24T steel.

Turning is a subtractive production process which is widely used among the various machining process. EN24T steel is a low alloy medium carbon steel and which find many of the applications in the manufacturing industries of automobile and machine tool parts. The main parameters which are considering in this experiment are speed, feed, depth of cut and also the tool geometry consideration of tool nose radius.

II. LITERATURE SURVEY

Many of the researchers have done some of the experiments on the related topics and some of them are given below.

Rajurkar KP in the paper "*Optimization of cutting process by GA approach*" The paper proposes a new optimization technique based on genetic algorithms (GA) for the determination of the cutting parameters in machining operations. In metal cutting processes, cutting conditions have an influence on reducing the production cost and time and deciding the quality of a final product. This paper presents a new methodology for continual improvement of cutting conditions with GA [7].

M Adinarayana in the paper "*Optimization of surface roughness, MRR and Power consumption*" explains the determination of optimal cutting parameters is one of the most important elements in any process planning of metal parts. The evolutionary algorithm Genetic Algorithm (GA) is used to improve many solutions of optimization complex problems in many applications. The present paper reviewed the ideal selection of cutting parameters in turning operation of EN24 work material using PVD coated tool using GA and its variants. This study deals with GA algorithm in different machining aspects in turning operation like surface roughness, material removal rate, and power consumption [1].

Adnan Jameel in his paper, *Using Genetic Algorithm to Optimize Machining parameters in Turning Operation* have significant importance for economic machining in minimizing of particular operating mistakes like tool fraction, wear, and chatter. The evolutionary algorithm GA is used to improve many solutions of optimization complex problems in many applications. This paper reviewed the ideal selection of cutting parameters in turning operation using GA and its variants. This study deals with GA algorithm in different machining aspects in turning operation like surface roughness, production rate , tool life, production cost, machining time and cutting temperature [3].

T. Srikanth and Dr V. kamala in their paper *A Real Coded Genetic Algorithm for Optimization of Cutting Parameters in Turning* and the findings are in constrained optimization problem like turning process, RCGA approach is necessary to get the optimum solutions faster. With the known boundaries of surface roughness and machining conditions, machining could be performed with a relatively high rate of success, with selected machining conditions. Integration of the proposed approach with an intelligent manufacturing system will lead to reduction in production cost, reduction in production time, flexibility in machining parameter selection and overall improvement of the product quality [16].

Saad Kariem Shather in his paper *Studying The Effect of Tool Nose Radius on Work piece Run Out and Surface Finish* found that Tool geometry is one of an important parameters which play important role in surface roughness and dimensional accuracy of work piece during mechanical

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machining by using a suitable tool nose radius then the conclusion of this study was Increasing nose radius refers to increase surface roughness but not less than 0.4 [17].

III. METHODOLOGY

Methodology is a system followed in defined area of study or process. This is a process of experimentation including analytical calculation and validation. The various steps that could followed in this process are follows,

Analytical process

1. Selection of the process, turning was selected for the optimization process.
2. Selection of the work material, EN24T steel was selected as the material for the process.
3. Selection of the Cutting Tool, coated carbide was the cutting tool selected for the operation.
4. Operating parameters selected for the process were speed, feed, depth of cut and the geometric parameter tool nose radius.
5. Optimization technique used for the operation was Genetic Algorithm, in which Java is used for coding.
6. Geometry selection of the cutting tool.

Validation Process

1. For experimental process LMW Smart Jr. lathe was selected for doing the turning operation.
2. Surface roughness was measured by using Surftest SJ 401, manufacturing Mitutoyo.
3. Comparison of the experimental result with theoretical value.

A. *Material Selection*

EN24T steel is selected for the operation as it has as an excellent machinability in T condition. It is used to make all metal cutting tools cold working as well as hot working. It is also used to make cold extrusion rams, dies punches etc. In Table I it describes the mechanical properties of the material

TABLE I Mechanical Properties of EN24 at T Condition

Hardness	24.2-32.1 HRC
Tensile Strength	850-1000 N/mm^2
Yield Strength	650 N/mm^2
% Elongation	13 %

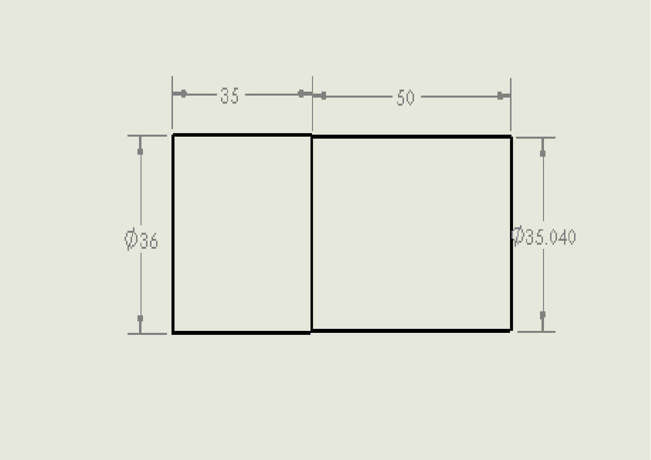

Fig 1 Design of work piece

B. *Cutting Tool Selection*

Cutting tool is the tool which removes the material from the work piece in the form of chips by shear deformation. Different cutting tools are opted for different machining operations. Carbide inserts are selected for the operation and they are of two types, coated and uncoated. By using powder metallurgy tungsten carbide particles are bonded together in a cobalt matrix.

C. *Selection of Operating Parameters*

Speed, feed, depth of cut are the operating parameters and nose radius is the geometric parameter considered for the experimentation. The parameters selected are shown in table II.

Speed refers to the speed of the spindle and work piece. Spindle speed in rpm. And it also refers in cutting speed which is in meters per minute.

Feed refers to the cutting tool and it is the movement of the cutting tool over the surface of the rotating work piece linearly and it is represented in millimeter per revolution.

Depth of cut is the distance moved by the tool in a direction perpendicular to the axis of rotation between the uncut surface and the cut surface or the thickness of the material removed. It is represented in millimeter.

Tool nose radius is the important geometry of the cutting insert. It is an important factor because it affects chip control, surface finish, magnitude of the cutting force and residual stresses. Nose profile deviation is the radial deviation of the actual profile of the nose from the ideal profile.

In the process took a range of operating parameters like speed in between 220 – 310 m/min, depth of cut 0.6 – 1.2 mm and nose radius in the range 0.8 – 1.6 mm

TABLE II Operating parameters

Speed (m/min)	220 – 310				
Feed (mm/rev)	.1	.15	.2	.25	.3
Depth of cut (mm)	0.6 – 1.2				
Nose Radius (mm)	0.8 – 1.6				

D. Optimization

It is the process of finding the best suitable result with the highest achievable performance under some constraints by maximizing desired factors and minimizing undesired one. Optimization process includes both maximization and minimization. Here it is a minimization process, or minimizing the Surface Roughness. There is many of the optimization techniques, some of them are Taguchi method, Regression analysis, Bee colony optimization, Response Surface Methodology, Ant Colony Optimization, Artificial Neural Network, Fuzzy Logic Optimization and Genetic Algorithm. However Genetic Algorithm was selected for the Optimization process.

1 .Genetic Algorithm

Genetic algorithm is a biological approach in which all the process creates a biological standard. It was first introduced in 1962. For solving optimization problems Genetic algorithm is the robust and adaptive method successfully used. The data included in GA are represented by an array of strings with finite length are known as chromosome where each bit is called allele or gene. The collection of the chromosomes is called a population. The population at certain point of time is called generation. The flow of the process is explained in the figure 2 as follows [1].

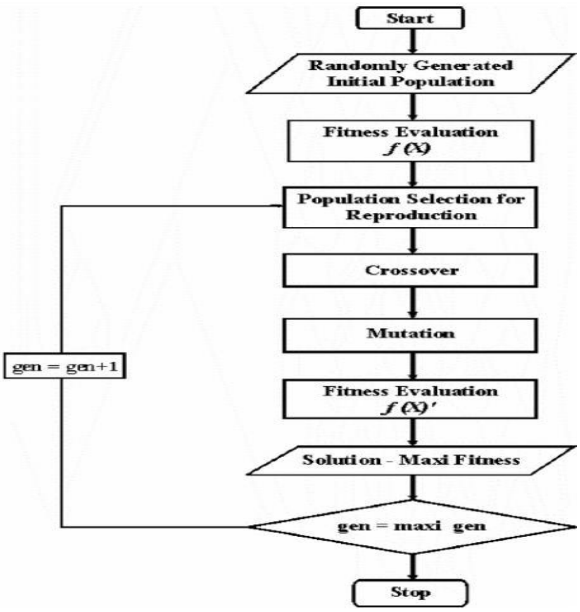

Fig 2 Standard procedure of GA

Initialization

There are two primary methods for initializing a population in Genetic Algorithm. They are Random initialization and Heuristic initialization. Random initialization is the process in which create the population with random solutions. Heuristic initialization is the process in which it creates the population using a known heuristic for the problem.

This investigation is a Heuristic initialization based program. The initialization program is described in the Figure 3 and the generated population is tabulated in the Table III.

```
/*
 * To change this template, choose Tools | Templates
 * and open the template in the editor.
 */
package genetic;

import java.util.Random;
import javax.sound.midi.Sequence;

/**
 *
 * @author my
 */
public class sequence {
    public static int SequenceLength;
    public double[] fvalue={.1,.15,.2,.25,.3};
    public ParameterValue[] vals;
    public double[][] range={{.6,1.2},{.8,1.6},{220,310}};
    public double Rank;
    public sequence()
    {
```

Fig 3 Program initialization

The generated populaation is as follows,

TABLE III Initial popualtion

.1	.15	.2	.25	.3	Rank
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67	3.773752776060386 6
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67	3.77672438395870 7
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.17 , 0.9 , 308.02 , 5.72	3.78229948200387 3
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.0 , 0.84 , 288.14 , 5.74	3.789177425608117 7

Evaluation of the Fitness Function

The fitness function is defined as it is a function which takes a definite solution to the problem as input and produces as output how good the solution is with respect to the problem in given constrains.

The fitness function used to calculate the surface roughness is as follows [3]

$$R_a = \frac{1.0632.f^{1.0198}.d^{0.0119}.H^{0.5234}.r^{0.1388}}{V^{0.229}}$$

Where R_a is the surface roughness in microns , f is the feed rate in mm/rev, d is the depth of cut in mm, H is the hardness in BHN, r is the nose radius in mm, V is the cutting speed in m/min.

In the constructed optimization problem, four decision variables are considered. They are cutting speed (v), feed (f), depth of cut (d) and tool nose radius (r). They are the cutting parameters of the process.

The objective function is Min *Ra* (*v*, *f*, *d*, *r*).

The fitness function program is represented in the figure 4.

```
        return ""+(v/100.0);
    }
    public String ToString()
    {
        return (((int)(d*100))/100.0)+" , "+(((int)(r*100))/100.0)+" , "+(((int)(v*100))/100.0)+" , "+(((:
    }
    public ParameterValue(double[][] range)
    {
        Random ra=new Random();
        d=range[0][0]+ra.nextDouble()*(range[0][1]-range[0][0]);
         r=range[1][0]+ra.nextDouble()*(range[1][1]-range[1][0]);
          v=range[2][0]+ra.nextDouble()*(range[2][1]-range[2][0]);
    }
    public double GetRank(double f)
    {
        double v1=1.0632*Math.pow(f, 1.0198)*Math.pow(d, 0.0119)*Math.pow(H,.5234)*Math.pow(r,0.1388);
        v1=v1/(Math.pow(v, 0.229));
        Ra=v1;
        return v1;
    }
    public String ToString(double f)
    {
```

Fig 4 Evaluation of Fitness Function

Selection

Parent Selection is the process in which selecting the parents which mate and recombine to produce the off-springs for the next generation.

Various types of selection techniques are evolved in genetic algorithm.

- Fitness Proportion Selection
- Roulette Wheel Selection
- Stochastic Universal Sampling
- Tournament Selection
- Rank Selection
- Random Selection

Random selection is adopted to do the experimentation. Random selection is the selection in which randomly select parents from the existing initialized population. The program of Initialization, Selection, Crossover, Mutation and the Best is shown in the Figure 5.

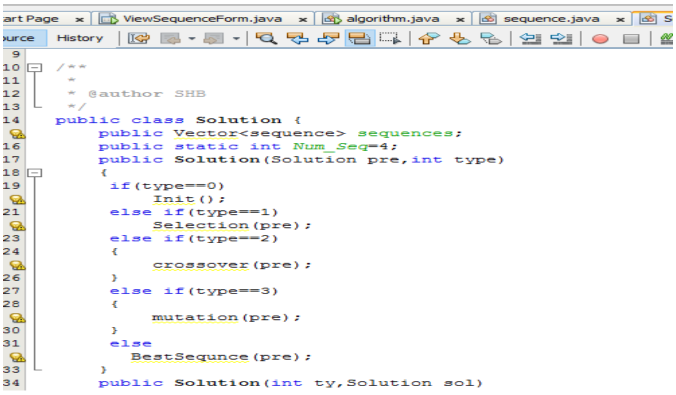

Fig 5 Program Initialization, Selection, Crossover, Mutation and the Best

In the program Algorithm is the platform used to run the Genetic Algorithm. Select the tab for Algorithm and rebuild the program to refresh the system and select the run program to get the result. The Algorithm is as shown in the Figure 6

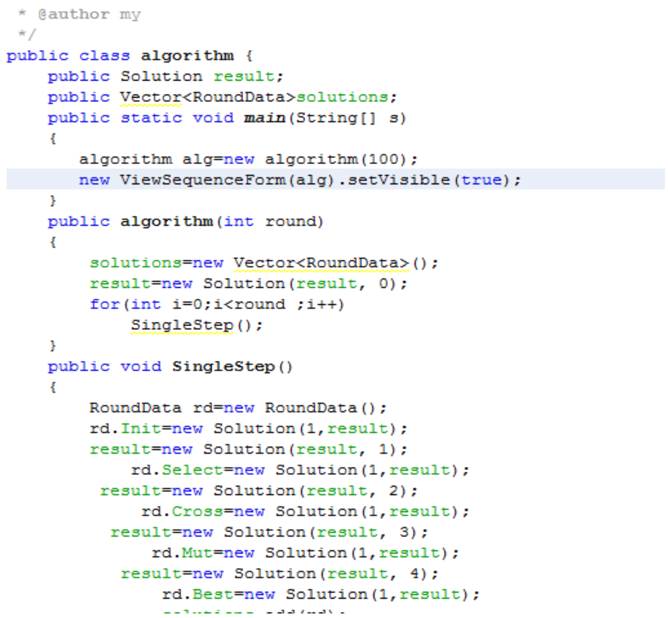

Fig 6 Algorithm

The population generated after selection is as follows in the Table IV. First four individuals in the initialization remains the same and the next one is selected among the two rows selected from the top four and the population generated after selection contains eight rows.

TABLE IV Population Generated after Selection

.1	.15	.2	.25	.3
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.17 , 0.9 , 308.02 , 5.72
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.0 , 0.84 , 288.14 , 5.74
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.0 , 0.84 , 288.14 , 5.74
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67

Crossover

The crossover operator is similar to reproduction and biological crossover. In this more than one parent is selected and one or more off-springs are produced using the genetic character of the parents that are selected in the experimentation.

The various techniques available in the crossover are

- Single point crossover
- Multipoint crossover
- Uniform crossover

Single point crossover is selected here for the crossover process. In this single point technique the tail of two parents is swapped to get new off-spring. The generated population after crossover is tabulated in the table V.

TABLE V Population Generated after Crossover

.1	.15	.2	.25	.3
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.17 , 0.9 , 308.02 , 5.72
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.0 , 0.84 , 288.14 , 5.74
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.17 , 0.9 , 308.02 , 5.72
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.0 , 0.84 , 288.14 , 5.74

Mutation

It is defined as a small random modification in the chromosome, to get a new better solution. Various mutation techniques are available in genetic algorithm. They are Bit Flip mutation, Swap mutation, Scramble mutation, Inversion mutation

Swap Mutation is designed for this experimentation. In which the genes of each chromosome is swapped in such a way that it will get the best solution of surface roughness. The mutation can be happened to the last generated four rows. The population generated after mutation is as follows in the Table VI.

TABLE VI Population Generated After Mutation

.1	.15	.2	.25	.3
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.17 , 0.9 , 308.02 , 5.72
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.0 , 0.84 , 288.14 , 5.74
0.71 , 0.81 , 275.15 , 1.87	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.17 , 0.9 , 308.02 , 5.72
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.91 , 1.43 , 264.55 , 6.29
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	1.18 , 1.18 , 223.58 , 5.31	1.0 , 0.84 , 288.14 , 5.74
0.93 , 0.95 , 286.96 , 1.9	0.82 , 1.23 , 266.22 , 3.03	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67

Best Solution (Survivor Selection)

It is the most important step in which it identifies which of the individuals are retained in the solution and which of them are kicked out of the solution. The best suited solution is tabulated in the table as shown in the table VII. This step is very crucial because it should make sure that the fitted individuals are not kicked out of the solution.

TABLE VII Best Population

.1	.15	.2	.25	.3
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67
0.93 , 0.95 , 286.96 , 1.9	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	0.78 , 0.83 , 297.82 , 5.67
0.71 , 0.81 , 275.15 , 1.87	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.17 , 0.9 , 308.02 , 5.72
0.86 , 0.85 , 275.15 , 1.89	1.03 , 0.83 , 309.08 , 2.78	0.81 , 0.92 , 309.3 , 3.77	0.79 , 0.85 , 298.13 , 4.73	1.17 , 0.9 , 308.02 , 5.72

The best chromosome here it is the best operating parameters which gives the optimized value of surface roughness is indicated in the figure 7.

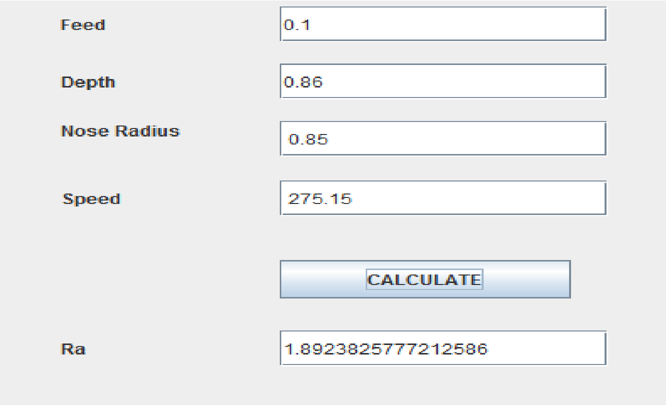

Fig 7 Best Solution

The best value of surface roughness is found out analytically which is shown in the figure 7. The designed value of nose radius is 0.85 mm but the available nose radius is 0.8 mm. And to get the R_a value at 0.8 mm nose radius conducted the test with 0.8 mm nose radius and got the R_a value as 1.876 µm and which is shown in the figure 8.

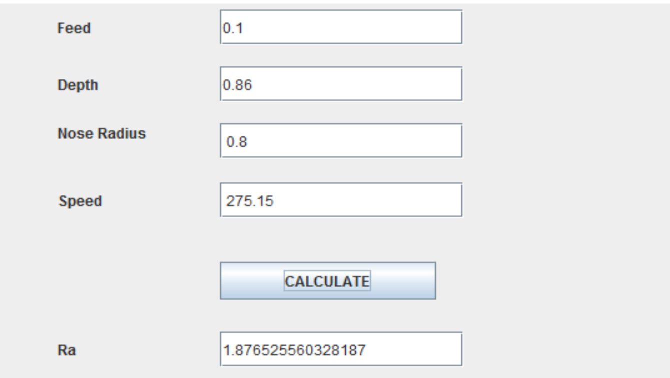

Fig 8 Best Tested solution

E. Geometry Selection of the Cutting Tool

As per the theoretical investigation the carbide tool suited to get the optimized value of roughness is CNMG 120408-XM GC15 shown in the figure 9.

Fig 9 Carbide Cutting Insert

IV. VALIDATION

A. Turning

Turning is the process in which the work piece rotates in a speed as same as that of the spindle speed and the cutting tool or the insert fed against the rotating work piece. As the tool moves according to the depth of cut given the material removed as in the form of chips.

LMW Smart Jr. lathe is used here to do the experiment which is shown in the figure 11.

Fig 11 LMW Smart Jr. CNC Lathe

The operating parameters are listed in the Table VIII which is obtained from the analytical operation.

TABLE VIII Data Sheet for operating parameters

Speed (m/min)	Feed (mm/rev)	Depth of Cut (mm)
275.15	0.1	0.86

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B. Roughness Measuring

The roughness value is measured by using the Surftest SJ401 manufactured by Mitutoyo. The measurements were taken at three different position of the work piece, and took the mean of the R_a value. The R_a value is represented in Microns (µm). The observations are recorded in the observation Table IX is given below.

TABLE IX Observation Table for R_a value

SI No	R_a	R_q	R_z
1	2.596	3.094	13.021
2	2.105	2.503	10.597
3	2.091	2.639	12.179

V. RESULT AND DISCUSSION

The roughness value (R_a) generated by using Genetic algorithm is lesser than the actual Roughness value (R_a). The roughness value can be obtained from the machine as shown in the figure 12.

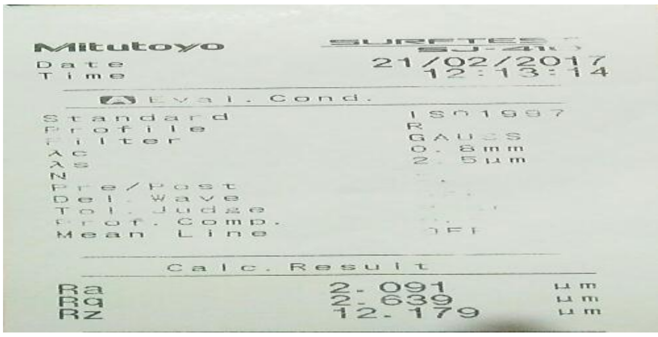

Fig 12 Experimental Result

The surface profile is also obtained from the machine which shows the variation in the roughness value, this is shown in the figure 13.

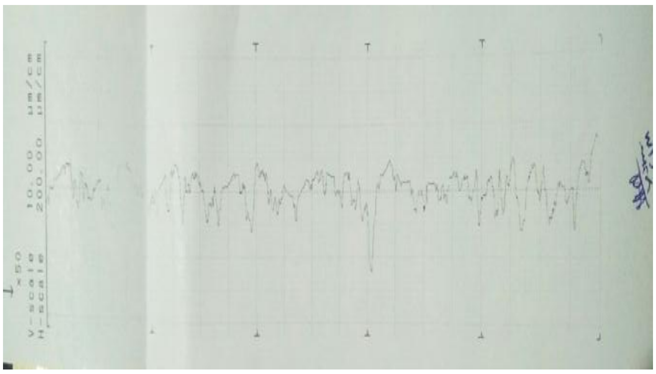

Fig 13 Graphical representation of Surface Texture

The three different values of the Roughness are tabulated as follows in the Table X.

TABLE X Roughness (R_a) Value

SI No	R_a (µm)
1	2.596
2	2.105
3	2.091

Taking the mean value of the observed R_a value by using the following equation,

$$R_a = \frac{2.596 + 2.105 + 2.091}{3}$$

$$R_a = 2.264 \ \mu m$$

The analytical Roughness value is 1.876 µm is shown in the figure 8 and the experimental value is 2.264 µm, which is the mean value of three different values of Roughness at three different positions. It is seen that the actual value of roughness is greater than that of the analytical value.

There is some error in the presented or proposed model of Genetic Algorithm for Optimization in the Turning Operation. This can be calculated by the following equation,

$$Percentage\ of\ error = \frac{experimental\ result - theoretical\ value}{experimental\ result}$$

$$Percentage\ of\ error = \frac{2.264 - 1.876}{2.264}$$

$$Percentage\ of\ error = 17.10\ \%$$

From the calculation it is observed that the percentage of error for this experiment is 17.1%.

VI. CONCLUSION

The effects of the process parameters such as, cutting speed, feed, depth of cut, on the response characteristic surface roughness, was studied on EN24T material in CNC turning. Based on the results obtained, the following conclusions can be postulated.

The experimental value of the surface roughness is different from the theoretical value. The variation is expressed in terms of percentage of error and the percentage of error is 17.10 %. The error can be reduced by including more material properties such as tensile stress, yield stress, etc.

Therefore this optimization program of the genetic algorithm is acceptable for turning operation of any of the materials, and the obtaining result will possess only 17.10 % of variation from the actual value.

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